Workbook for Students

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**Workbook
for
Students**

Based on METS-3

Based on:

'Management for (student) Engineers, Technologists
and Scientists' (METS-3)

Content

Foreword

This workbook is based on the second and third editions of the textbook, 'Management for (student) Engineers, Technologists and Scientists' (METS-2 & METS-3).

Purpose of workbook

This workbook encourages an active learning process. It tries to include questions for self-evaluation addressing the whole range of Bloom's taxonomy – in other words from questions that test basic concepts to more complex questions that test higher levels of knowledge and skills. It is work in progress.

The following types of questions are included in this workbook:

- Section A – True and false questions
- Section B – Multiple choice questions (MCQs)
- Section C – Short questions, long questions and calculations
- Section D – Project work
- Section E – Case studies
- Section F – Sources on the world wide web (WWW)

Some of the projects and case studies will require learners to consult other sources of information as well.

Please contact me at wilhelmpnel@gmail.com if you have any suggestions on how this book can be improved.

I wish you success with your studies.

Wilhelm (Willie) P. Nel

How to use this workbook

Note: The 2ⁿᵈ edition of the textbook entitled 'Management for Engineers, Technologists and Scientists' is abbreviated as METS-2. Therefore, 'METS-2: 265' refers to page 265 in Management for Engineers, Technologists and Scientists. METS-3, refers to the 3ʳᵈ edition.

How to answer multiple choice questions

Example 1

Suppose a question reads as follows:

> The rating error(s) (Liebenberg:1996) where the appraiser makes a decision about an employee based on a personal belief or view (e.g. gender, age, religion, education) and not on objective performance information is referred to as:
>
> [1] Trait assessment
>
> [2] Strictness
>
> [3] Errors of logic
>
> [4] Bias, prejudice and stereotyping
>
> The correct answer in this case is ***Bias, prejudice and stereotyping*** and therefore [4] must be marked on the mark reading sheet

Only one alternative must be marked.

Example 2

Suppose a question reads as follows:

> Which of the following statements is/are **correct**?
>
> a) Good employment relations will usually result in improved employee productivity.
> b) Good employment relations will usually result in reduced absenteeism.
> c) One of the main functions of a trade union is to negotiate better wages and working conditions on behalf of its members.
>
> [1] a
> [2] a and c
> [3] a, b and c
> [4] b and c
> [5] c
>
> All three of the statements (a, b and c) are correct, and therefore you would mark alternative [3] on the mark-reading sheet.

Example 3

Read the following 3 statements:

a) Staff functions are directly responsible for accomplishing the objectives of the organisation.

b) The span of management refers to the number of people in management positions at an organisation.

c) Control includes measuring actual results.

Which of the above statements is/are **correct**?   (1)

[1] a

[2] a and c

[3] a, b and c

[4] b

[5] none (not 1, 2, 3 or 4)

Option [5] is correct for the following reasons:

a) False. See METS-2, p. 19

b) False.

c) True.

None of [1], [2], [3] or [4] is correct.

_____

Chapter 1, The Environment in which Technical People Work

Section 1 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

1A.1 Gold mining company ABC will benefit from a weak rand during times when its gold is exported and the mine does not have to import equipment.

True – See METS-3: 11

Other True/False questions (without answers)

-

Section 1 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '1.9 [1]'.

Examples (questions and answers)

1B.1   Which **one** of the following is a (non-technical) skill and/or knowledge area that an engineer is not expected to have detailed knowledge of?

    [1]   Professionalism and ethics

    [2]   Engineering economics

    [3]   Managing people

    [4]   Problem solving

    [5]   Archaeology   (2)

1B.1 Answer: [5]; METS-2, p. 5   (2)

Other MCQs (without answers)

1B.2   The initial stage in the life cycle of an organisation is the ...

[1] inception stage

[2] high-growth stage

[3] maturity stage

[4] decline stage   (2)

1B.3 Which one of the following is <u>not</u> an example of a project that may be initiated during
the life of an existing shaft, plant or factory?

[1] maintenance project

[2] facility upgrading project

[3] facility expansion project

[4] initial project to establish/construct a new shaft, plant or factory   (2)

1B.4 Read the following three statements:

a) Sole proprietorships, Partnerships and Close Corporations are all examples of
different forms of business enterprises.

b) "To make profit" is one of the goals of a business.

c) One definition of management is 'to get things done through people'.

Which of the above statements is/are **correct**?   (2)

[1] a

[2] a and b

[3] a, b and c

[4] a and c

[5] None of the options (1, 2, 3, or 4) is correct.

1B.5 Read the following three statements:

a) South African exporters usually benefit from a weakening rand while local
consumers will struggle to maintain their standard of living.

b) Fast increasing interest rates are likely to have a bigger negative impact on
companies and households with high levels of debt.

c) The political and regulatory environment in which companies operate can pose a
risk to them in the form of higher taxes and tougher legislation.

Which of the above statements is/are **correct**?   (2)

[1] a

[2] a and b

[3] a, b and c

[4] a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

1B.6 Read the following 3 statements:
   a)   The 3Ps refer to profit, people and planet.
   b)   Technology is neutral but can be used by people in constructive and destructive ways.
   c)   The free market system flourishes because of diversity of consumer choice, products and brands.

   Which of the above statements is/are **correct**?   (2)
   [1]   a
   [2]   a and b
   [3]   a, b and c
   [4]   a and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

1B.7   Which **one** of the following is a not factor that an engineer or engineering team has to consider when designing a product?
   [1]   Ease of maintenance
   [2]   Aesthetics
   [3]   Quality
   [4]   Production method
   [5]   The sales tax that consumers will pay when purchasing the product.   (2)

Section 1 C – short and long questions

Examples (questions and answers)

-

Other questions (without answers)

Question 1C.1
List and briefly describe three different types of projects that a mine, plant or factory may undertake before, during and at the end of its operational life.   (3)

Question 1C.2
Discuss the factors that an engineer or engineering team has to consider when designing a product.   (7)

Question 1C.3

The successful engineer of today needs more than merely technical skills and knowledge. List **four** of the non-technical skills and knowledge areas that an engineer should acquire.   (4)

Question 1C.4

White suggests that engineering managers involved in the manufacturing of products face six main challenges. **List** only 4 of these challenges.   (4)

Question 1C.5

Twenty two percent of people with a College education in the USA majoring in engineering and eighteen percent of those majoring in the physical sciences are employed in management positions (Carnevale et al: 120, 165). Why do you think so many of these people are involved in management?   (4)

Reference

Carnevale, A.P., Strohl, J. & Melton, M. 2011 What's it worth?: The Economic Value of College Majors, Georgetown University, Center on Education and the Work Force.

Question 1C.6

Define innovation chasm and provide possible solutions to the problem.   (2)

Section 1 D – Mini-projects

Section 1E – Case studies

Section 1F – Sources on the world wide web

- - - - End (Questions on Chapter 1) - - - -

Chapter 2, Principles of General Management

Section 2 A – True/false questions
This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

2A.1 The following **true/false questions** are based on **section 2.1** "**Management**" (METS-3: 15-18) of the textbook.

2A.1.1   The functions of management is universal in the sense that they are applicable to a one-person business as well as to large multinational conglomerates. The same principles apply and the same kinds of activities are carried out, although at different levels and with different complexities. (Example: answer is provided)
Answer: True, (METS-3: 15)   (1)

2A.1.2   Planning is one of the traditional/classical management functions. (Example: answer is provided)
Answer: True, (METS-3: 16; METS-2: 13)   (1)

2A.1.3   The aim of the organising function is to correct or improve outcomes by revising plans or formulating new ones. (Example: answer is provided)
Answer: False, (METS-3: 17). This statement is true for the controlling function.   (1)

2A.1.4   The management process has great influence over both the internal and external environments.   (1)

2A.1.5   According to Minzberg, the "figurehead" role of a manager involves performing duties of a ceremonial nature.   (1)

2A.1.6   The "disseminator" role of a manager involves the scanning of the environment.   (1)

2A.1.7   General management is an essential part of every manager's task.   (1)

2A.1.8   Leadership is not part of management.   (1)

2A.2 The following **true/false questions** are based on **section 2.2** "**The Planning function**" (METS-3: 18-20) of the textbook.

2A.2.1   Planning should precede acting. (<u>Example</u>: answer is provided)   (1)
   <u>Answer</u>: True, First plan and then act/implement (METS-3: 19).

2A.2.2   Objectives provide standards against which performance can be measured.   (1)

2A.2.3   Effectiveness measurements reflect the ratio of resources used (inputs) to the outputs generated.   (1)

2A.2.4   Decision making is related to the general management function of planning.   (1)

2A.2.5   Planning without leadership may not result in action.   (1)

2A.2.6   Planning is a linear process.   (1)

2A.2.7   Budgeting is about expressing plans in terms of financial numbers.   (1)

2A.3 The following **true/false questions** are based on **section 2.3** "**The Organising function**" (METS-3: 20-23) of the textbook.

2A.3.1   The organisational structure is the primary means of division of work.   (1)

2A.3.2   The project organisation is grouped into different functions such as finance, personnel, production and marketing.   (1)

2A.3.3   Authority is the right to demand compliance by subordinates based on formal position.   (1)

2A.3.4   Responsibility is the assigned obligation of a subordinate to carry out a delegated task or activity. (1)

2A.3.5   The delegation of authority always entails the creation of accountability. (1)

2A.4 The following **true/false questions** are based on **section 2.4** "**The Controlling function**" (METS-3: 24) of the textbook.

2A.4.1   The "identification of alternatives" is one of the activities that form part of the control process. (1)

2A.5 The following **true/false questions** are based on **section 2.5** "**Leadership**" (METS-3: 25-29) of the textbook.

2A.5.1   In the context of leadership, endurance is the capacity for emotional and mental balance. (1)

2A.5.2   Managers use only one specific style of leadership. (1)

2A.6 The following **true/false questions** are based on **section 2.6** "**Empowerment and self-managing work teams**" (METS-3: 29-32) of the textbook.

2A.6.1   Empowerment is a function of authority, resources, information and accountability. (1)

2A.6.2   Self-managing work teams are groups of employees who manage themselves with little direct supervision. (1)

2A.6.3   A self-managing work team (SMWT) is a groups of isolated specialists. (1)

2A.7 The following **true/false questions** are based on **section 2.7** "**Application of Management principles when managing Projects**" (METS-3: 32-36) of the textbook.

2A.7.1   The general management functions of plannind, organising, leading and controlling are executed through a variety of project management tools, procedures and systems during the project management stage of a deliverable such as a product, plant or organisation. (1)

2A.7.2   Each project worker reports only to his functional manager in a matrix organisational structure. (1)

2A.7.3   The matrix structure, utilised during the project phase when a new large mine is constructed, will probably be replaced by a functional, divisional or product organisational structure when the operational phase follows the project phase. (1)

_ _ _ _ _ _

Section 2 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '2.9 [1]'.

2B.1 The following **multiple choice questions** are based on **section 2.1** "Management" (METS-3: 15-18) of the textbook.

2B.1.1   Read the following 3 statements (Example: answer is provided):
   a) The traditional management functions are planning, organising, leadership and control (POLC).
   b) The aim of the organising function is to correct or improve outcomes by revising plans or formulating new ones.
   c) The management process has great influence over both the internal and external environments.
   Which of the above statements is/are **correct**? (2)
   [1]   a
   [2]   a and b
   [3]   a, b and c
   [4]   a and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

Answer

2B.1.1   [1]

      a) True, (METS-3: 16; METS-2: 13)

      b) False, (METS-3: 17). This statement is true for the controlling function.

      c) False. The managerial process usually has limited influence over the external environment (METS-3: 17).

2B.1.2   Read the following 3 statements:

      a) According to Minzberg, the "figurehead" role of a manager involves performing duties of a ceremonial nature.

      b) The "disseminator" role of a manager involves the scanning of the environment.

      c) General management is an essential part of every manager's task.

      Which of the above statements is/are **correct**?   (2)

      [1]   a

      [2]   a and b

      [3]   a, b and c

      [4]   a and c

      [5]   None of the options (1, 2, 3, or 4) is correct.

2B.1.3   Which one of the following is a general management function?

      [1]   Controlling

      [2]   Strategy

      [3]   System

      [4]   Physical assets   (2)

2B.2 The following **multiple choice questions** are based on **section 2.2** "**The Planning function**" (METS-3: 18-20) of the textbook.

2B.2.1   Which **one** of the following activities does not form part of the planning process?

      [1]   Searching and identification of opportunities

      [2]   Formulation of objectives

      [3]   Measuring actual performance

      [4]   Identification of alternatives   (2)

2B2.2   Read the following 3 statements:

      a) Planning should precede acting.

b) Decision-making is related to the general management function of planning.

c) Planning without leadership may not result in action.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and b

[3] a, b and c

[4] a and c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.2.3 Read the following 3 statements:

a) Efficiency measures give an indication of whether goals were achieved.

b) Budgeting is about expressing plans in terms of financial numbers.

c) Planning is a linear process.

Which of the above statements is/are **correct**? (2)

[1] b

[2] a and b

[3] a, b and c

[4] c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.3 The following **multiple choice questions** are based on **section 2.3** "**The Organising function**" (METS-3: 20-23) of the textbook.

2B.3.1 Read the following 3 statements:

a) Authority is the right to demand compliance by subordinates based on formal position.

b) Responsibility is the assigned obligation of a subordinate to carry out a delegated task or activity.

c) The delegation of authority always entails the creation of accountability.

Which of the above statements is/are **correct**? (2)

[1] b

[2] a and b

[3] a, b and c

[4] c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.3.2   Organising is the management function responsible for:

[1]   creating structures/work units for the organisation

[2]   determining how an organisation will achieve its objectives

[3]   measuring the actual performance, and comparing it with pre-set standards or goals

[4]   influencing, motivating and directing individuals or teams   (2)

2B.3.3   Read the following 3 statements:

a)   Organising is about creating structures or work units.

b)   Once a superior has delegated a task to a subordinate he/she is no longer responsible for the successful completion of that task.

c)   Narrow spans of management result in tall, multi-layered organisation structures.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   a and c

[3]   a, b and c

[4]   c

[5]   None of the options (1, 2, 3, or 4) is correct.

2B.3.4   Read the following three statements regarding the principles of general management.

a)   Employees, that form part of a matrix organisational structure, have both functional and project responsibilities.

b)   A manager has the right to delegate authority and responsibility to a subordinate.

c)   Delegation is the assignment of tasks and the authority to carry out those tasks to a subordinate who assumes accountability for performing them.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   a and c

[3]   c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

2B.3.5   Read the following three statements regarding organising.

a)   An organisation that is grouped into different functions such as finance, personnel, engineering, production and marketing is known as a functional organisation.

b) A team based structure can be described as an organisational structure that is designed around products, projects or product groups. Each product group or project may have its own production, engineering and marketing functions.

c) A customer organisation structure is designed around customer profiles. Different types of clients may therefore be catered for differently in order to respond better to specific customer needs. E.g. personal banking versus corporate banking..

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3] c

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

Fig. 1 Organisational structures

i) ….. organisational structure   **ii) …. organisational structure**
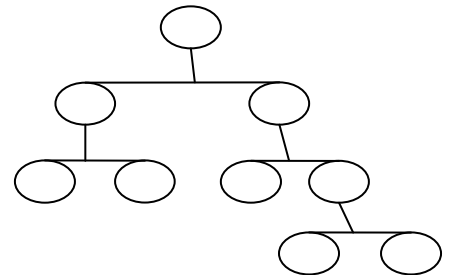
2B.3.6 Read the following 4 statements:

a) Figure 1 (i) represents a tall organisational structure

b) A flat organisational structure has a narrow span of control

c) A tall organisational structure results in many management levels and many managers.

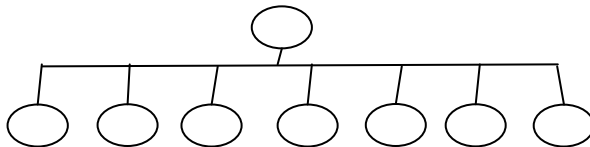d) A flat organisational structure results in long communication lines

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3] a, b and c

[4] c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.4 The following **multiple choice questions** are based on **section 2.4** "**The Controlling function**" (METS-3: 24) of the textbook.

2B.4.1   Which **one** of the following activities forms part of the control process?

    [1]   Searching and identification of opportunities

    [2]   Formulation of objectives

    [3]   Identification of deviations

    [4]   Identification of alternatives   (2)

2B.5 The following **multiple choice questions** are based on **section 2.5** "**Leadership**" (METS-3: 25-29) of the textbook.

2B.5.1   According to Hersey and Blanchard's situational leadership model/theory, …

    a)   a leader will tell subordinates what to do, when to do it and how to perform a task when the delegating style is applied.

    b)   a telling style should be used when a subordinate is unable to perform a task and unwilling to be responsible for performing a task.

    c)   a leader should focus on his/her followers when deciding which style to apply in a specific situation.

Which of the above statements is/are **correct**?   (2)

    [1]   a

    [2]   a and c

    [3]   c

    [4]   b and c

    [5]   None of the options (1, 2, 3, or 4) is correct.

2B.5.2   Which **one** of the following statements was **not** made by Bennis regarding the difference between leaders and managers?   (2)

    [1]   Leaders innovate, while managers administers.

    [2]   Leaders develop while managers maintain.

    [3]   Leaders focus on systems and structures, while managers focus on people.

2B.5.3   Which **one** of the following statements was **not** made by Bennis regarding the difference between leaders and managers?   (2)

[1] Leaders inspire trust, while managers rely on control.

[2] Leaders challenge the status quo, while managers accept the status quo.

[3] Leaders do things right, while managers do the right thing.

2B.5.4 What is the appropriate leadership style for a subordinate who is unable but willing to perform a task?

 [1] Telling

 [2] Selling

 [3] Participating

 [4] Delegating (2)

2B.5.5 According to Mintzberg, managerial work can be classified into 3 broad categories where a manager can play the following roles: interpersonal, informational and decisional. Which one of the following below is the duty of a manager when he/she is playing the informational role? (2)

 [1] disturbance handler

 [2] figurehead

 [3] resource allocator

 [4] monitor

2B.5.6 In the context of leadership what is meant by endurance? (2)

 [1] the capacity to believe

 [2] the capacity for emotional and mental balance and resilience

 [3] the capacity to sustain effort over long periods and fix one's attention on essential issues without becoming distracted

 [4] ability to communicate and persuade

2B.5.7 Read the following three statements regarding Likert's systems of leadership.

 a) Likert proposed three systems of leadership, namely autocratic, participative and democratic leadership.

 b) The "participative" manager uses a consultative style according to Likert.

 c) The "democratic" manager has complete confidence and trust in subordinates and always ask them for opinions.

 Which of the above statements is/are **correct**? (2)

 [1] b

 [2] a and c

[3]   c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

2.6   The following **multiple choice questions** are based on **section 2.6** "**Empowerment and self-managing work teams**" (METS-3: 29-32) of the textbook.

2B.6.1   Read the following three statements:

a)   Empowerment is a function of authority, resources, information and accountability.

b)   Self-managing work teams are groups of employees who manage themselves with little direct supervision.

c)   A self-managing work team (SMWT) is a groups of isolated specialists.

Which of the above statements is/are **correct**?   (2)

[1]   b

[2]   a and c

[3]   c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

2.B7   The following **multiple choice questions** are based on **section 2.7** "**Application of Management principles when managing Projects**" (METS-3: 32-36) of the textbook.

2B.7.1   Read the following three statements:

a)   The general management functions of plannind, organising, leading and controlling are executed through a variety of project management tools, procedures and systems during the project management stage of a deliverable such as a product, plant or organisation.

b)   Each project worker reports only to his functional manager in a matrix organisational structure.

c)   The matrix structure, utilised during the project phase when a new large mine is constructed, will probably be replaced by a functional, divisional or product organisational structure when the operational phase follows the project phase.

Which of the above statements is/are **correct**? (2)

[1] b

[2] a and c

[3] c

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.8 The following **multiple choice questions** are based on **Chapter 2** "Principles of General Management" (METS-3: 15-38) of the textbook. Please note that these questions are usually based on more than one section of the chapter.

2B.8.1 Read the following 3 statements:

a) Staff functions are directly responsible for accomplishing the objectives of the organisation.

b) The span of management refers to the number of people in management positions at an organisation.

c) Control includes measuring actual results.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3] a, b and c

[4] c

[5] None of the options (1, 2, 3, or 4) is correct.

2B.8.2 Read the following three statements regarding the principles of general management.

a) The phenomenon that tasks are assigned to different units or people in an organisation according to criteria such as competencies and skills is known as differentiation of work.

b) A matrix organisation structure is basically two functional structures superimposed on one another.

c) Authority is about the right to demand compliance by subordinates based on formal position and control over rewards and sanctions.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3]   c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

2B.8.3   Read the following 3 statements (*Based on Sections 2.1 and 2.2 of METS-3*):

a)   The traditional management functions are planning, organising, leadership and control (POLC).

b)   Implementation is the step during which plans are implemented by management only.

c)   Sometimes it may be necessary to revise or update plans.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   a and b

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _ _

Section 2 C – short and long questions

2C.1 The following **short and long questions** are based on **section 2.1** "**Management**" (METS-3: 15-18) of the textbook.

Question 2C.1.1 (Mintzberg)

Match each of Mintzberg's managerial roles (on the left-hand side) with the best description (on the right-hand side). In your answer book, write down only the number and next to it the letter representing the correct option, eg 1. z.   (10)

Managerial role		Description
1. Figurehead		a) building external information systems
2. Leader		b) passes information on to subordinates
3. Liaison		c) generation of new business
4. Monitor		d) manager has to respond to strikes, natural disasters and accidents
5. Disseminator		e) motivation of people
6. Spokesperson		f) allocation of resources
7. Entrepreneur		g) sending of information outside the unit

8. Disturbance handler		h) negotiating for various things (resources, changes)
9. Resource allocator		i) scans the environment
10. Negotiator		j) duties of a ceremonial nature

Question 2C.1.2

You have been appointed in a senior position at a company. Use the following table to describe the roles that you expect to play in your new position. (10)

Interpersonal roles	• Figurehead • Leader • Liaison
Informational roles	• Monitor • Disseminator • Spokesperson
Decisional roles	• Entrepreneur • Disturbance handler • Resource allocator • Negotiator

2C.2 The following **short and long questions** are based on **section 2.2** "**The Planning function**" (METS-3: 18-20) of the textbook.

Question 2C.2.1

Name the steps in the planning process. (To show the steps in a diagram would be sufficient). (6)

Question 2C.2.2

List at least 2 objectives. These may be fictitious or from your work environment. Explain how these objectives may provide direction for employees' activities. (3)

2C.3 The following **short and long questions** are based on **section 2.3** "**The Organising function**" (METS-3: 20-23) of the textbook.

Question 2C.3.1 (Delegation)

Define delegation and explain what successful delegation requires. (4)

Question 2C.3.2 (Oganising)

Organising involves a number of activities, namely:

- the development and maintenance of an organisational structure
- the delegation of authority or work
- the creation and maintenance of relationships

Choose any **two** of the above activities and explain how they are practised in the organisation by which you are/were employed. Provide a theoretical answer if you are unemployed. (6)

Question 2C.3.3 (organisational structure: tall vs flat)

Differentiate between a tall and a flat organisational structure. (4)

Question 2C.3.4 (Span of management)

The gap between top management and the shop-floor employee has decreased in many organisations due to the elimination of several layers of management. This has resulted in increasing spans of management. Explain when the span of management can be increased in an organisation, and provide guidelines. (5)

Question 2C.3.5 (Span of management)

You are employed by a company whose main business is to manufacture parts to order. The company also provides maintenance services. The company has workshops in the North-West, Gauteng and Mpumalanga provinces of South Africa and a head office in Johannesburg. Tasks are done by the various types of artisans and technicians employed and range from routine to complex. The company has experienced very high staff turnover in the last number of years and find it very difficult to recruit experienced staff. Many artisans and technicians are still in training. This high staff turnover impacts negatively on the company's teams, which find themselves constantly in a state of flux. To make matters worse, the company's workshops are extremely hazardous. In fact, last year's safety statistics were the worst in the company's history.

Required:

Create guidelines for top management to guide them when making decisions regarding the span of supervision and management within the company. (6)

Question 2C.3.6 (Staff vs line functions)

Distinguish between line and staff functions. Give an example of at least one department or position in an organisation that performs line functions and another that performs staff functions. (4)

Question 2C.3.7 (Coordination)

Define "coordination" and explain how coordination between departments or functional areas can be achieved in an organisation. (7)

Question 2C.3.8

Explain when and how a matrix organisational structure will be used in the minerals industry. (3)

Question 2C.3.9

Describe the dangers of having little or no co-ordination between departments or functional areas. (2)

2C.4 The following **short and long questions** are based on **section 2.4** "**The Controlling function**" (METS-3: 24) of the textbook.

Question 2C.4.1

Explain what is meant by yardsticks in the control process. Give typical examples of yardsticks that are applied in your department. (

Question 2C.4.2

Describe the control process and explain the role of control in the achievement of production and other objectives. Briefly describe how management and supervisors should exercise effective control. (10)

Question 2C.4.3

"Control engineering or control systems engineering is the engineering discipline that applies control theory to design systems with desired behaviors. The practice uses sensors to measure the output performance of the device being controlled and those measurements can be used to give feedback to the input actuators that can make corrections toward desired performance. When a device is designed to perform without the need of human inputs for correction it is called automatic control (such as cruise control for regulating a car's speed) … Although such controllers need not be electrical many are and hence control engineering is

often viewed as a subfield of electrical engineering" (Source: en.wikipedia.org/wiki/Control_engineering; accessed on: 11 Dec 2014).

Required: Define the management control function and explain the purpose of the control function in a management system. Explain how it may work in theory and/or practice. How is controlling in an organisation established? Briefly comment on the similarities between an engineering control system and a management control system. Briefly comment on the following practice at organisation ABC: "Actual expenditure by Departments in the 2014 financial year was only compared with the budgeted expenditure for that year by the end of the financial year. No progress reports were generated during the year."   (14)

2C.5 The following **short and long questions** are based on **section 2.5** "**Leadership**" (METS-3: 25-29) of the textbook.

Question 2C.5.1
An established company wants to offer a new service. The company wants to recruit a person to lead the team that will offer the new service. List and describe the various traits, characteristics and attributes that the leader of this new division should have.   (10)

Question 2C.5.2 (Likert's four systems of leaderhip)

i)   Select any **two** of the following four leadership styles. Describe these styles briefly and explain the impact that they may have on subordinates.   (6)

- Exploitative autocratic
- Benevolent autocratic
- Participative
- Democratic

Or

ii)   Match each of the following styles of leadership (on the left-hand side) with the best statement or description (on the right-hand side). In your answer book, write down the number of the leadership style, and next to it, the letter representing the correct option, for example, 1. j.   (4)

Likert's style of leadership	Description
1. Exploitive autocratic style	a. The manager always asks subordinates for opinions and always tries to make constructive use of them.
2. Benevolent autocratic style	b. The manager has substantial but not complete confidence and trust - but still wishes to keep control of decisions.
3. Participative style	c. The manager has no confidence or trust in subordinates.
4. Democractic style	d. The manager sometimes gets ideas and opinions from subordinates about solving job problems.

Question 2C.5.3

Briefly **describe** vision as a leadership trait. (2)

Question 2C.5.4 (Hersey and Blanchard's situational leadership model)

i) Study the Hersey and Blanchard situational leadership model below. Fill in the names of the four leadership styles labelled a to d. Fill in the two types of leadership behaviour labelled e and f.
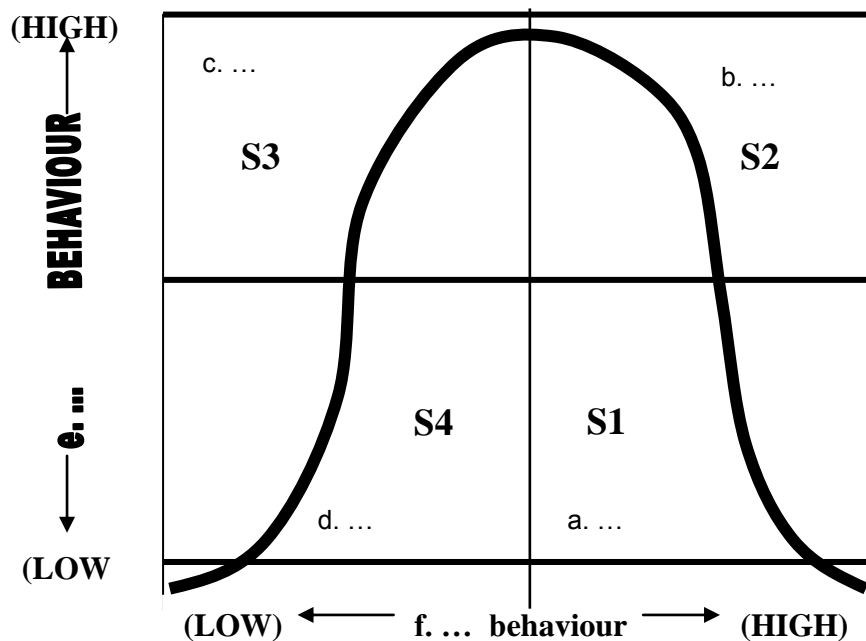
(Source: METS-2, p. 27, Figure 2.4)

ii)   The table below refers to follower readiness and the styles that supervisors and managers should apply according to the Hersey and Blanchard situational leadership model. Fill in the missing words that describe the readiness of followers (a and b), as well as the action that should be taken by a manager or supervisor.

Follower Readiness			
R1	R2	R3	R4
Unable and unwilling or insecure	a. …	b. …	Able and willing or confident
Action by supervisor /manager			
Supervisor should provide clear and specific directions about how to do the task. (S1, the telling style).	c. …	d. …	Use the delegating leadership style (S4).

Or

iii) The situational theory of leadership is a contingency theory that focussed on followers. Successful leadership is achieved by selecting the right leadership style which, according to this theory, is either *telling*, *selling*, *participating* or *delegating*.
Explain how this theory combines the two leadership dimensions, (namely *relationship behaviour* and *task behaviour*) and how the follower's *maturity* influences the optimum selection of a leadership style. (8)

Or

iv) Briefly describe Hersey and Blanchard's situational leadership model. (8)

Or

v) You are a shiftboss on a gold mine. Apply Hersey and Blanchard's situational leadership theory to the following situations?

a. John, the miner of one of your sections, was previously employed at an iron ore mine. He is a hard worker, but experiences some difficulty with the amount of explosives to be used and his drilling rate expectations are unrealistic due to different rock conditions and drilling equipment on the gold mine. He expects the drilling operators to drill many more holes per shift than what may be possible.

b. Fernando is one of your team leaders. He has a number of years of experience in his current position. Lately, the quality of his work and the safety conditions in his panel are not to standard. The stope team is also not producing the same production outputs as before.

c. One of the young miners who did very well as a trainee was immediately put in charge of a relatively large stoping section. He is unsure about his ability to manage the section successfully and very stressed out about whether he will attain the production and safety targets.

d. John, an experienced miner on trackless mechanised mining, was retrenched from a closing shaft and obtained a job on your mine in a conventional section. He is not coping very well with the scraper cleaning method used in this section and often ends up with choked stopes and full ore passes.

e. You are the electrical supervisor at a processing plant. One of the electricians reporting to you has some experience of the electrification of houses but has no experience in an industrial environment. He is not familiar with a number of the safety precautions that have to be taken in this new environment. Apply Hersey and Blanchard's situational leadership theory to this situation. (2)

Question 2C.5.5

Much has been written about leadership. Bennis wrote about the characteristics of managers versus leaders; Dunn wrote about the personality traits of most effective leaders; Likert proposed four systems of organisational leadership; and House & Mitchell developed the path-goal leadership theory. Use this theory to propose the traits, skills and style needed by a leader in any industry of your choice (e.g. the minerals industry). (10)

Question 2C.5.6

The chief executive officer (CEO) of your organisation (or an organisation that you are familiar with) has recently resigned. Use the following list of leadership traits to describe who you should be looking for to fill the vacancy.

Leadership traits: vision, focus, energy, creativity, empathy, influence, endurance, stability & faith (8)

Question 2C.5.7

Bennis says that a new generation of leaders is required in order for organisations to survive in the twenty-first century. Briefly explain how he differentiates between leaders and managers. State whether you agree with Bennis and explain your decision. (8)

2C.6 The following **short and long questions** are based on **section 2.6** "**Empowerment and self-managing work teams**" (METS-3: 29-32) of the textbook.

Question 2C.6.1

Match each of the following descriptions (on the left-hand side) with the correct the correct core attribute of the SMWT leader (on the right-hand side). In your answer book, write down the number and next to it, the letter representing the correct option, for example, 1. z. (4)

Description	Core attribute
1. The SMWT leader serves as a role model for others by 'walking the talk' and demonstrating the desired behaviour.	a. Coach
2. The SMWT leader teaches others and helps them develop to their potential.	b. Business analyser
3. The SMWT leader understands the big picture and is able to translate changes in the business environment into opportunities for the organisation.	c. Living example

4. The SMWT leader brings together the necessary tools, information and resources for the team to get the job done, and facilitates group efforts.	d. Barrier buster
	e. Facilitator
	f. Customer advocate

Question 2C.6.2 (empowerment)

Compare how employees are empowered to be successful team players in self-managing work teams in organisations with flatter, more responsive structures as opposed to the situation in traditional organisations that have hierarchical, pyramid structures. Compare the traditional dictatorial managerial/leadership style with that to be found in this transformed environment, where employees are empowered to assume some of the traditional management responsibilities. (10)

Question 2C.6.3 (SMWT)

Briefly explain what a self-directed (self-managing) work team is. Explain why the leader of such a team should be able to:

- Facilitate
- Analyse business
- Overcome barriers (4)

Question 2C.6.4 (SMWTs)

Discuss four characteristics of self-managing work teams (SMWTs). (4)

2C.7 The following **short and long questions** are based on **section 2.7** "**Application of Management principles when managing Projects**" (METS-3: 32-36) of the textbook.

Question 2C.7.1

Describe how the general management functions of planning, leading, organising and control (PLOC) are applied during the project stages and operational stages of a mine, factor, plant or other facility. Also point out possible differences in the way that PLOC functions practised during these two stages. (25)

Question 2C.7.2

State the type of organisational structure shown below. Discuss the application and a number of characteristics of this organisational structure. (6)

	Functional manager 1:	Functional manager 2:	Functional manager 3:	Functional manager 4:
Project manager	Task 1			
	Task 2			
	Task 3			
	Task 4			
	Task 5			
	Task 5			
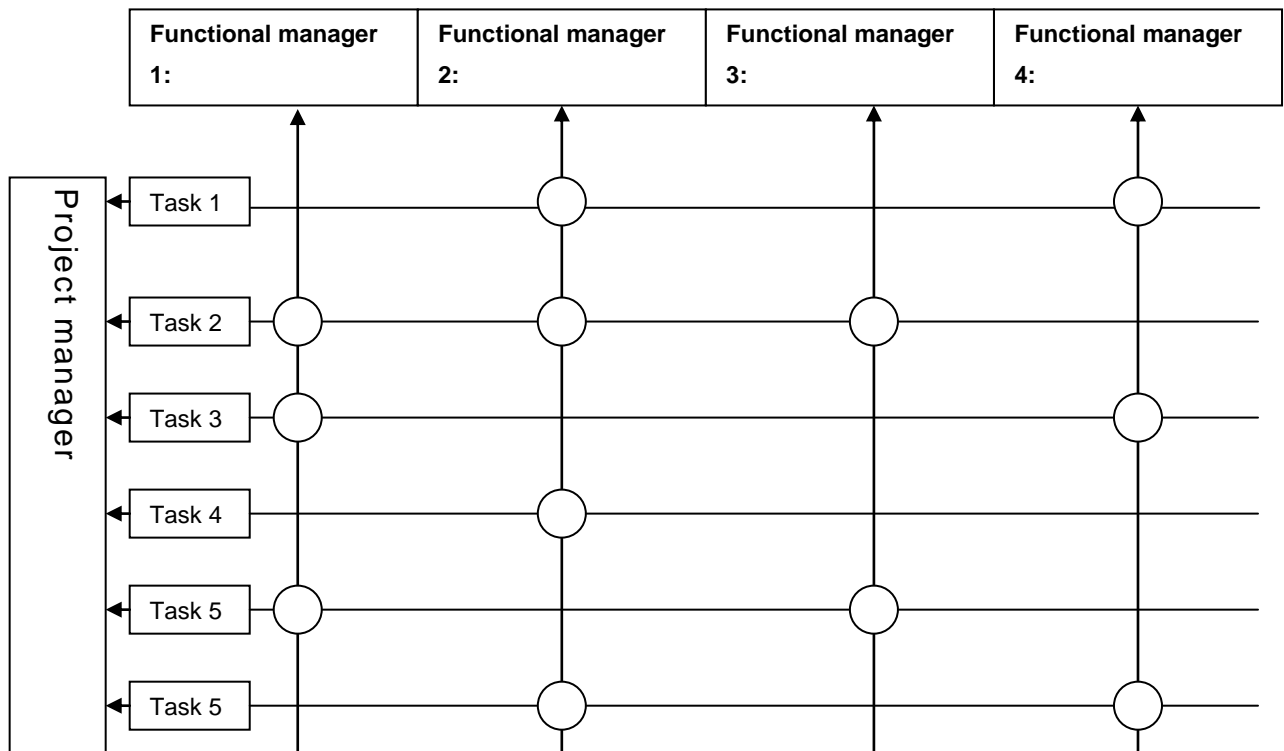
2C.8 The following **short and long questions** are based on **Chapter 2** "Principles of General Management" (METS-3: 15-38) of the textbook.

Question 2C.8.1 (From various parts of Chapter 2)

Define the following:

a) Differentiation of work (1)

b) Matrix organisation (1)

c) Span of management (1)

d) Authority (1)

e) Responsibility (1)

f) Accountability (1)

g) Delegation (1)

h) Self-directed (or self-managing) work team (1)

i) Skill (1)

j) Co-ordination (1)

k) Directive leadership (1)

l) Control (1)

Question 2C.8.2 (From various parts of Chapter 2)

Match each of the terms and concepts (on the left-hand side) with the best description (on the right-hand side). In your answer book, write down only the number and next to it the letter representing the correct option, eg 1. z.   (12)

Terms and concepts		Descriptions
1. Differentiation of work		a) the right to demand compliance by subordinates based on formal position and control over rewards and sanctions.
2. Matrix organisation		b) the assigned obligation of a subordinate to carry out a delegated task or activity.
3. Span of management		c) the assignment of tasks and the authority to carry out those tasks to a subordinate
4. Authority		d) an ability acquired by training
5. Responsibility		e) duties are assigned to different people according to criteria such as competencies and skill.
6. Accountability		f) a group of employees who have the day-to-day responsibility of managing themselves with minimum direct supervision
7. Delegation		g) the process of achieving unity of effort among various business units or people
8. Self-directed work team		h) actual performance is measured and compared against pre-set standards or goals
9. Skill		i) basically a project structure that is horizontally superimposed on a functional structure
10. Co-ordination		j) the obligation of an individual or organisation to accou for its activities
11. Directive leadership		k) Subordinates know exactly what is expected of them a the leader gives specific directions.
12. Control		l) the number of subordinates reporting to a manager

Question 2C.8.3

Differentiate between the classical application of planning, organising, leading and controlling in organisations and how management is done in self-managing work teams (SMWTs).

Comment on the process of management at your organisation (or one that you may be familiar with). (10)

Question 2C.8.4

Describe the process of management at your workplace (or an organisation that you are familiar with).
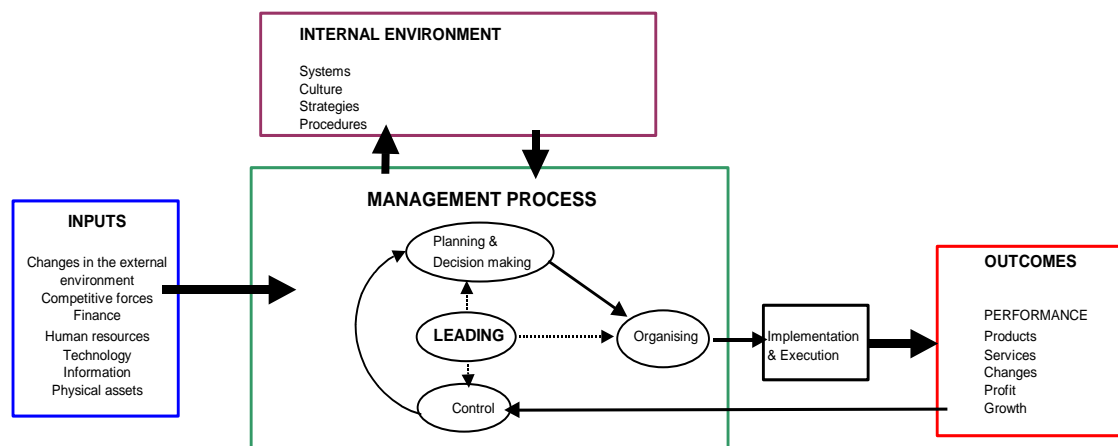
You may refer to the following:

Short-term operational planning

- How is it done?
- How often is it done?
- Scope of planning
- Give examples of objectives that must be achieved on a daily, weekly, monthly or yearly basis.
- Is planning done in a structured or unstructured way? Comments.

Organising

- Illustrate the organisational structure (organogram) of the organisation (e.g. plant) with reporting lines, number of people employed (in each section) and span of management of each supervisor or manager.
- Evaluate the span of management of each supervisor.
- Are supervisors in charge of too many or too few subordinates?
- Differentiation of work

Leadership / motivation

- How are employees motivated?
- Briefly describe incentive/bonus schemes as motivators

The control process at your specific workplace

- How do supervisors and management ensure that objectives are met? **[20]**

Question 2C.8.5 (From both sections 2.3 and 2.7)

Sketch the organogram (organisation structure) of your organisation (you may also do this for a fictitious organisation). You should show the various departments/functional areas that the organisation consists of. Indicate which of the following would best describe this organisation structure:

- Functional
- Product
- Customer
- Matrix
- Team-based   (5)

Question 2C.8.6

Briefly explain why planning is considered the starting point of the management process. Explain the close relationship between planning and the other elements of the management process.   (6)

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Section 2D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 2D.1 (Supervisory management)

Write a report on supervisory management (and/or middle level management) issues related to the operations at a mine, factory, smelter or plant. What is the supervisory role of shift bosses, foreman or other supervisors during the production (or mining) life cycle? Refer to a specific mine, factory or plant if possible. Refer to planning, leadership, control, co-ordination, organising, communication, human relations, workplace (industrial) relations, health and safety, quality assurance, the meeting of production targets and the improvement of productivity.

Section 2E – Case studies

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Section 2F – Sources on the World Wide Web

- Henry Mintzberg's interpersonal roles in management - http://education-portal.com/academy/lesson/interpersonal-roles-in-management-types-definition-quiz.html
- Zigarelli, M. 10 leadership theories in a nutshell – 5 minute video on 10 leadership theories – http://www.12manage.com

- - - - End (Chapter 2) - - - -

Chapter 3 Human Resource Management

Section 3 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

3A.1 Women and people with disabilities are just some of the groups describe as designated groups in the Employment Equity Act 55 of 1998.

Answer: True, METS-2: 84   (1)

3A.2 An employer who employs 50 or more employees, is a designated employer in terms of the Employment Equity Act 55 of 1998.

Answer: True, METS-2: 84   (1)

Other True/False questions (without answers)

-

Section 3 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '3.9 [1]'.

Examples (questions and answers)

3B.1 Read the following three statements:
   a)   The human resource function is a line function.
   b)   The HR department usually decides on the qualifications and skills of an engineer that must be recruited for the maintenance department.
   c)   Human resource management can be defined as all the processes, methods, systems and procedures employed to attract, acquire, develop and manage human resources.

   Which of the above statements is/are **correct**?   (2)
   [1]   c
   [2]   a and b

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

3B.1 Answer: [1]

a)   Incorrect. It is a staff function. (METS-3: 39)

b)   Incorrect. Such information must be obtained by the HR department from the maintenance or engineering department and placed in the advertisement. (METS-2, pp. 37 and 41).

c)   Correct. (METS-3: 39)

Other MCQs (without answers)

3B.2 Read the following three statements:

a)   Internal recruitment has both advantages and disadvantages.

b)   An engineer should form part of the panel when a technologist or engineer is interviewed for placement in a technical position at such a company.

c)   The Skills Development Act makes provision for learnerships.

Which of the above statements is/are **correct**?   (1)

[1]   c

[2]   a and b

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

3B.3 Which one of the following items does not form part of the human resource planning process?

[1]   Review strategic business plan

[2]   Develop strategic human resource plan

[3]   Set human resource objectives

[4]   Compile skills profile

[5]   Drawing up a job advertisement

3B.4 Which one of the following items does not form part of the human resource planning process?

[1]   Conduct human resource forecasting

[2]   Develop employment equity plans

[3]   Develop human resource actions plans

[4]   Implement action plan

[5]   Generating a checklist of questions for a job interview

3B.5 Read the following three statements regarding rating errors that may occur when evaluating employee performance:

a)   The halo effect refers to a supervisor or manager concentrating on an employee's good attributes which then influence all other ratings.

b)   Bias, prejudice and stereotyping may result in all employees being appraised as average performers.

c)   Leniency refers to the same criteria being applied to both management and technicians.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   a and b

[3]   a and c

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _ _

Section 3 C – short and long questions

Examples (questions and answers)

Question 3C.1

There is a vacancy in your section/department. Describe the various phases in the process of finding a suitable candidate and making him/her part of the team.   (8)

Answer 3C.1

Some of the steps:

*   Get a job description for the various positions involved - this will provide you with information such as qualifications and skills that candidates should have.

*   Decide whether recruitment should be done internally or externally, based on the advantages and disadvantages of each method.

*   Decide whether recruitment should be done by means of advertising, consultants or a labour bureau, e.g. Teba.

*   Selection process (preliminary screening, testing, interviewing, affirmative action requirements)
*   Final selection (from shortlist)
*   Induction – to get the new candidate productive in his/her new environment as soon as possible.

Other questions (without answers)

Question 3C.2

Describe the human resource planning process.   (9)

Question 3C.3

Differentiate between internal and external recruitment.   (2)

Question3C.4

Describe the two main pieces of training legislation in South Africa.   (4)

Question 3C.5

Describe the human resource planning process and indicate the impact that HIV/AIDS may have on this.   (10)

Question 3C.6

Differentiate between internal and external recruitment. Distinguish between the advantages and disadvantages of internal and external recruitment.   (6)

Question 3C.7

Draw up a job advertisement for the position of an artisan you want to employ at your company. Make sure that you meet the requirements of a good advertisement.   (6)

Question 3C.8

Develop a checklist of questions you can ask the candidates for the position of artisan when you are going to conduct the interviews. Indicate the guidelines you will follow to ensure that the interview will be successful.   (8)

Question 3C.9

Develop a performance appraisal form you can use to evaluate the performance of an artisan. (8)

Question 3C.10

Identify the rating errors you should guard against when evaluating employee performance. Name the error and briefly describe the error. (8)

Question 3C.11

Explain how you would conduct a performance discussion. (6)

Question 3C.12

Evaluate the following promotion policy of ABC mine: "Only the best artisans are made foremen." (4)

Question 3C.13

Briefly explain what a performance standard is and give an example of a performance standard for your current job or a position that you are familiar with. (4)

Question 3C.14

As the new manager of BCM Electrical, you have to implement a performance management system.

Develop/design a performance plan that will assist you in measuring the performance of one of your employees. Choose any occupation, e.g. draughtsperson. You may use the template below: (6)

CPA	TASK	STANDARDS	SCORE
			0 1 2 3 4
			0 1 2 3 4

			0 1 2 3 4
			0 1 2 3 4
Final score			
SUPERVISOR'S COMMENT:			
EMPLOYEE'S COMMENT:			

Question 3C.15

There is a shortage of engineers in a number of countries and many young people need to be trained. Explain how engineers can implement the phases of the training process. Make sure you mention the sequential phases that an engineer must follow in order to ensure effective acquisition and transfer of knowledge and skills in the workplace.   [8]

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Section 3D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 3D.1 [HIV/AIDS in the workplace]

The following question was asked in the Mine Manager's Certificate of Competency (MMCoC) examinations in May 2003 (Section B, Paper III, Mine Management and Industrial Law – Question 2)

Question from a past MMCoC examination paper
You are the Manager of a prominent Gold Mine in South Africa. The mine belongs to a large mining house which is listed on the Johannesburg Stock Exchange. The company sells 60% of its gold overseas. The company has therefore a fair amount of exposure to the international community.

It is brought to your attention that 1 200 of the workforce of 7 000 on your mine is HIV positive and that 60% of them can no longer work underground.

3.1 What is the legal position of these people according to current legislation? (3)

3.2 What do you propose to do with those who cannot work anymore? (5)

3.3 What preventative measure will you implement on the mine to prevent further spread of the disease, given that there is no current programme on the mine? (7)

3.4 How will you approach the problem with future appointments? (4)

[19]

Write a report on HIV/AIDS in the workplace. In your report you should deal with the following issues:

- What are the various questions asked in the past MMCoC question?
- What is the impact of HIV/AIDS on your company and industry?
- Does your company (or a company that you know) have a HIV/AIDS plan? Please describe.
- Report on any successes that your organisation had in combating this epidemic.
- What does the SA constitution and various HR-related laws (eg Employment Equity Act, Labour Relations Act, Compensation of Occupational Injuries and Diseases Act and the Occupational Health and Safety Act) require of employers in terms of the treatment of employees who have HIV/AIDS?
- What are the legal rights of HIV/AIDS positive employees who are being discriminated against?
- What is the cost of HIV/AIDS to business?
- May an employer "force" an employee to undergo HIV/AIDS testing and disclose his/her status?

Project 3D.2 [Preparing for an interview]

All young (and older) professionals have to go for a job interview at some point in time during their lives. Write a report to inform young professionals how to prepare for such an interview.

Section 3E – Case studies

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Section 3F – Sources on the world wide web

3F.1 Do a google search to obtain information on "scarce skills". In South Africa, for example, it is the intention of government to publish findings regarding scarce skills at least every two years (Search: "Government Gazette number 380 scarce skills May 2014").

3F.2 Go to the website of the Engineering Council of South Africa (ECSA) and have a look at the standards they developed for various learning programmes such as the Diploma, Advanced Diploma, B Eng-degree and so on.

Section 3G – Additional readings / information sources on **Engineering Education**

- Nel, W.P., May 2014. Universities and Decision-making: Programme and Qualification Mix – Four Learning Pathways. Journal of the Southern African Institute of Mining and Metallurgy. Vol 114, pp. 411-418 {The four main pathways consisting of HEQSF-aligned learning programmes that can be used by South African universities to develop students from National Senior Certificate to doctorate level are described and evaluated. A recommended future programme and qualification mix (PQM) for mining engineering programmes at the University of South Africa (UNISA) is provided.}

- - - - End (Questions on Chapter 3) - - - -

Chapter 4, The impact of Employment Relations and Labour Legislation on an Organisation

Note: Part III of this workbook also includes questions on employment relations and labour legislation.

Section 4 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

4A.1 Good employment relations will usually result in improved productivity of employees. (1)
   True, METS-2, p. 60

4A.2 Good employment relations will usually result in reduced absenteeism. (1)
   True, METS-2, p. 61

4A.3 The state, Cosatu and employees are called the tripartite employment relationship. (1)
   False, The tripartite relationship refers to the state, employees and employers (METS-2: 61).

4A.4 One of the main functions of a trade union is to negotiate better wages and working conditions on behalf of their members. (1)
   True, METS-2, p. 62

4A.5 One of the roles of the state is to provide a legal framework within which workplace relations can be managed. (1)
   True. The state does this by means of various acts e.g. the LRA (METS-2: 62).

4A.6 The Labour Relations Act (LRA) sets minimum standards for conditions of service, such as working hours and overtime. (1)
   False, METS-2:62. It is the BCEA that sets minimum standards and conditions of service.

4A.7 The employee's ordinary hours of work and days of work are some of the information that an employer should supply to an employee at the commencement of employment. (1)
   True. METS-2: 62. This should be provided i.t.o. the BCEA.

4A.8 Deductions made from an employee's remuneration are some of the information that an employer should supply to an employee at the commencement of employment. (1)
   True. METS-2: 63. This should be provided i.t.o. the BCEA.

4A.9 The Basic Conditions of Employment Act applies to employees and employers in the minerals industry. (1)
   True, METS-2: 63, Table 4.1

4A.10   In terms of the Basic Conditions of Employment Act (BCEA) an employer must give employees who work continuously for at least five hours a meal interval of at least 20 minutes.

False, Meal interval should be at least 30 minutes long. METS-2: 63

Other True/False questions (without answers)

4A.11 In terms of the BCEA work performed after 18h00 and before 06h00 the next day is classified as night work. (1)

4A.12 An employee who works on a public holiday must receive 1,5 times the ordinary wage for that day. (1)

4A.13 An employee is entitled to 14 consecutive days' annual leave per leave cycle. (1)

4A.14 The employer is not required to pay the employee while on maternity leave. (1)

4A.15 When an employee is dismissed owing to operational requirements then the employer must pay at least two weeks' salary for each year of continuous service. (1)

4A.16 In terms of the BCEA it is a criminal offence to employ a child that is under 15 years of age. (1)

4A.17 Independent contractors are covered by the Labour Relations Act but not by the Basic Conditions of Employment Act. (1)

4A.18 The primary aim of discipline in any organisation should not be to punish employees, but rather to point out their unacceptable behaviour or performance and to motivate them to change it. (1)

4A.19 The primary aim of discipline in any organisation should be to punish employees. (1)

4A.20 The LRA provides guidelines for workplace discipline. (1)

4A.21 The main purpose of the grievance procedure is to prevent lockouts. (1)

4A.22 The grievance procedure is used by employers who are dissatisfied with the performance of employees. (1)

4A.23 An employee may be suspended for committing an offence such as fraud or theft. (1)

4A.24 Offences are usually classified as minor, serious, very serious and dismissable in the disciplinary codes of organisations. (1)

4A.25 Arriving late for work and loafing are both usually classified as serious offences in the disciplinary code of organisations. (1)

4A.26 An employee is entitled to an interpreter during a disciplinary hearing. (1)

4A.27 An employee is entitled to calling his/her own witnesses during a disciplinary hearing. (1)

4A.28 One example of dismissal (in terms of the Labour Relations Act) is when the employer renews a fixed term contract of employment of an employee on less

favourable terms when the employee reasonably expected it to be renewed on the same or similar terms. (1)

4A.29 An employer has the right to dismiss an employee who participated in a strike that was undertaken in accordance with the provisions of Chapter IV of the Labour Relations Act. (1)

4A.30 Procedural fairness means that an employee may be dismissed only if there is a valid reason to do so. (1)

4A.31 The CCMA stands for the Council of Conciliation, Media and Arbitration. (1)

4A.32 Pre-dismissal arbitration, conciliation, conciliation and arbitration (con-arb) and arbitration are some of the mechanisms that are available to the CCMA when solving a dispute. (1)

4A.33 An employee has the right to strike if the issue in dispute has been referred to the CCMA and a certificate stating that the dispute remains unresolved has been issued. (1)

4A.34 An employee employed by a mining or engineering company has the right to join a trade union. (1)

4A.35 One of the organisational rights of unions is the right of access to a workplace to communicate with its members. (1)

4A.36 The Skills Development Levies Act imposes a levy equal to 0,25% of the employer's total wage bill. (1)

4A.37 The purpose of the Unemployment Insurance Fund (UIF) is to provide retired employees with money. (1)

4A.38 Employees must contribute three% of their salary to the UIF, while employers must contribute 3% of their total salary bill to the UIF. (1)

4A.39 The UIF provides benefits and security for unemployed people. (1)

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Section 4 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '4.9 [1]'.

Examples (questions and answers)

4.1 Read the following three statements:
   a) Good employment relations will usually result in improved productivity of employees.

b) Good employment relations will usually result in reduced absenteeism.

c) One of the main functions of a trade union is to negotiate better wages and working conditions on behalf of their members.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   a and c

[3]   a, b and c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 4.1: [3] a) True, (METS-2: 60; METS-3: 62); b) True, (METS-2: 61; METS-3: 63); c) True, (METS-2: 62; METS-3: 63)

4.2   Read the following three statements:

a) The state provides a legal framework within which the employee-employer relationship should be managed.

b) The Labour Relations Act sets minimum standards for conditions of service, such as working hours and overtime.

c) The Basic Conditions of Employment Act provides for a skills plan.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   a and c

[3]   a, b and c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 4.2: [2]; a) True, (METS-2: 62; METS-3: 64); b) False, (METS-2: 62; METS-3: 64). It is the BCEA that does that; c) True, METS-2: 63, Table 4.1

4.3   Read the following three statements:

a) Independent contractors are covered by the Labour Relations Act but not by the Basic Conditions of Employment Act.

b) The grievance procedure is used by employers who are dissatisfied with the performance of employees.

c) Procedural fairness means that an employee may be dismissed only if there is a valid reason to do so.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   a and c

[3]   a, b and c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 4.3: [5]; a) False, (METS-2: 67; METS-3: 67); b) False, (METS-2: 69; METS-3: 68 - Fig. 4.4); c) False, (METS-2: 75; METS-3: 76)

4.4   Read the following three statements:

a)   An employer has the right to dismiss an employee who participated in a in a "protected" strike – a strike that was undertaken in accordance with the provisions of Chapter IV of the Labour Relations Act.

b)   Employees are usually dismissed for late-coming.

c)   The CCMA has the same powers as a provincial division of the Supreme Court.

Which of the above statements is/are **correct**?   (2)

[1]   c

[2]   a and c

[3]   a, b and c

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 4.4: [5]; a) False, (METS-2: 74; METS-3: 75); b) False, (METS-2: 70; METS-3: 72 – table 4.2). Late-coming is a minor offence. Repeated late-coming, and several warnings later, may however result in dismissal. c) False, (METS-2: 79; METS-3: 80). It is the Labour Court that has the same powers as the provincial division of the Supreme Court.

Other MCQs (without answers)

4.5   Read the following three statements:

a)   An employee has the right to strike if the issue in dispute has been referred to the CCMA and a certificate stating that the dispute remains unresolved has been issued.

b)   Every employee has the right to join a trade union.

c)   The Skills Development Levies Act imposes a levy equal to 0,25% of the employer's total wage bill.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and b

[3] a, b and c

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

4.6 Read the following three statements:

a) Offences are usually classified as minor, serious, very serious and dismissable in the disciplinary codes of organisations.

b) The CCMA stands for the Council of Conciliation, Media and Arbitration.

c) The role of the state in the employment relations system is to provide a legal framework and to be the watchdog.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3] a, b and c

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

4.7 Read the following three statements:

a) The primary aim of discipline in any organisation should be to punish employees.

b) In terms of the Basic Conditions of Employment Act (BCEA) an employer must give employees who work continuously for at least five hours a meal interval of at least 20 minutes.

c) In terms of the BCEA work performed after 18h00 and before 06h00 the next day is classified as night work.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and c

[3] b and c

[4] c

[5] None of the options (1, 2, 3, or 4) is correct.

4.8 Read the following three statements:

a) An employee who works on a public holiday must receive 1,5 times the ordinary wage for that day.

b)　An employee is entitled to 14 consecutive days' annual leave per leave cycle.

c)　The employer is not required to pay the employee while on maternity leave.

Which of the above statements is/are **correct**? (2)

[1]　a

[2]　a and c

[3]　b and c

[4]　c

[5]　None of the options (1, 2, 3, or 4) is correct.

4.9　Read the following three statements:

a)　When an employee is dismissed owing to operational requirements then the employer must pay at least two weeks' salary for each year of continuous service in terms of the Basic Conditions of Employment Act (BCEA).

b)　In terms of the BCEA it is a criminal offence to employ a child who is under 15 years of age.

c)　Arriving late for work and loafing are both usually classified as serious offences in the disciplinary code of organisations.

Which of the above statements is/are **correct**? (2)

[1]　b

[2]　a and b

[3]　b and c

[4]　a

[5]　None of the options (1, 2, 3, or 4) is correct.

4.10　Read the following three statements:

a)　An employee is entitled to an interpreter during a disciplinary hearing.

b)　An employee is entitled to calling his/her own witnesses during a disciplinary hearing.

c)　One example of dismissal (in terms of the Labour Relations Act) is when the employer renew a fixed term contract of employment of an employee on less favourable terms when the employee reasonably expected it to be renewed on the same or similar terms.

Which of the above statements is/are **correct**? (2)

[1]　a

[2]　a and b

[3]　b and c

[4]　a, b and c

[5]　None of the options (1, 2, 3, or 4) is correct.

4.11 Read the following three statements:

a) An employee may lodge a grievance if his/her supervisor expects him/her to contravene safety standards and endanger the lives of co-workers.

b) The grievance procedure is used by employers who are dissatisfied with the performance of employees.

c) The grievance procedure is a form of upward communication from employees to employers.

Which of the above statements is/are **correct**? (2)

[1] a and c

[2] a

[3] b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

4.12 Read the following three statements:

a) One of the organisational rights of unions is the right of access to a workplace to communicate with its members.

b) An employee employed by a mining or engineering company has the right to join a trade union.

c) One of the main functions of a trade union is to negotiate for better wages and working conditions on behalf of its members.

Which of the above statements is/are **correct**? (2)

[1] a and b

[2] b and c

[3] c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

4.13 Which **one** of the following does **not** form part of the information that an employer should provide to a new employee at commencement of employment? (2)

[1] brief description of the work

[2] date on which employment began

[3] wage or wage rate

[4] annual, future pay increases during period of employment

[5] deductions that will be made

4.14 Read the following three statements:

a) The primary aim of discipline in any organisation should not be to punish employees, but rather to point out their unacceptable behaviour or performance and to motivate them to change it.

b) The LRA provides guidelines for workplace discipline.

c) Arriving late for work and loafing are both usually classified as dismissible offences in the disciplinary code of organisations.

Which of the above statements is/are **correct**? (2)

[1] a

[2] a and b

[3] a and c

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

4.15 Read the following three statements:

a) An employee has the right to strike if the issue in dispute has been referred to the CCMA and a certificate stating that the dispute remains unresolved has been issued.

b) One of the roles of the state is to provide a legal framework within which workplace relations can be managed.

c) Pre-dismissal arbitration, conciliation, conciliation and arbitration (con-arb) and arbitration are some of the mechanisms that are available to the CCMA when solving a dispute.

Which of the above statements is/are **correct**? (2)

[1] a and b

[2] b and c

[3] a, b and c

[4] a and c

[5] None of the options (1, 2, 3, or 4) is correct.

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Section 4 C – short and long questions

Examples (questions and answers)

Question 4.1 (Legislation)

It is a big task to learn and continuously update your knowledge of the various acts of a country as they change. For reference purposes it is important to know the purpose of the acts relevant to the business environment in general and your specific industry so that you know which act to consult when you want to refresh your memory or look up something. Match each of the statements or descriptions (on the left-hand side) with the relevant Act (on the right-hand side). Note that more than one item from the left-hand side may be linked to a specific Act. In your answer book, write down only the number and next to it the letter representing the correct option, eg 1. z. (15)

	Acts
1. Children under the age of 15 may not be employed	
2. This Act regulates a fund that provides benefits and security for unemployed people (who previously contributed to it)	a) Unemployment Insurance Act 63 of 2001
3. This Act specifies details regarding severance pay	b) Labour Relations Act
4. This Act provides guidelines for workplace discipline.	c) Skills Development Act 97 of 1998
5. This Act provides details regarding annual, sick, maternity and family responsibility leave	d) Occupational Health and Safety Act 85 of 1993
6. This Act regulates a fund that provides maternity benefits.	e) Basic Conditions of Employment Act 75 of 1997
7. This Act specifies the notice period that must be given by employees on termination of employment	f) Compensation for Occupational Injuries and Diseases Act 130 of 1993
8. This Act specifies payment for Sunday work and work on public holidays	g) Employment Equity Act 55 of 1998.
9. This Act provides for a skills plan for all employees.	
10. Employers must reduce the risks to health and safety in the workplace.	
11. This Act specifies ordinary hours of work	
12. This Act requires employees to invest in the education and training of the workforce.	
13. This Act deals with claims due to injuries in the workplace.	
14. Equal opportunities should be provided to all employees in the workplace.	

15. This Act states that an employee has the right to join a trade union.	

Answers

1. e METS-2: 64
2. a METS-2: 85
3. e METS-2: 64
4. b METS-2: 67
5. e METS-2: 64
6. a METS-2: 85
7. e METS-2: 64
8. e METS-2: 64
9. c METS-2: 85
10. d METS-2: 86
11. e METS-2: 64
12. c METS-2: 85
13. f METS-2: 86
14. g METS-2: 84
15. b METS-2: 83

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Other questions (without answers)

Question 4c.2 (Grievances)

a)   Define and provide an example of a Grievance.   (2)

b)   State the advantage of a grievance procedure in a workplace.   (4)

c)   Describe the purpose of the grievance procedure and briefly explain how grievances should be lodged and handled.   (6)

   or

d)   Your team is behind schedule and your supervisor expects you to take shortcuts to catch up. To do so, you will have to contravene company safety standards and endanger the lives of your colleagues. You want to lodge a grievance. Discuss the steps of this process.   (5)

Question 4c.3

Explain when an employee may be suspended.   (2)

Question 4c.4

A dispute was referred to the CCMA. Briefly list and describe the mechanisms that are available to the CCMA to solve this dispute. (8)

Question 4c.5 (Legislation)

i)   Briefly describe the purpose of the Unemployment Insurance Fund (UIF). (2)

ii)   List the workers that are excluded from the Unemployment Insurance Act 63 of 2001. (6)

iii) What contributions do employees and employers have to make to the UIF? (2)

{**Note**: Some students confuse the UIF with a pension fund.}

Question 4c.6

List the three participants of the employment relations system and briefly outline their functions and roles. (6)

Question 4c.7

While doing a spot check at the gate, the security guard finds that a worker who is employed by one of the workshops has a shifting spanner in his overall pocket. How should this situation be managed in terms of the organisation's disciplinary code and hearing procedure? (12)

Question 4c.8

Describe the role of unions in an organisation. What matters should they be consulted about? (6)

Question 4c.9 (Legislation)

Under the Occupational Health and Safety Act 85 of 1993, briefly mention the duties of:

a.   Employers (3)

b.   Employees (1)

c.   Safety Committees (1)

d.   Safety representatives (1)

[6]

Question 4c.10

State two (2) advantages of sound employment relations. (2)

Question 4c.11

Explain the difference between a strike and a lock-out (4)

Question 4c.12

Explain the purpose of giving a warning to an employee in case of undesirable behaviour. (2)

Question 4c.13

State the circumstances under which it is legal to suspend an employee without pay. (2)

Question 4c.14

State the primary aim of organisational discipline. (2)

Question 4c.15

List any two roles of the CCMA in dispute resolutions. (2)

Question 4c.16 (Legislation)

You are a manager at an organisation with a number of supervisors and other employees reporting to you. Due to the nature of your work you have to know and consult the relevant labour laws. Discuss five different but important pieces of labour legislation (laws) that governs and protects the employment relationship in the work place. (10)

Question 4c.17

Define the following:

   a) Demotion (1)
   b) Contract of employment (2)

Question 4c.18

List some of the information that an employer should supply to an employee at the commencement of employment. [10]

Question 4c.19

Explain the provisions set out in the BCEA with regard to:

a) sick leave (2)
b) notice period: termination of employment (2)

[4]

Question 4c.20

One of your colleagues at work rushed into your office telling you that your boss informed her that she has to attend a disciplinary hearing in an hour's time. She is not quite sure about the

complaint against her but thinks that it arose from an argument that she had with the boss earlier in the day. She has never been involved in a disciplinary hearing and does not know what to expect. She is desperately looking for help and knows that you are studying engineering management. What will you tell her? Remember to inform her of her rights before, during and after the disciplinary hearing. [12]

Question 4c.21

In terms of the Labour Relations Act there are only three grounds that justify dismissal. List and briefly explain them. (6)

Question 4c.22

Discuss the purpose of the Employment Equity Act (No 55 of 1998). (3)

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Section 4D – Project work

<u>Note</u>: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 4D.1 (Disciplinary procedure)

Write a report on the disciplinary code and the disciplinary hearing procedure of the organisation that you are employed by or any other organisation that you are familiar with. In this report you should refer to the following:

- What must happen before, during and after the hearing?
- What are the different role players and their roles?
- What happens after the disciplinary hearing if the accused employee is not satisfied with the process?

You must also select at least one specific disciplinary case that was held at the organisation or a fictional one and explain how the above guidelines must be applied in practice. Alternatively, you may use one or both the following two examples and explain how the disciplinary procedure will be applied in such cases.

<u>Example 1</u>

While doing a spot check at the gate, the security guard finds that a worker who is employed by one of the workshops has a shifting spanner in his overall pocket. How should this situation be managed in terms of the organisation's disciplinary code and hearing procedure?

Example 2

You are a shift-boss, foreman or supervisor at a mine, plant or factory. One of your miners or subordinates was found under the influence of alcohol through a random drug test. How should this situation be managed in terms of the organisation's disciplinary code and hearing procedure?

The following must be attached to your report (as annexures):

- A copy of the organisation's disciplinary code.
- Any other documents that form part of the organisation's disciplinary process for example: 1) a charge sheet, 2) a checklist that may be used to ensure that the hearing is done in a procedurally correct manner, 3) guidelines for a misconduct investigation and 4) disciplinary policy.
- The correct terminology must be attached in a glossary of terminology. For example, are the terms "accused" and "defendant" used in the case of a disciplinary hearing? If yes, list and define them in the glossary.

Section 4E – Case studies

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Section 4F – Sources on the world wide web

- - - - End (Questions on Chapter 4) - - - -

Chapter 5, Managing People and Teams

Section 5 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

5A.1 The following **true/false questions** are based on **section 5.1 "Introduction"** (METS-3: 91) of the textbook. (1)

5A.1.1   The Engineering Council of South Africa (ECSA) requires that technicians should be able to work effectively in a team environment. (Example: answer is provided)
Answer: True, See ECSA learning outcome 4.2 – "Work effectively in a team environment" (Source: Competency standard for registration as a Professional Engineering Technician -
https://www.ecsa.co.za/ECSADocuments/ECSA%20Documents/Documents/R02PNr0d61.pdf) (1)

5A.1.2   A lot of work today is done in a team environment. (1)

5A.1.3   The South African workforce is diverse. (1)

5A.1.4   Managers and supervisors must have people skills in the areas of human relations, conflict management, teamwork and diversity management to ensure sound human relations in the workplace. (1)

5A.2 The following **true/false questions** are based on **section 5.2 "Human relations"** (METS-3: 92) of the textbook.

5A.2.1   Different beliefs, attitudes and behaviours of employees may cause problems in the workplace from time to time. (1)

5A.3 The following **true/false questions** are based on **section 5.3 "Guidelines for sound human relations"** (METS-3: 93) of the textbook.

5A.3.1   Effective managers have the skill to integrate employees' contributions.   (1)

5A.3.2   Networking is an important aspect of human relations.   (1)

5A.4 The following **true/false questions** are based on **section 5.4 "Conflict"** (METS-3: 94-96) of the textbook.

5A.4.1   A breakdown in communication may be a cause of conflict.

5A.4.2   Intrapersonal conflict often develops between two individuals as a result of different needs and goals.

5A.4.3   The "avoidance" conflict management style is sometimes followed with the hope that the conflict will go away.

5A.5 The following **true/false questions** are based on **section 5.5 "Teamwork"** (METS-3: 97-99) of the textbook.

5A.5.1   Teamwork is very important in a project environment due to the typical size and complexity of projects such as the construction of a new deep level mine shaft.

5A.5.2   Team members do not have guidelines or rules to follow during the norming stage of team development.

5A.6 The following **true/false questions** are based on **section 5.6 "Diversity Management"** (METS-3: 99-103) of the textbook.

5A.6.1   Ableism, ageism, classism and racism are just a few types of discrimination.

5A.6.2   An example of ableism is when an all-male selection panel rejects a female employee's application for a senior position because the panel members believe that she cannot handle stress because she is female.

5A.6.3 An example of classism is when an 18-year-old employee who joined the company recently is excluded from decision-making structures because the more experienced managers believe that she does not have the necessary insight and experience to provide input.

5A.7 The following **true/false questions** are based on **section 5.7 "Conclusion"** (METS-3: 103) of the textbook.

5A.7.1 People skills is one of the important factors contributing towards achieving a productive organisation.

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Section 5 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '5.9 [1]'.

5B.1 The following **multiple choice questions** are based on **section 5.1 "Introduction"** (METS-3: 91) of the textbook.

5B.1.1 Read the following 3 statements:
a) Teamwork is essential when extensive software programs are developed, a casino is built or a deep level mineral resource is mined.
b) The Engineering Council of South Africa (ECSA) requires that technicians should be able to work effectively in a team environment.
c) The South African workforce is diverse.

Which of the above statements is/are **correct**? (2)
[1] b
[2] a, b and c
[3] b and c
[4] a and c
[5] None of the options (1, 2, 3, or 4) is correct.

5B.2 The following **multiple choice questions** are based on **section 5.2 "Human relations"** (METS-3: 92) of the textbook.

None.

5B.3 The following **multiple choice questions** are based on **section 5.3 "Guidelines for sound human relations"** (METS-3: 93) of the textbook.

5B.3.1   Read the following 3 statements:
a)   Employees are likely to discuss their true opinions and feelings with superiors whom they do not trust.
b)   Effective managers have the skill to integrate employees' contributions.
c)   Managers will motivate employees when giving them recognition for their inputs.
Which of the above statements is/are **correct**?   (2)
[1]   b
[2]   b and c
[3]   a, b and c
[4]   a and b
[5]   None of the options (1, 2, 3, or 4) is correct.

5B.3.2   Read the following 3 statements:
a)   Networking is an important aspect of human relations.
b)   A degree of conflict in the workplace should not necessarily be viewed as negative.
c)   People like to be valued and appreciated.
Which of the above statements is/are **correct**?   (2)
[1]   b and c
[2]   a and c
[3]   a and b
[4]   a, b and c
[5]   None of the options (1, 2, 3, or 4) is correct.

5B.4 The following **multiple choice questions** are based on **section 5.4 "Conflict"** (METS-3: 94-96) of the textbook.

5B.4.1   Read the following 3 statements regarding strategies for dealing with conflict:
a)   A "Win-loose" strategy is when one party achieve its goals at the expense of the other party.

b) With a loose-loose strategy the manager or majority rules.

c) A win-win situation results when conflict is resolved in such a manner that both parties end up as winners.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

5B.5 The following **multiple choice questions** are based on **section 5.5 "Teamwork"** (METS-3: 97-99) of the textbook.

5B.5.1 The stages (in the correct chronological order) that you would expect a team to go through in order to become fully functional are the following: (2)

[1] Forming, performing, storming and norming

[2] Forming, norming, storming and performing

[3] Forming, storming, norming and performing

5B.5.2 Teams usually go through the following four stages in its development: forming, storming, norming and performing. Which one of the following best describes the 'norming' stage? (2)

[1] The team members come together and the team is formed. Team members have not worked together previously as a team.

[2] The team is productive and achieve its goals.

[3] Team members start to communicate. They have not yet established guidelines or rules to guide their behaviour and actions.

[4] Team members establish ground-rules to guide themselves.

5B.5.3 Read the following 3 statements regarding team member roles:

a) A "problem solver" trains other team members in job/skill areas and continually shares knowledge with others.

b) The "customer advocate" demonstrates good interpersonal skills and supports other team members.

c) The "skilled worker" strives to meet the needs of the customer better.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

5B.6 The following **multiple choice questions** are based on **section 5.6 "Diversity Management"** (METS-3: 99-103) of the textbook.

5B.6.1 Read the following 3 statements:

a) Ableism, ageism, classism and racism are just a few types of discrimination.

b) An example of ableism is when an all-male selection panel rejects a female employee's application for a senior position because the panel members believe that she cannot handle stress because she is female.

c) An example of classism is when an 18-year-old employee who joined the company recently is excluded from decision-making structures because the more experienced managers believe that she does not have the necessary insight and experience to provide input.

Which of the above statements is/are **correct**?   (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

5B.7 The following **multiple choice questions** are based on **section 5.7 "Conclusion"** (METS-3: 103) of the textbook.

None.

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Section 5 C – short and long questions

5C.1 The following **short and long questions** are based on **section 5.1 "Introduction"** (METS-3: 91) of the textbook.

Question 5C.1.1

Engineers and technologists that manage or supervise people need certain skills. List some of the skills that they need to ensure that conflict between employees and diversity of employees do not influence effective teamwork negatively. Draw a table similar to the one below and list at least three skills under each of the headings provided. (12)

Human relations	Conflict management	Teamwork	Diversity management

5C.2 The following **short and long questions** are based on **section 5.2 "Human relations"** (METS-3: 92) of the textbook.

Question 5C.2.1

List at least five reasons why engineers should have well-developed human relations skills.

5C.3 The following **short and long questions** are based on **section 5.3 "Guidelines for sound human relations"** (METS-3: 93) of the textbook.

Question 5C.3.1

Provide guidelines that an engineering manager should follow to promote sound human relations in the workplace. You may use the following pointers: (6)

- Communication
- Trust
- Positive attitude
- Open-mindedness
- Appreciation
- Networking

5C.4 The following **short and long questions** are based on **section 5.4 "Conflict"** (METS-3: 94-96) of the textbook.

Question 5C.4.1

Briefly describe any **two** of the following strategies for dealing with conflict:

- Win-lose strategy
- Lose-lose strategy
- Win-win strategy (4)

Question 5C.4.2

Discuss the following conflict management styles. Which style do you use most often when confronted with a conflict situation? Explain.

Avoidance

Competing

Compromising

Accommodating

Collaboration (10)

Question 5C.4.3

One of the less experienced supervisors in your department approached you for some advice. He wants advice on how to deal constructively with conflict in his team. Provide him with some guidelines. (6)

Or

You are the manager of two employees who continually clash over various issues. Describe what you will do to resolve the conflict in your team. (6)

Or

"You are managing a team of ten people, but two of the team members don't get along with each other. How will you manage the conflict situation?" [Source: DME, Mine Managers Examination, Mine Management and Industrial Law, 15 May 2008, Question 2.2] (10)

Question 5C.4.4

Briefly differentiate between the following three major types of conflict:

- Intrapersonal conflict
- Interpersonal conflict

- Intergroup conflict (3)

Question 5C.4.5

Briefly evaluate the following factors in terms of their potential to cause conflict in the workplace:

- Breakdown in communication
- Personality clashes
- Inconsistent and unfair behaviour
- Autocratic management style
- Lack of resources
- Persons from different cultures having to work together (6)

Question 5C.4.6

Briefly differentiate between the following types of conflict:
- Intrapersonal conflict
- Interpersonal conflict
- Intergroup conflict (3)

5C.5 The following **short and long questions** are based on **section 5.5 "Teamwork"** (METS-3: 97-99) of the textbook.

Question 5C.5.1

A. List and describe the four stages that you would expect a new team to go through as it develops into a well-functioning unit that achieves its objectives. (8)

B. You are appointed by a company to serve on a team responsible for re-designing one of the systems in the organisation. List and briefly describe the stages that you would expect this new team to go through to become fully functional. (8)

Question 5C.5.2 a) (SMWT roles)

List the roles of the members in a self-managing work team (SMWT). (4)

Question 5C.5.2 b) (SMWT design)

A new team must be formed at your organisation in order to solve a problem that one of your main clients experience. How will you go about to select various people at your organisation

to serve on this self-managing work team? Explain the different roles that members will have to play in this team environment. (6)

Question 5C.5.3

Match each of the following team member roles with the correct description. In your answer book, write down the number of each role, and next to it the letter representing the correct option, e.g. 1. h. (7)

1. Problem solver	a. Trains others in job/skill areas and continually shares knowledge with others.
2. Trainer	b. Demonstrates all the necessary skills and knowledge to perform the job well, and continually strives to improve skill sets and assure total quality.
3. Decision-maker	c. Demonstrates good interpersonal skills and supports other team members.
4. Customer advocate	d. Understands and utilises problem-solving techniques to regularly identify and solve problems.
5. Team player	e. Provides input and makes decisions on issues that directly influence the work area.
6. Resource provider	f. Strives to meet the needs of the customer better.
7. Skilled worker	g. Has a diverse and ever-expanding set of skills that continually broadens the knowledge base.

Question 5C.5.4

List the advantages of teamwork. (5)

5C.6 The following **short and long questions** are based on **section 5.6 "Diversity Management"** (METS-3: 99-103) of the textbook.

Question 5C.6.1

Match each of the following types of discrimination with the correct example. In your answer book, write down the number of each type of discrimination, and next to it the letter representing the correct option, e.g. 1. f.

Type of discrimination	Example of discrimination
1. Ableism	a. An 18-year-old employee who joined the company recently is excluded from decision-making structures because the more experienced managers believe that she does not have the necessary insight and experience to provide input.
2. Ageism	b. An all-male selection panel rejects a female employee's application for a senior position because the panel members believe that she cannot handle stress because she is female.
3. Classism	c. The building does not cater for people with disabilities.
4. Religionism	d. The tea room may be used by managers only and engineers. Administrative staff, technologists and labourers are not allowed in the tea room.
5. Sexism	e. An important meeting is scheduled for a Friday afternoon, when Muslim staff members will be unable to attend owing to religious commitments.

Question 5C.6.2

Below follows six (6) examples of interactions between people in the workplace. In each case, decide whether or not one or more of the parties is/are guilty of discrimination.

The type (or types) of discrimination (ableism, ageism, classism, religionism, sexism) should also be determined in each case (if, in your opinion, such discrimination is present). Give brief reasons for your answers, especially when you link an example to more than one form of discrimination.

Note: The mark allocation is not necessarily an indication of: 1) whether discrimination is present or not, or 2) the number of forms of discrimination that may be present.

<u>Workplace example 1</u>

An all-male selection panel rejects a female employee's application for a senior position because the panel members believe that the applicant cannot handle stress because she is female. {2}

<u>Workplace example 2</u>

A relatively inexperienced, female engineering graduate phones a subordinate, an experienced male artisan in an underground mine workshop, and asks him to install the three-phase electric motor that she ordered for one of the battery-driven locomotives used on that level. He asks her to come down from her office on the surface to show him how to install such a motor in the locomotive. (The female engineer did not consult the male artisan before ordering the motor, and she ordered the wrong type of electric motor.) {2}

<u>Workplace example 3</u>

A remark by a male mine overseer at a deep-level underground mine: "Underground work is not for women. I do not want women in my section." {2}

<u>Workplace example 4</u>

A 23-year-old female engineer, who joined the company recently, is excluded from decision-making structures because the more experienced, predominantly male managers believe that she does not have the necessary insight and experience to provide input. {2}

<u>Workplace example 5</u>

The tea room may be used by managers and engineers only. Administrative staff and artisans are not allowed in the tea room. {2}

<u>Workplace example 6</u>

An important meeting is scheduled for a Friday afternoon, when Muslim staff members will be unable to attend owing to religious commitments. {2}

Question 5C.6.3

Define diversity management and list four possible advantages of diversity management. (6)

Question 5C.6.4

   A. Define ubuntu and explain how a manager could practice the principles of ubuntu. (5)

B. Explain how managers and engineers can use the concept of ubuntu to improve people management in the work place. [6]

5C.7 The following **short and long questions** are based on **section 5.7 "Conclusion"** (METS-3: 103) of the textbook.

Question 5C.7.1

Briefly explain how managers with sound people skills may contribute towards a productive organisation? (2)

5C.8 The following **short and long questions** are based on **Chapter 5, "Managing people and teams",** (METS-3: 91 -103) of the textbook.

Question 5C.8.1 a)

There are huge cultural differences between Swedes and Somalians. This is described by one Somali immigrant as follows: "For Somali immigrants [coming to Sweden] is like being transported to Mars" (Source: The Economist, 2013. Special report: The Nordic Countries, 2 Feb 2013: 7). South Africa is known as the rainbow nation because of the various cultural groups that live in the country. These cultural groups have to work together to reach national goals, organisational goals and personal dreams. You have been appointed to a senior management position in a multi-cultural environment. Briefly describe how you envisage maintaining and nurturing sound human relations in this environment. (12)

Question 5C.8.1 b)

You have been appointed to a senior management position in a company. Briefly describe how you envisage maintaining and nurturing sound human relations in this multicultural environment. (12)

Question 5C.8.1 c)

You are appointed manager at an engineering company. Your team consists of people from different ethnical backgrounds (Zulus, Vendas, Xhosas, Afrikaans-speaking whites, Asians, and so on). Provide guidelines that you would follow to manage this diverse group effectively. (12)

Question 5C.8.2 (Combines Qs: 5C.10, 5C.13, 5C.15, 5C.16)

Match each of the terms and concepts (on the left-hand side) with the best description, definition or characteristic (on the right-hand side). In your answer book, write down only the number and next to it the letter representing the correct option, eg 1. z. (8)

Terms and concepts		Acts
1. intrapersonal conflict		a) develops between two individuals as a result of different needs and goals.
2. win-lose strategy for dealing with conflict		b) complex problems are solved more effectively
3. an advantage of team work		c) results in the expression of incompatible ideas between two or more teams.
4. interpersonal conflict		d) A form of discrimination
5. diversity management		e) occurs within an individual when two equally attractive and irreconcilable alternatives are presented.
6. cultural differences		f) one party achieve its goals at the expense of the other party.
7. intergroup conflict		g) it has the potential to cause conflict in the workplace
8. ageism		h) A comprehensive and holistic process for creating and maintaining an environment in which all employees feel comfortable, recognised, valued and appreciated despite differences such as race, gender, culture, religion, disability or sexual orientation.

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Section 5D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 5D.1 (Management of diversity)

Former South African president, Mr Thabo Mbeki, said at a meeting of African leaders in Tanzania that continental policies were not being implemented by some governments, and part of

the problem was a failure to manage diverse societies. According to him, Africa's failure to manage its diverse societies had resulted in persistent social instability, civil war and violent conflicts, exclusion and inequality, a lack of cohesion, and an increased "brain drain". According to him success on the continent, with its diverse cultures and languages, depended on a common national identity, a shared objective, and proper management of diversity (Source: SAPA, 1 Aug 2014, Intelligensia needed to help Africa – Mbeki, Engineering News).

You are an executive at a multinational mining company that owns and manages a number of mines in various African countries. Describe in detail how you envisage maintaining and nurturing sound human relations in this environment.   In your report you may provide some (background) information on:

- the cultural and language diversity to be found in Africa
- mining companies that you think are operating successfully in Africa. Why are they successful?
- how you are planning to overcome possible language barriers. Do you think the use of Fanagalo on South African mines was a good or bad idea? Explain.

Section 5E – Case studies

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Section 5F – Sources on the world wide web

- - - - End (Questions on Chapter 5) - - - -

Chapter 6, Engineering Contracts and Law

Section 6 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer where appropriate.

Examples (questions and answers)

6A.1 The law of obligation is based on the principle that one must honour one's promises.
True, METS-2: 106

6A.2 All agreements between persons are contracts.
False, Not all agreements create obligations. METS-2: 107.

6A.3 A contract is an agreement that creates rights and duties.
True, METS-2: 107

6A.4 Parties must reach agreement before a contract can be formed.
True. It is one of the requirements for a contract. METS-2: 107

6A.5 A contract can only come into existence when both parties have contractual capacity.
True. It is one of the requirements for a contract. METS-2: 107.

6A.6 The creditor has a duty to perform.
False, The debtor has a duty to perform. METS-2: 108

6A.7 In terms of a contract, a debtor is a person who has a duty to perform.
True. METS-2: 108

6A.8 One of the requirements of an offer is that it must be definite and complete.
True. It is one of the requirements of an offer. METS-2: 110.

6A.9 A tender that was called for constitutes an offer.
False, A tender that was called for was not addressed to a specific person which is one of the requirements of an offer. METS-2: 110.

6A.10 An advertisement is an offer to do business.
False, It is only an invitation to do business – not an offer. METS-2: 110

6A.11 One of the requirements of an offer is that it must be directed at a definite person or persons.
True. METS-2: 110.

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Other True/False questions (without answers)

6A.12   A contract has not yet been concluded when a counter-offer is made.

6A.13   An offer lapses or expires when a counter-offer is made.

6A.14   An offer lapses on the death of the offeror or offeree.

6A.15   The acceptance of an offer must be unconditional for a valid contract to be formed.

6A.16   If the consensus of one of the parties is legally invalid, there can be no contract.

6A.17   For a contract with the state (where government is one of the parties) to be valid, such a contract must be authorised by the relevant minister.

6A.18   Minors, who are older than seven years, have limited contractual capacity.

6A.19   A minor under the age of seven has no contractual capacity.

6A.20   In South Africa contracts may, in principle, be concluded orally or even by conduct alone.

6A.21   In South Africa, a contract for the sale of land must be in writing for it to be valid.

6A.22   When the representatives of two companies agree that their verbal contract must be reduced to writing, then a valid contract will only be concluded once it has been reduced to writing.

6A.23   A contract is unlawful when the performance to be rendered is forbidden by law.

6A.24   A contract to commit a crime, eg fraud, would be void (not valid).

6A.25   The registration of professional engineers, technologists and technicians are regulated by the ECSA (Engineering Council of South Africa).

6A.26   A resident engineer must watch and supervise the design and execution of works.

6A.27   The purchase price of an item is an example of the naturalia of a contract of purchase and sale.

6A.28   The essentialia of a contract are the terms that the law deems essential for placing a contract into a certain category.

6A.29   To sell something "voetstoots" (as is) would normally form part of the naturalia of a (purchase and sale) contract.

6A.30   The incidentalia are the additional terms that are included in a contract in order to provide for special requirements of the parties.

6A.31   Express terms are terms in a contract that are incorporated into contracts by operation of law.

6A.32   Implied terms are terms in a contract which the parties incorporate into a contract.

6A.33   Tacit terms are incorporated into contracts without having to be expressed in words. It is based on the parties' true intention.

6A.34   A warranty is a contractual term whereby a contracting party assumes absolute liability for proper performance.

6A.35　　　A condition is a clause in a contract that entitles a contracting party to summarily cancel the contract owing to the other's breach.

6A.36　　　A supposition is a clause in a contract that states that the party who commits breach of contract must render a specified performance to the aggrieved party.

6A.37　　　Primary, secondary and tertiary rules can be used to interpret contracts.

6A.38　　　The law of contract recognises five distinct ways in which breach of contract may occur.

6A.39　　　*Mora debitoris* means "delay of the debtor".

6A.40　　　*Mora creditoris* means delay of the creditor.

6A.41　　　If a party to a contract indicates that he/she does **not** intend to perform in terms of the contract, there is a breach of contract in the form of positive malperformance.

6A.42　　　An innocent party (to a contract) is always entitled to claim specific performance.

6A.43　　　Cancellation (recission) of a contract is possible only in exceptional circumstances.

6A.44　　　Delegation is when contractual duties are transferred to a third party.

6A.45　　　Release is when a contract is replaced by a new contract.

6A.46　　　Novation is when a contract is cancelled by agreement.

6A.47　　　If John owes Lucky R1000 whilst Lucky owes John R800 then John owes Lucky R200 after set-off.

6A.48　　　No formalities are required for letting and hiring of work contracts.

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Section 6 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '6.15 [1]'.

Examples (questions and answers)

6B.1　Read the following three statements:
  a)　The law of obligation is based on the principle that one must honour one's promises.
  b)　All agreements between persons are contracts.
  c)　The creditor has a duty to perform.
  Which of the above statements is/are **correct**? (2)
  [1]　b and c
  [2]　a and c

[3]   a and b

[4]   a

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 6B.1: [4]

a)   True, METS-2: 106

b)   False, METS-2: 107.

c)   False, see METS-2: 108

6B.2 Read the following three statements:

a)   A request for a quotation constitutes a firm offer to do business.

b)   If the consensus of one of the parties is legally invalid, there can be no contract.

c)   A minor under the age of seven has no contractual capacity.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 6B.2: [1]

a)   False, METS-2: 110.

b)   True, METS-2: 112

c)   True, METS-2: 117

6B.3 Read the following three statements:

a)   In South Africa contracts may, in principle, be concluded orally or even by conduct
     alone.

b)   A contract is unlawful when the performance to be rendered is forbidden by law.

c)   A resident engineer must watch and supervise the works.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 6B.3: [4]

    a)   True, METS-2: 118

    b)   True. METS-2: 121

    c)   True, METS-2: 124

6B.4 Read the following three statements:

    a)   The purchase price of an item is an example of the naturalia of a contract of purchase and sale.

    b)   Tacit or implied terms are incorporated into contracts without having to be expressed in words.

    c)   Primary, secondary and tertiary rules can be used to interpret contracts.

    Which of the above statements is/are **correct**?   (2)

    [1]   b and c

    [2]   a and c

    [3]   a and b

    [4]   a, b and c

    [5]   None of the options (1, 2, 3, or 4) is correct.

Answer 6B.4: [1]

    a)   False, METS-2: 125

    b)   True, METS-2: 126

    c)   True, METS-2: 128

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Other MCQs (without answers)

6B.5 Read the following three statements:

    a)   The law of contract recognises five distinct ways in which breach of contract may occur.

    b)   An innocent party is always entitled to claim specific performance.

    c)   Cancellation of a contract is possible only in exceptional circumstances.

    Which of the above statements is/are **correct**?   (2)

    [1]   b and c

    [2]   a and c

    [3]   a and b

    [4]   a, b and c

    [5]   None of the options (1, 2, 3, or 4) is correct.

6B.6 The carport at Peter's new home was rusty and in a bad condition. He entered into a contract with AAA Carports for the construction of a new carport on 5 January 2014. He paid AAA Carports an amount of R3000 on 5 January 2014. The terms of the contract stated that Peter was responsible for removing the old carport and that AAA Carports had to start constructing the new carport on the same spot at any time on or after 12 January 2014. The company had to complete the carport by 19 January 2014. On 12 January 2014 a supervisor and workers from AAA Carports arrived at Peter's home to start with the construction of the carport. By then Peter had not yet removed the old carport – he did so only on 14 January 2014. Which **one** of the following statements is correct? (2)

[1] Peter did not breach the contract because AAA Carports had until 19 January to construct the car port.

[2] There was a breach of contract known as mora creditoris.

[3] AAA Carports are in the wrong, because they should have checked with Peter if he had removed the old carport.

[4] There was a breach of contract, known as repudiation.

[5] There was a breach of contract, known as mora debitoris.

6B.7 Which **one** of the following statements is **incorrect**? (2)

[1] The essentialia of a contract are the terms that the law deems essential for placing a contract into a certain category.

[2] To sell something "voetstoots" ('as is') would normally form part of the naturalia of a (purchase-and-sale) contract.

[3] The incidentalia are the additional terms that are included in a contract in order to provide for special requirements of the parties.

6B.8 Which **one** of the following statements is **correct**? (2)

[1] Implied terms are terms in a contract which the parties incorporate into a contract.

[2] Express terms are terms in a contract that are incorporated into contracts by operation of law.

[3] Tacit terms are not expressed in words but are based on the parties' true intention.

6B.9 Which one of the following is **not** a requirement for the conclusion of a valid contract? (2)

[1] Each party to the contract must have capacity to act.

[2] There must be consensus between the parties.

[3] It must be physically possible to perform in terms of the contract.

[4] The contract must be permitted by law.

[5] The contract must be in writing, signed and dated.

6B.10 Richard makes an offer to buy Tumelo's car for R10 000. He gives Tumelo 10 days to accept his offer. On the ninth day, Tumelo informs Richard that he will sell his car to him, but that he wants R12 000 for it.

Which one of the following statements is **correct**? (2)

[1] A contract came into existence between Richard and Tumelo with a purchase price of R12 000.

[2] A contract came into existence between Richard and Tumelo with a purchase price of R10 000.

[3] No contract came into existence between Richard and Tumelo as Tumelo made a counter-offer, which Richard has not yet accepted.

[4] Richard's offer still stands.

6B.11 Which **one** of the following statements is **correct**? (2)

If a party to a contract indicates that he/she does **not** intend to perform in terms of the contract, there is a breach of contract in the form of

[1] *mora debitoris*

[2] repudiation

[3] positive malperformance

[4] prevention of performance

6B.12 Read the following three statements:

a) A contract is an agreement that creates rights and duties.

b) When the representatives of two companies agree that their verbal contract must be reduced to writing, then a valid contract will only be concluded once it has been reduced to writing.

c) *Mora debitoris* means "delay of the debtor".

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

6B.13   Read the following three statements:

a)   *Mora creditoris* means "delay of the creditor".

b)   An offer lapses or expires when a counter-offer is made.

c)   In terms of a contract, a debtor is a person who has a duty to perform.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

6B.14 Your company (X) wants to enter into a contract with another company (Y), which manufactures components that form part of the product that your company assembles. X offers Y a price of R10,50 per component but Y wants R11,50 per component. Read the following three statements:

a)   There is no agreement between the two parties and therefore no contract.

b)   X's offer expired because Y made a counter-offer.

c)   A contract will come into existence if X informs Y that it is willing to pay R11,50 per component.

Which of the above statements is/are **correct**?   (2)

[1]   a and b

[2]   b and c

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

6B.15 Read the three statements below regarding the contract for the letting and hiring of work.

a)   This is a contract whereby a specialist is hired to perform a specific piece of work by an owner of a mine, plant, etc.

b)   The hired party (contractor) is not employed by the owner and therefore not under his/her control.

c)   The contractor is entitled to be remunerated for "extras" and variations not provided for in the original contract if the owner consented to them.

Which of the above statements is/are **correct**?   (2)

[1]   a and b

[2]   b and c

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

6B.16 Read the three statements below:

a)   Duress arises when a prospective contractant is forced/compelled by means by of an unlawful threat/intimidation by the other party (or someone acting on his/her behalf), which causes fear in the prospective contractant, to conclude the contract.

b)   Duress usually results in a void contract because the consent of one party is obtained in an improper manner.

c)   Culpable misrepresentation (either fraudulent or negligent) is a wrongful statement of fact made by one party (or his or her agent) to the other party (or his/her agent) prior to finalising the contract, which misrepresentation persuades the latter party to conclude the contract.

Which of the above statements is/are **correct**?   (2)

[1]   a and b

[2]   b and c

[3]   a, b and c

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

6B.17   Read the following three statements:

a)   A warranty is a contractual term whereby a contracting party assumes absolute liability for proper performance.

b)   A condition is a clause in a contract that entitles a contracting party to summarily cancel the contract owing to the other's breach.

c)   A supposition is a clause in a contract that states that the party who commits breach of contract must render a specified performance to the aggrieved party.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   b

[3]   a and c

[4]   a and b

[5]   None of the options (1, 2, 3 or 4) is correct

6B.18   Read the following three statements:

a)   Release is when a contract is replaced by a new contract.

b)   Novation is when a contract is cancelled by agreement.

c) If John owes Lucky R1000 whilst Lucky owes John R800 then John owes Lucky R200 after set-off.

Which of the above statements is/are **correct**? (2)

[1] c

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3 or 4) is correct

6B.19A surface mining company enters into a contract with an earthmoving company. The purpose of the contractual agreement is to outsource the loading and hauling functions at the mine to the earthmoving contractor at a fee. The fee structure is described in detail in the contract. Read the following four statements:

a) The surface mining company is both a creditor and a debtor.

b) As a debtor the surface mining company may claim performance from the earthmoving contractor to do the loading and hauling at the mine.

c) As creditor, the surface mining company has a duty to perform, namely to pay the earthmoving contractor for loading and hauling services provided.

d) The earthmoving contractor is a creditor because it may claim the fee from the mine for work done. It is also a debtor because it has to deliver loading and hauling services to the mine.

Which of the above statements is/are **correct**? (2)

[1] a, b, and c

[2] a and d

[3] a and b

[4] a, b, c and d

[5] none (not 1, 2, 3 or 4)

– – – – – –

Section 6 C – short and long questions

Examples (questions and answers)

Question 6c.1

Explain whether your mine, plant or factory must accept the lowest tender, e.g. for drilling blast holes. (3)

<u>Answer</u>

The employer has no obligation to accept a particular tender or lowest tender (unless the tender documents state otherwise). A tender is not an offer. It is merely an invitation to do business. Not only cost but also other factors such as safety, deliverability and quality have to be considered. The safety record and track record of the contractor may be considered before a decision is made to accept a tender or not.

For further information, in addition to chapter 6 of METS-2, see:

- Bracher PA, August 1992, Some legal aspects of the tender, Institute of Quarrying of SA   (3)

Question 6c.2
List two factors that can render a contract voidable.   (2)

Answer 6c.2

<div style="border:1px solid black; padding:8px;">

<u>Definitions of "voidable"</u> (background)

1) In contracts, *voidable* is a term typically used with respect to a contract that is valid and binding unless avoided or declared void by a party to the contract who is legitimately exercising a power to avoid the contractual obligations (http://legal-dictionary.thefreedictionary.com/voidable).

2) A contract that has legal effect and force when it is made, but is liable to be subsequently annulled or set aside by the courts through the process of rescission (http://www.businessdictionary.com/definition/voidable-contract.html).

</div>

{Any two of the following: }
- Misrepresentation (METS-2: 114)
- Duress (METS-2: 115)
- Undue influence (METS-2: 116)   (2)

Question 6c.3
Explain the contractual capacity of the following parties: (4)
- A company
- A boy, 17 years old
- A child, 6 years old
- The state

Answer 6c.3

Company: A company is a juristic person and needs representatives (or organs) to act on its behalf. The contractual capacity of the representative is determined by the powers given to him by the company. (METS-3: 117)

Boy, 17 years old: The boy has limited contractual capacity (METS-3: 117). The boy may only conclude a valid contract with the assistance of his guardian.

Child, 6 years of age: Has no contractual capacity. (METS-3: 117)

State: Contract must be authorised by the responsible minister. (METS-3: 117)   (4)

Question 6c.4

a)   List and discuss a number of reasons for making use of contractors.   (6)

Answer 6c.4 (a)

Consult the references below when answering 6c.2 b to d.

a)   Those operations/activities that are not considered to be the core business of an organisation and which other organisations may provide with greater efficiency and at reduced cost to the company should be outsourced.

Loading and hauling at a mine may be contracted out for the following reasons:

- The contractor must usually provide his/her own equipment. The mining company therefore requires less capital to buy and maintain equipment.

- Production could be increased without increasing the capacity of the loading and hauling fleet of the mine by contracting out some of the work.

- It may sometimes be more cost effective to contract out certain work. A small quarry may for example not fully utilise expensive equipment.

- Some of the requirements of the Mining Charter could be met by contracting such work out to a BEE company.

References:

- Bracher PA, August 1992, Some legal aspects of the tender, Institute of Quarrying of SA

- Ford M, 11 March 1993, Selective and effective use of contractors at Rietspruit opencast services – 24th Annual General Meeting, Institute of Quarrying of SA

Other questions (without answers)

b) List various costs that have to be considered when deciding on whether an activity should be done in-house or to invite contractors to tender for it. (6)

(Minerals Industry)

c) Discuss a number of managerial implications of using contractors at a mine or quarry. (8)

d) What is your mine's policy towards the use of contractors? Discuss some examples of activities that are already contracted out or which should be contracted out in future. Which types of activities on a mine could be contracted out successfully? (8)

Question 6c.5

Your company (A) wants to enter into a contract with another company (B), which manufactures components that form part of the product that your company assembles.

a) When does a contract come into force/existence? List the requirements for a contract to come into existence. (4)

b) Your company offers company B a price of R10,50 per component. Company B wants at least R11,50 per component. Briefly explain whether a valid contract has been concluded or not. (1)

[5]

Question 6c.6

Briefly distinguish between *mora debitoris* and *mora creditoris*. (2)

Question 6c.7

Briefly explain the principles related to the contract for the letting and hiring of work. (4)

Question 6c.8

Differentiate between the following two types of contracts:

- Contracts for the letting and hiring of work
- Contracts for the letting and hiring of personal services in return for remuneration (8)

Question 6c.9

Briefly define a contract. (2)

Question 6c.10

a) Define obligation and contractual performance and explain the consequences of the coming into existence of an obligation. Create an example of a contract to illustrate the specific duties of each party to the contract. (6)

Or

b) A surface mining company enters into a contract with an earth-moving company. The purpose of the contractual agreement is to outsource the loading and hauling functions at the mine to the earthmoving contractor at a fee. The fee structure is described in detail in the contract. Describe obligation and contractual performance in the context of this case. Explain the consequences of an obligation coming into existence. You must use the following terminology in your explanation and it should be clear what these terms mean: debtor, creditor, right and duty. (4)

Question 6c.11
Briefly differentiate between the requirements for a valid offer and a valid contract. (8)

Question 6c.12
Differentiate between express, implied and tacit terms. (3)

Question 6c.13
Define duress and state what the consequences of duress could be when drawing up a contract. (2)

Question 6c.14
You want to rent a workshop for your company and to enter into a contract with the owner of the workshop. List and discuss some of the requirements and terms of this contract.
{Hint: This is a broad question. The following may be discussed: 1) Requirements for a contract to come into existence (METS-2: 107) and 2) terms of a contract (METS-2, pp. 125-128)} (8)

Question 6c.15
Mary and Susan agree that their verbal contract must be reduced to writing. Explain whether a valid contract will be concluded before it has been reduced to writing. (METS-2, p. 136, 6.6) (3)

Question 6c.16
Discuss the transfer and termination of obligations arising from a contract. (8)

Question 6c.17
a) List four ways in which an offer lapses or expires. (4)

b) A mining magnate offers the shareholders of Supersteel (Pty) Ltd, a small local company, R26m for one of their workshops. Indicate whether this offer would still be valid (or not) in each one of the following cases.

   i) The mining magnate changes his mind and withdraw the offer before it was accepted by Supersteel.

   ii) The offer expired.

   iii) The mining magnate died of a heart attack before the offer was accepted by Supersteel.

   iv) Supersteel indicated that they are only willing to sell the workshop for R32m.

{4 x ½}

Required: just indicate in each of the four cases whether the offer is still valid or not. (2)

Question 6c.18

Match each of the following terms of contract in the left-hand column with its correct definition in the right-hand column. In your answer book, write down the number of each term, and next to it the letter representing the correct option, e.g. 1. j. (6)

1. Condition	a. Determines a specific time or period within which the contract will either become operative or be dissolved.
2. Time clause	b. A contractual term whereby a contracting party assumes absolute liability for proper performance.
3. Supposition	c. A clause that entitle a contracting party to summarily cancel the contract due to the other's breach.
4. Warranty	d. A clause that states that the party who commits breach of contract must render a specified performance to the aggrieved party.
5. Cancellation clause	e. A contractual term that renders the operation of a contract dependent on an event that has already taken place.
6. Penalty clause	f. A contractual term that renders the operation and consequences of the contract dependent on the occurrence or non-occurrence of a specific uncertain future event.

Question 6c.19

Match each of the following terms of contract on the left of the table with the correct example on the right of the table below. In your answer book, write down the number of each term, and next to it the letter representing the correct option, for example "1. j". (6)

1. Condition	a. On 21 December 2007, John buys steel from XYZ Timber and Steel. They agree that delivery will take place on 3 January 2008.
2. Time clause	b. DEF Mining Company Ltd. enters into a contract with EFG Smelter Construction Ltd for the design and construction of a new smelter. One of the clauses in the contract states that the smelter will have an output of 8 000 ounces of platinum per day.
3. Supposition	c. Peter and John incorporate into their lease contract a clause stating that if Peter is late in paying rent, John is entitled to cancel the contract.
4. Warranty	d. STU Civil Engineers and Contractors and VWX Hotels and Casinos entered into a contract for the design and building of a new casino. VWX wishes the new casino to be completed by 10 December 200X, in time to open for the December holiday season. One of the clauses in the contract states that VWX will be able to claim R10 000 for each day that STU is late.
5. Cancellation clause	e. ABC Exploration Ltd. agrees to buy Lucky's farm, provided that the soil contains gold ore that can be economically exploited. ABC has not done any exploration on the farm yet, and therefore does not know whether the soil is gold-bearing or not.
6. Penalty clause	f. BCD Gold Mining Company agrees that it will buy the farm of Mr Groenewald's farm if BCD's application for a mining licence is successful. (Mr Groenewald is the owner of a farm, on which gold ore has been discovered that can be exploited economically.)

Question 6c.20

Match each of the following terms (related to the transfer and termination of obligations arising from a contract) in the left-hand column with the correct description or example in the

right-hand column. In your answer book, write down only the number of each term, and next to it the letter representing the correct option, e.g. 1. j. (4)

1. Cession agreement	a. The transfer of contractual duties from the original debtor to a third party.
2. Delegation	b. Peter was required to deliver golden earrings to Sharon. They both agreed that he would deliver a golden ring in its place.
3. Novation	c. Rights arising from a contract can be transferred by the holder thereof to another person.
4. Set-off	d. Example 1: John owes his father R500. Before he could pay his father this amount, he fixed his father's car for the amount of R1 500. The result is that his father now has to pay him R1 000. Example 2: LG Electronics has entered into a cross licensing agreement with GE Consumer & Industrial that will allow LG and GE to use one another's patents for refrigerators and cooking appliances without paying licensing fees (27 Feb 2008, http://www.appliancemagazine.com).

Question 6c.21

ABC Electricity Generation Ltd is and independent power producer (IPP). Eskom made ABC an offer to purchase 600 000 MWh of electric energy over a period of one year at a price of 45c/kWh. ABC informs Eskom that it would provide the 600 000 MWh but at a price of 55c/kWh. Determine and explain whether a contract came into existence. (2)

Question 6c.22

List five ways in which breach of contract can occur. (5)

Question 6c.23

List three (3) remedies for breach of contract. (3)

Question 6c.24

Differentiate between a debtor and creditor – the terminology as used in the context of contracts. (2)

Question 6c.25

Briefly explain what a mistake is with regard to a contract. (2)

Question 6c.26

Why would a *call for tenders* not constitute an offer? (1)

Question 6c.27

Match each of the concepts in the left-hand column with its definition or description in the right-hand column. In your answer book, write down the number and next to it the letter representing the correct option, for example 1. z.

Legal concept		Definition or description of concept
1. Contract		a) the terms that the law deems essential for placing a contract into a certain category
2. Mistake		b) terms that naturally form part of a contract
3. Duress		c) additional terms that parties themselves make part of a contract
4. Essentialia		d) an agreement that creates obligations and legal ties
5. Naturalia		e) one or both parties to a contract have the incorrect impression. Such incorrect impression affects the validity of the contract.
6. Incidentalia		f) when a prospective contractant is forced or compelled by means of an unlawful threat or intimidation by the other party
7. Tacit		g) not expressed in words but based on the parties' true intention
8. Repudiation		h) intention of one of the parties not to meet its duties

(8)

Question 6c.28

Pete, aged 17, buys a washing machine from Maria on credit for the amount of R1000. He received the appliance from Maria but must still pay her the amount by 1 April. On the due date, Pete forgets to pay her.

i)   Define the obligation in this example. (1)

ii)   Who is the creditor in this example? (1)

iii)   Discuss in detail whether this transaction constitutes a contract. Provide reasons. (5)

iv) Explain whether and how your answer in question (iii) would change if Pete was married. (2)

[8]

Question 6c.29

Explain whether or not a valid offer was made in the following case: Arnold told Ben that he can buy his car at a very low price of which the exact amount can be agreed upon later. (2)

Question 6c.30

List two factors that can render a contract voidable. (2)

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Section 6D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 6D.1 ()

Section 6E – Case studies

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Section 6F – Sources on the world wide web

- - - - End (Questions on Chapter 6) - - - -

Chapter 7, Operations Management

Section 7 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

<u>Examples</u> (questions and answers)

7A.1 During the operational transformation process, equipment is used by skilled or semi-skilled operators to produce tangible or intangible goods.
True, METS-2: 138

7A.2 In the case of a hard rock mine, explosives is an example of transforming inputs.
True, METS-2: 138

7A.3 The value added at a mine is the difference between the selling price of the mineral and the costs of inputs.
True, METS-2: 139

7A.4 Remote mines usually keep more spares in stock. The cost of storing and insuring these is known as holding cost.
True, METS-2: 153

<u>Other True/False questions (without answers)</u>

7A.5 Unlike a product, a service cannot be kept in stock (inventory).

7A.6 Category C items are high value items according to the A-B-C inventory classification system.

7A.7 Productivity can be improved by producing the same amount of output with less input.

7A.8 Automated guided vehicles usually form part of flexible manufacturing systems.

7A.9 A just-in-time system fulfils any demand without delay.

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Section 7 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '7.9 [1]'.

Examples (questions and answers)

7B.1 Read the following three statements:
   a) Service industries deal with tangible products.
   b) Jobs are usually created in service industries (such as tourism) at much lower capital investment than in manufacturing industries.
   c) Manufacturing and service industries both use labour and capital, two of the factors of production. Service industries are usually more labour intensive than manufacturing industries.
   Which of the above statements is/are **correct**?   (2)
   [1] b and c
   [2] a and c
   [3] a and b
   [4] b
   [5] None of the options (1, 2, 3, or 4) is correct.

7.1 Answer: [1]
   a) False; b) True; c) True; [1]

_ _ _ _ _ _

Other MCQs (without answers)

7B.2 Read the following three statements:
   a) Unlike a product, a service can be kept in stock (inventory).
   b) Under-utilised capacity is likely to result in higher unit costs.
   c) Quality problems are more likely to exist during periods when the demand for the product(s) of a company is very high.
   Which of the above statements is/are **correct**?   (2)
   [1] a and c
   [2] b and c
   [3] a and b
   [4] c
   [5] None of the options (1, 2, 3, or 4) is correct.

7B.3 Read the following three statements:

    a)   Utilisation of flexible manufacturing machines usually requires longer development and planning times.

    b)   Flexibility, lower costs, minimum waste and high quality are some of the characteristics of just-in-time manufacturing.

    c)   Productivity can be improved by producing the same amount of output with less input.

    Which of the above statements is/are **correct**?   (2)

    [1]   a and c

    [2]   b and c

    [3]   a and b

    [4]   c

    [5]   None of the options (1, 2, 3, or 4) is correct.

7B.4 The following are characteristics of manufacturing industries.

    a)   The final product cannot be stored (kept in inventory).

    b)   Direct contact between the manufacturer and consumer is required.

    c)   Large capital outlays are usually required.

    Which of the above statements is/are **correct**?   (2)

    [1]   a and c

    [2]   b and c

    [3]   a and b

    [4]   c

    [5]   None of the options (1, 2, 3, or 4) is correct.

7B.5 Read the following three statements:

    a)   Category C items are high value items according to the A-B-C inventory classification system.

    b)   Automated guided vehicles usually form part of flexible manufacturing systems.

    c)   A just-in-time system fulfils any demand without delay.

    Which of the above statements is/are **correct**?   (2)

    [1]   b and c

    [2]   a and c

    [3]   a and b

    [4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

7B.6 Read the following three statements:
   a)   Money, material, machines, manpower and management are some of the inputs required in the transformation process.
   b)   The value added during the transformation process is the difference between the costs of all the inputs and the price fetched by the finished product or service.
   c)   Some of the specific inputs that you will usually find at mines are drilling machines, machine operators, engineers, miners and protective equipment, etc.

   Which of the above statements is/are **correct**?   (2)
   [1]   b and c
   [2]   a and c
   [3]   a and b
   [4]   a, b and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

7B.7 Read the following three statements:
   a)   Ease of disassembly has to be considered when a new product is designed.
   b)   The capacity of a productive unit provides the upper limit on the amount of work that such a unit can do.
   c)   Effective capacity is the maximum rate at which a process can produce for extended periods.

   Which of the above statements is/are **correct**?   (2)
   [1]   b and c
   [2]   a and c
   [3]   a and b
   [4]   a, b and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

7B.8 Read the following three statements:
   a)   Capacity measurement should be done in monetary value.
   b)   Lower inventory levels are one of the benefits of a JIT system.
   c)   Inventory can prevent stock-outs.

   Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

7B.9 Read the following three statements:

a)   Inventory that is in transit between the manufacturer and the customer is known as work-in-progress (WIP).

b)   Holding cost is one of the types of costs related to keeping inventory.

c)   The A-B-C inventory classification system is based on the Pareto principle.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

7B.10   Read the following three statements:

a)   Management should focus on controlling category C items in the A-B-C inventory classification system.

b)   The installation of newer and better machines is one way to improve productivity.

c)   Human resource policies and work ethic have an impact on the productivity of employees.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a and b

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

7B.11   The concept of zero (or minimal) inventory is called: (2)

[1]   Six sigma

[2]   Continuous improvement

[3]   Just in Time

[4] Zero defects

7B.12 Read the following three statements:

   a) During the operational transformation process, equipment is used by skilled or semi-skilled operators to produce tangible or intangible goods.

   b) In the case of a hard rock mine, explosives are an example of transforming inputs.

   c) The value added at a mine is the difference between the selling price of the mineral and the costs of inputs (per unit).

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the above options (1, 2, 3, or 4) is correct.

7B.13 Read the following three statements:

   a) Service industries deal with tangible products only.

   b) Unlike a product, a service can be kept in stock (inventory).

   c) Compared with service industries, manufacturing industries usually require large capital outlays.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the above options (1, 2, 3, or 4) is correct.

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Section 7 C – short and long questions

Examples (questions and answers)

Question 7C.1

Define manufacturing and service operations and differentiate between manufacturing and service industries. Provide one example each of a company that participates in the manufacturing and service industries. Tabulate your answer as follows:

Manufacturing		Service
	Definition	
	Product characteristics	
	Ability to keep the product in stock/inventory	
	Degree of contact with consumer during the production process	
	Size and scale of facilities required	
	Ease with which quality can be measured	
	Proximity to customers	
	Ability to resell	
	Patentability	
	Example	

(20)

Answer 7C.1

METS-2, pp. 139-140, including table 7.2

Manufacturing	Key words	Service
Focused on production / manufacturing of product.	*Definition*	Focus on acts that are useful to customers
Physical product, may be durable	*Product characteristics*	Intangible product, usually perishable, can be used once only.
Can be stored in a warehouse, for example	*Ability to keep the product in stock/inventory*	Final product cannot be stored
No direct contact between consumer and producer	*Degree of contact with consumer during the production process*	Must be direct contact
Output is usually produced in large plants or factories; large capital outlays are required (except for SMEs)	*Size and scale of facilities required*	Facilities for the service industry are usually much smaller; labour intensive, rather than capital intensive
Easy to determine and measure quality	*Ease with which quality can be measured*	Harder to determine and measure quality
Not essential to be on the consumer's doorstep	*Proximity to customers*	Essential to be close to the consumer of the service rendered
Output can be resold numerous times	*Ability to resell*	Cannot be resold to a third party
Easy to patent	*Patentability*	Difficult to patent output

Toyota, Ford, etc.	*Example(s)*	Nedbank, FNB (banking services)

(20)

Question 7C.2

Use the diagram below to explain the transformation process at an organisation that you are familiar with.
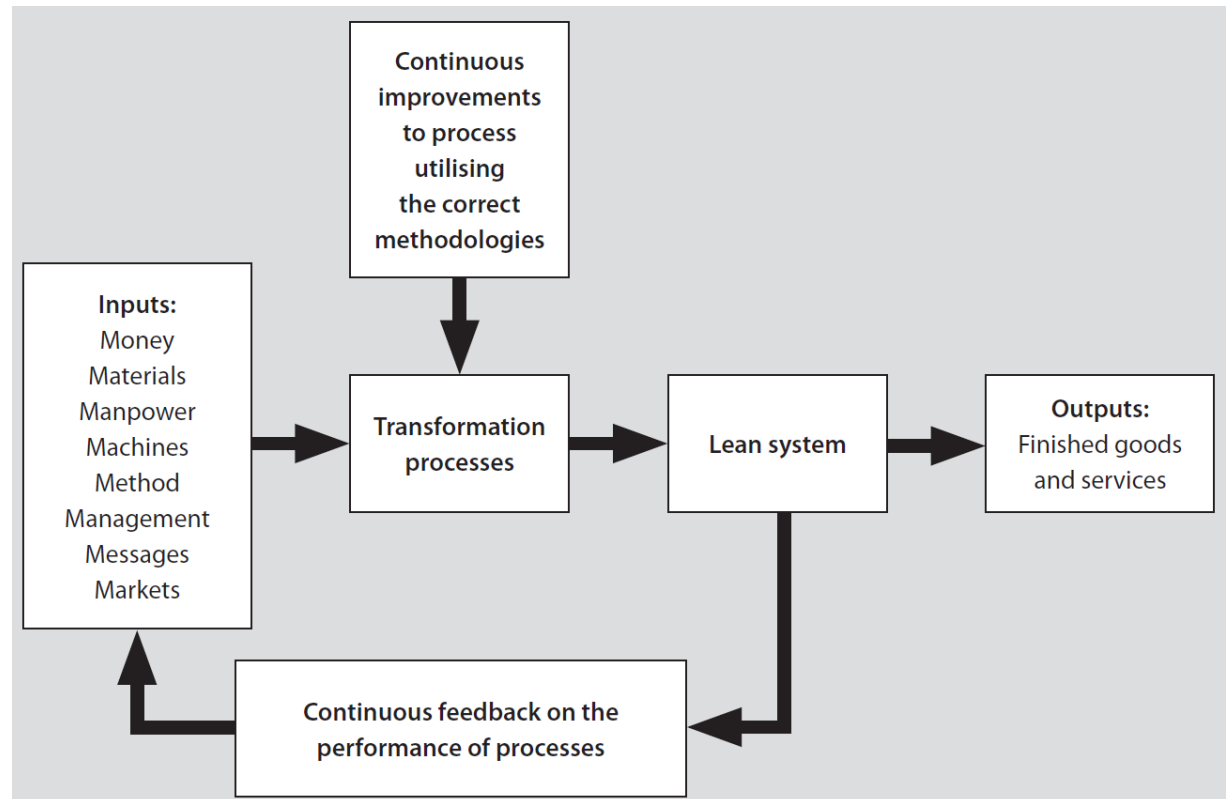
(Source: METS-3: 140 – Fig 7.1) (9)

Answer 7C.2

The transformation process at a mine's <u>survey department</u> – provided by a student:

Inputs	Transformation	Outputs
- Theodolite - Surveyors and assistants - Tripods	- Surveying - Installing pegs - Measuring - Installing grade - Tunnel layouts	- Provide direction on where to mine - Location of mining - Distances from pillars and other underground structures

(9)

Other questions (without answers)

Question 7C.3

Define the term "transformation process" and describe the nature of the transformation process. Provide examples of transformation processes and describe the transformation process at a mine, plant, factory or other organisation with which you are familiar. (18)

Question 7C.4

Discuss and explain the operations design process. (12)

Question 7C.5

Differentiate between design capacity, effective capacity and actual output. Use the information below to calculate the efficiency and utilisation at a repair workshop of a car dealership:

Design capacity: 100 vehicles per day
Effective capacity: 80 vehicles per day
Actual output: 72 vehicles per day   (5)

Question 7C.6

Discuss different types of capacity measurements available, giving examples. You may refer to capacity measurement at your place of work as well as other types of business such as an airline, university and repair facility. Tabulate your answer as follows:

BUSINESS	INPUTS	OUTPUTS
Filling station (example)	Number of pumps	Quantity of fuel pumped
…	…	…
…	…	…

(6)

Question 7C.7

Explain how the following factors will affect the availability of production capacity:
- Process design
- Product design
- Product variety
- Product quality
- Production scheduling

- Materials management
- Equipment maintenance
- People management (8)

Question 7C.8

Define a flexible manufacturing system (FMS) and discuss some of its characteristics. Also list some of its advantages and disadvantages.

Question 7C.9

Briefly explain what just-in-time (JIT) is. Give one example of where it is applied or where it can be applied at your organisation or an organsation that you are familiar with. (2)

Question 7C.10

Define capacity. Describe the capacity of your mine, plant or department in terms of the output (e.g. tons of ore in the case of a mine) that it is designed to produce or services that it can offer. (2)

Question 7C.11

No 2 RV shaft of Deep Levels Gold Mining Ltd was designed to handle 255 000 tons of rock per month. The effective capacity of the mine is, however, only 245 000 tons of rock per month. Calculate the efficiency of this shaft for the past month, when 225 000 tons of rock were hoisted. (2)

Question 7C.12

Provide examples of waste that can be eliminated with a JIT system. (6)

Question 7C.13

Differentiate between design capacity, effective capacity and actual output. (6)

Question 7C.14

Briefly define the following types of inventory:
- Finished goods
- In transit
- Raw materials

- Work-in-process (WIP) (4)

Question 7C.15

Briefly explain the purpose of keeping an inventory of spare parts and material at a mine, plant, factory or coal-fired power station. (6)

Question 7C.16

Briefly define the following types of inventory costs: (3)
- Holding cost
- Ordering cost
- Shortage cost

Question 7C.17

Briefly describe the A-B-C inventory classification system and explain how this system can be used to manage inventory. (4)

Or

You have been appointed as the production manager at a new mid-size mine where you are also responsible for the mine store and the management of inventory. Due to its limited size, not all inventory items can be stored in the store where it will be more secure. Some will have to be stored under-roof in a fenched-in area while others may only be guarded (by a security guard). Design some operational guidelines for the store overseer using the A-B-C inventory classification system. (4)

Question 7C.18

Define productivity and use the definition to explain how productivity can be improved in general and specifically at your place of work or other organization that you are familiar with. List at least one method (yardstick) that is used at your place of work (or elsewhere) to measure productivity. (5)

Question 7C.19

List five of the eight input Ms of operations management. (5)

Question 7C.20

Briefly list and discuss the main factors to be considered when designing a new product or service. (6)

Question 7C.21

Why should companies measure productivity and do productivity analysis? (3)

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 7D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 7D.1 (Improving productivity – Minerals industry)

Ernest and Young (EY) identified low productivity as the number one risk for mining companies in its 2014-2015 report titled "Business risks facing mining and metals". It describes the situation regarding productivity in the minerals industry as follows:

"The need to address the decade-long decline in productivity due to the sector's quest for growth during the supercycle has pushed productivity to the top of EY's risk ranking. The effects of extremely weakened productivity across the business are now most obvious as commodity prices continue to soften, margins have been cut and there is nowhere else to look for profitability" (EY 2014:2).

Furthermore, according to the 2014-2015 World Competitiveness Report, South Africa is doing very poorly in terms of "pay and productivity". South Africa is almost last of the 144 economies that were surveyed (number 136 out of 144)

7th pillar: Labor market efficiency

7.01	Cooperation in labor-employer relations	2.5	144
7.02	Flexibility of wage determination	2.7	139
7.03	Hiring and firing practices	2.1	143
7.04	Redundancy costs, weeks of salary*	9.3	33
7.05	Effect of taxation on incentives to work	4.5	15
7.06	Pay and productivity	2.7	136

Source: World Economic Forum, 2014-2015 World Competitiveness Report

The following question was asked in the Mine Manager's Certificate of Competency (MMCoC) examinations in October 2002 (Section B, Paper III, Mine Management and Industrial Law – Question 3)

Question from a past MMCoC paper

You are the manager of a mine supplying an international market with your product. The demand for the product you are mining has dropped substantially and therefore the price has also decreased.

You would like to implement a comprehensive change management process to reduce cost and increase productivity on your mine. Describe the steps you will take to implement such a process.

You should deal with the above described situation in your report and/or describe how an organisation of your choice should go about improving productivity.

You must define productivity and use the definition to explain how productivity can be improved in general and specifically at your place of work or another organisation that you are familiar with. List at least one method (yardstick) that is used at your place of work (or elsewhere) to measure productivity.

Section 7E – Case studies

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 7F – Sources on the world wide web

- - - - End (Questions on Chapter 7) - - - -

Chapter 8, Total Quality Management

Section 8 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer where appropriate.

<u>Examples</u> (questions and answers)

8A.1 The goal of total quality management is perfect quality (zero defect).
True. METS-2: 158.

8A.2 To design and build quality into the product is one of the fundamental principles of TQM.
True. METS-2: 158

8A.3 The quality of a commodity-like product offered to customers can be used to (somewhat) differentiate one company's product from that of another.
True. That is what the Granite Rock Company is doing with their products. METS-2: 159. Note that a commodity-like product is a fairly standard (non-unique) product, e.g. aggregate, gold, iron and sugar. A computer game is unique and therefore not a commodity.

8A.4 The focus group technique is the most useful and versatile qualitative research technique for determining the voice of the customer.
True. METS-2: 161

8A.5 A process improvement team (PIT) is a small group of employees (at shop-floor level) that improve processes and solve quality problems.
True. METS-2: 161.

8A.6 The quality control department at an organisation should be held solely responsible for quality.
False. PITs (and all other employees) should be held responsible for quality. METS-2: 161.

8A.7 *Kaizen* is the Japanese word for process variation.
False. Kaizen means "(continuous) improvement". METS-2: 162

8A.8 Continuous improvement is an important aspect of quality improvement.
True. It is also known as Kaizen. METS-2: 162.

8A.9 The prevention of future quality problems is a key responsibility of new product development teams.
True. METS-2: 163

8A.10   Quality must already be kept in mind when a new product is designed.

         True. METS-2: 163

_ _ _ _ _ _

Other True/False questions (without answers)

8A.11   The cost of fixing potential quality problems during the product development phase is usually less than to fix such problems once they are embedded in the product.

8A.12   Quality function deployment is a formal method for transforming customer requirements into technical requirements.

8A.13   For a process to be at Six Sigma it must have less than 3,4 defects per one thousand opportunities for error.

8A.14   A process is a repetitive set of interacting activities that uses resources to transform a defined set of inputs into outputs that are of value to a customer.

8A.15   Process variation results in products of which the quality varies.

8A.16   Deming's rule of thumb is that 94% of all variations are due to special causes and 6% are due to common causes.

8A.17   The ability of a process to produce acceptable quality characteristics is called process performance.

8A.18   Variation in product quality owing to an incorrect tool setting falls under the category, "variation due to common causes".

8A.19   A badly worn machine that causes variation in the output of a manufacturing process is an example of a common cause of variation.

8A.20   A process is in control when all common causes of variation have been removed.

8A.21   The process chart and Pareto analysis are two examples of tools that can be used to improve processes.

8A.22   The use of control charts is part of statistical process control.

8A.23   The suppliers of raw materials, components and sub-assemblies should ideally also apply TQM principles.

8A.24   The cost of quality (COQ) can be thought of as the cost of achieving conformance to quality standards plus the cost of non-conformance..

8A.25   Costs related to rework, scrap, inspection, warranty claims and testing are examples of the cost of quality.

8A.26   Failure costs are costs associated with evaluation and either correcting or replacing defective products, components or materials that do not meet quality standards.

8A.27   The International Organisation for Standardisation is the publisher of the ISO 9000 standards.

_ _ _ _ _ _

Section 8 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '8.1 [1]'.

<u>Examples</u> (questions and answers)

8.1   The quality improvement tool that can be described as "a diagram that rank and
        displays defects in order of frequency of occurrence (from left to right) is a: (2)
        [1]   control chart
        [2]   vertical bar chart
        [3]   histogram
        [4]   Pareto chart
        [5]   run chart

 (Souce: http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.1: [4]; METS-2: 169   (2)

8.2   The cost of quality includes ...
        a)   cost of all work to build a product or service that conforms to the requirements
        b)   training programmes
        c)   cost of all work resulting from nonconformance to the requirements.
        Which of the above statements is/are **correct**?   (2)
        [1]   a and b
        [2]   a and c
        [3]   a, b and c
        [4]   a
        [5]   None of the options (1, 2, 3, or 4) is correct.

Adapted from:

http://www.yancy.org/research/project_management/quality_sample_questions.html

Answer 8.2: [3]; a) True; b) True; c) true   (2)

8.3   Control chart theory is based on the differences of the causes of variations in quality. Which one of the following is not an example of, or cannot be linked to, <u>assignable causes</u> of variation?   (2)

   [1]   differences among machines

   [2]   inherent variation due to chance

   [3]   differences among workers

   [4]   differences among materials

Adapted from:

http://www.yancy.org/research/project_management/quality_sample_questions.html

Answer 8.3: [2] This is a common cause and not assignable. METS-2: 166   (2)

8.4   The Pareto Principle is a technique used by quality managers to determine which quality control problems should be corrected. Which one of the following statements best represents the philosophy employed by this principle?   (2)

   [1]   To minimise financial losses from quality control problems, all problems which have a measureable cost associated with them should be corrected.

   [2]   The majority of defects are caused by a small percentage of the identifiable problems. Improvement efforts should be reserved for those few vital problems.

   [3]   To achieve zero defects all quality control problems, including those which do not have a direct financial cost should be corrected.

   [4]   Generally, 80% of the quality control problems are justifiable for correction via cost-benefit analysis. The remaining 20% are not financially worthy of improvement efforts.

(Souce: http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.4: [2], METS-3: 169   (2)

8.5   Using Pareto's Rule and given the data in the table below, where should corrective action focus?   (2)

Origin of problem	% of problems
Design	80
Development	2
Prototype	9
Testing	3

Fabrication	6

    [1]   Design

    [2]   Design, development and prototype

    [3]   Design and prototype

    [4]   Development, prototype and fabrication

(Souce: http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.5: [1]   (2)

8.6   Which one of the following is not a quality management tool?   (2)

    [1]   Fishbone diagram

    [2]   Pareto analysis

    [3]   The process chart

    [4]   Histograms

    [5]   Product life cycle

(Adapted from:

http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.6: [5]; METS-3, pp. 169-170   (2)

8.7   The ISO 9000 series is:

    [1]   a set of instructions for preparing control charts

    [2]   a set of guidelines for quality

    [3]   a set of forms and procedures to ensure quality

    [4]   an international standard that describes a recommended quality system

    [5]   intended to be applied only to manufactured products

(Souce: http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.7: [4]   (2)

8.8   Statistical process control uses diagrams called "Control Charts." These charts depict

    horizontal, parallel lines to represent _____ standard deviations.   (2)

    [1]   six

    [2]   five

    [3]   four

    [4]   three

[5] two

(Souce: http://www.yancy.org/research/project_management/quality_sample_questions.html)

Answer 8.8: [4]; METS-3: 172   (2)

_ _ _ _ _ _

Other questions (without answers)

8.9 Read the following three statements:
   a) Process variation results in products of which the quality varies.
   b) Variation in product quality due to an incorrect tool setting falls under the category, 'variation due to common causes'.
   c) A process is in control when all the general causes of variation have been removed.

   Which of the above statements is/are **correct**?   (2)
   [1] b and c
   [2] a and c
   [3] a and b
   [4] a
   [5] None of the options (1, 2, 3, or 4) is correct.

8.10 Read the following three statements:
   a) The quality control department at an organisation should solely be held responsible for quality.
   b) The cost of quality (COQ) can be thought of as the cost of achieving conformance to quality standards plus the cost of non-conformance..
   c) A process improvement team is a team of employees at shop-floor level who is responsible for quality in their work area.

   Which of the above statements is/are **correct**?   (2)
   [1] b and c
   [2] a and c
   [3] a and b
   [4] a
   [5] None of the options (1, 2, 3, or 4) is correct.

8.11 Read the following three statements:

a)   The prevention of future quality problems is a key responsibility of new product development teams.

b)   The cost of fixing potential quality problems during the product development phase is usually less than the cost of fixing such problems once they are embedded in the product.

c)   Quality function deployment is a formal method for transforming customer requirements into technical requirements.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a, b and c

[4]   a and b

[5]   None of the options (1, 2, 3, or 4) is correct.

8.12 Read the following three statements:

a)   A process is a repetitive set of interacting activities that uses resources to transform a defined set of inputs into outputs that are of value to a customer.

b)   Costs related to rework, scrap, inspection, warranty claims and testing are examples of failure costs.

c)   *Kaizen* is the Japanese word for process variation.

Which of the above statements is/are **correct**?   (2)

[1]   a and b

[2]   a and c

[3]   a, b and c

[4]   a

[5]   None of the options (1, 2, 3, or 4) is correct.

8.13 Read the following three statements:

a)   The goal of total quality management is perfect quality or zero defect.

b)   The focus group technique is the most useful qualitative research technique for determining the voice of the customer.

c)   Quality must be a consideration as early as the design phase of a new product.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a and c

[3]   a, b and c

[4]   a and b

[5]   None of the options (1, 2, 3, or 4) is correct.

8.14 Which one of the following is not a fundamental principle of TQM?   (2)

    [1]   Understand and answer the voice of the customer.

    [2]   Control chart

    [3]   All people in an enterprise must be totally involved in quality improvement.

    [4]   Continuously strive for zero defect.

    [5]   Focus on the process.

8.15 Which one of the following is <u>not</u> a characteristic of process variation that is caused by
a common cause?   (2)

    [1]   Variation due to chance.

    [2]   Cannot be traced to a specific source.

    [3]   6% of all causes.

_ _ _ _ _ _

Section 8 C – short and long questions

<u>Examples</u> (questions and answers)

-

<u>Other questions (without answers)</u>

Question 8c.1

Explain why all people in an organisation should be involved in quality improvement.   (4)

Question 8c.2

i)   List three advantages of establishing single sources of supply (of raw materials,
components and sub-assemblies).   (3)

or

ii)   Is it an advantage (or disadvantage) for a company to have a single source of supply
(of raw materials, components and sub-assemblies) from a TQM perspective? Provide
at least one reason for your answer.   (2)

Question 8c.3

Describe the steps to be followed when implementing TQM (total quality management) on an
enterprise-wide basis.   (5)

Question 8c.4

List the fundamental principles of TQM. (7)

Question 8c.5

Discuss the TQM principles used by the Granite Rock Company. Describe how the company has applied them. Which TQM practice do you think has made the greatest contribution to the company's success? (10)

Question 8c.6

TQM is about gaining understanding of what customers need. List and briefly explain the approaches to understanding customers, their needs, expectations, perceptions, requirements and the forces that drive them. (12)

Question 8c.7

Richard Sconberger has set up rules that sustain the habit of continuous quality improvement while aiming for zero defects. List these rules. (7)

Question 8c.8

Explain how the new products development process can contribute to product quality. (6)

Question 8c.9

Explain how the quality of products and services offered by an organisation can be improved. (6)

Question 8c.10

Explain why the concept of process variation is key to TQM? (3)

Question 8c.11

Differentiate between common cause and special causes of variation. Why is it important to differentiate between these two types of cause? (7)

Question 8c.12

Choose any **three** of the following quality improvement tools and briefly explain how they each can contribute to quality improvement:

- Process chart

- Pareto analysis
- Ishikawa diagram
- Histograms
- Run diagrams and correlation diagrams
- Control charts (6)

Question 8c.13

Discuss what is meant by "quality is free". (5)

Question 8c.14

Define the following: (16)

- Project Quality Management
- A process improvement team (PIT)
- Quality Assurance
- Quality Circle
- Quality Audit
- Just-In-Time (JIT)
- Total Quality Management (TQM)
- Define the ISO 9000 quality standards.

Question 8c.15

Match each of the following quality management terms on the left of the table with the correct definition/description on the right starting with term number 2. In your answer book, write down the number of each term, and next to it the letter representing the correct option e.g. 1. c. (5)

1. Process chart	a. It is based on the 80/20 rule.
2. Pareto analysis	b. It indicates the frequency of various events/causes.
3. Ishikawa diagram	c. It is used to map activities involved in the manufacturing of a product or delivery of a service so that value-adding and wasteful activities can be identified.
4. Histograms	d. It is used to identify relationships between events and time and between problems and causes.
5. Run charts and correlation diagrams	e. It is used in statistical process control.
6. Control charts	f. It is also known as the cause-and-effect diagram.

Question 8c.16

Study the "voice of customer" (VOC) chart below and explain the role of such a chart in the new product development process. (3)

VOC Number	VOC	Importance	Light weight	Self-cleaning	Rotating cord connector	Teflon coated base	20 second warmup period	Intelligent controls	Transparent water reservoir
Product: Steam Iron									
Importance: 3 = Most Important 2 = Moderately Important 1 = Least Important									
						Product Characteristic			
1	Saves time	3	3	3		3	3	3	
2	Right temperature for all types of fabric	3					3	3	
3	Plate clean at all times	2		2		2		2	
4	See when water is depleted	2							2
5	Heats up in a short period	2					2	2	
6	Cord does not twist and snag	2			2				
7	Optional manual temperature and steam control	2						2	
8	Easy to store	1	1		1				
		Total:	4	5	3	5	8	12	2

Question 8c.17

Describe what your organisation is doing to improve the quality of products and services offered by it. Explain what can still be done to improve the quality of products and services still further. (6)

Question 8c.18

Define the ISO 9000 quality standards. (2)

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 8D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 8D.1 ()

Section 8E – Case studies

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 8F – Sources on the world wide web

- - - - End (Questions on Chapter 8) - - - -

Chapter 9, An Introduction to Safety Management

Section 9 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

9A.1 Inadequate maintenance could result in accidents.
True. METS-2: 181

9A.2 Sketches should be made and/or photographs should be taken of an accident scene.
True. METS-2: 194

9A.3 An accident scene should be inspected for hazards that may cause other accidents.
True. METS-2: 194

9A.4 An engineer should only approve designs that conform to the applicable industry standards.
True. METS-2: 185

9A.5 Loss of production is one of many possible results of industrial accidents.
True. METS-2: 192

Other True/False questions (without answers)

9A.6 Risk assessment is a detailed, systematic examination of any activity, location or operational system to identify risks.

9A.7 'Lost production' is often one of the consequences related to industrial accidents.

_ _ _ _ _ _

Section 9 B – Multiple choice questions

This question consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example "9.9 [1]".

Examples (questions and answers)

		Likelihood of occurrence

		Weekly	Monthly	Annually	1 in 10 years
Consequence	Fatality	1	2	3	4
	Permanent disability	2	3	4	5
	Hospitalisation	3	4	5	6
	Lost time	4	5	6	7

9B.1 Read the following statements regarding the above table:

a) The above method of measuring risk is known as the vertical line graph assessment method.

b) A risk rating of 1 indicates high risk and immediate attention is required.

c) A risk rating of 7 will only be recorded; no management action is required.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

9B.1 Answer: [1];

a) false, it is the risk matrix approach – METS-2, p. 189 ; b) true; c) true

_ _ _ _ _ _

Other MCQs (without answers)

9B.2 Read the following three statements:

a) Risk assessment is a detailed, systematic examination of any activity, location or operational system to identify risks.

b) "Lost production" is often one of the consequences of industrial accidents.

c) A single, isolated, unsafe act will probably not cause an accident.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

9B.3 Read the following three statements:

a) Supervisors employed by mines and factories should know the safety and health requirements of their mine or factory and should adhere respectively to the Mine Health and Safety Act and the Occupational Health and Safety Act.

b) The decriminalisation of some safety-related offences has resulted in an administrative fine system.

c) System safety principles are used in design and to identify system faults.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

9B.4 Read the following three statements:

a) The setting of safety standards is part of the process of safety performance management.

b) Safety performance auditing may include the examination of documentary proof, the visual inspection of workplaces, the evaluation of accident statistics and the setting of safety standards.

c) A pre-use checklist is a baseline risk assessment tool.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a

[5] None of the options (1, 2, 3, or 4) is correct.

9B.5 Read the following three statements:

a) Common law is based on previous decisions by the courts.

b) Vicarious liability is the duty of a principal (e.g. employer) to take responsibility for the consequences of the acts or omissions of an agent (e.g. employee).

c) The contravention of a regulation is a criminal act.

Which of the above statements is/are **correct**? (2)

[1]   b and c

[2]   a, b and c

[3]   a and b

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

9B.6 Read the following three statements:

a)   Ethics refers to the generally accepted standards of right and wrong in a society.

b)   Morals refer to abstract codes that are specific to a particular profession, e.g. engineering morals.

c)   An aeronautical engineer may design mines.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a, b and c

[3]   a and b

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

9B.7 Read the following three statements:

a)   Fault-tree analysis, HAZOP studies and failure mode analysis are some of the tools that can be used to identify hazards.

b)   The purpose of accident investigations is to determine the basic and root causes of each accident.

c)   A reconstruction/re-enactment of an accident should always be done to obtain better information regarding the causes of the accident.

Which of the above statements is/are **correct**?   (2)

[1]   b and c

[2]   a, b and c

[3]   a and b

[4]   a and c

[5]   None of the options (1, 2, 3, or 4) is correct.

– – – – – –

Section 9 C – short and long questions

Examples (questions and answers)

Question 9C.1

(Source: Question 3.1.1, May 2004, Mine Manager's Examination, Mine Management and Industrial Law)

List the requirements of an effective safety management system and explain how you would incorporate these into a system to improve the safety performance of your organisation?   (10)

Suggested solution

A safety management system should (Petersen D, 1996, Analyzing Safety System Effectiveness, 3rd ed, pp. 44-45):

- Achieve continuous improvement of the safety process including:
    o The accident investigation process
    o Employee involvement
    o Operating practices
    o Discipline policies
- Build a positive safety culture including:
    o Support for safety
    o Management's credibility
    o Recognition that worker's receive for contributions
    o General attitudes of employees
    o Amount of stress that people feel daily on the job
- Improve the skills of supervisors and managers as evidenced by:
    o Effectiveness of supervisory training
    o Perception about the quality of supervisors
    o Goal-setting process
- Improve the skills of employees including:
    o Training
    o Handling of new workers – induction
    o Communication effectiveness
- Improve employee behaviour including:
    o Safety contacts
    o Alcohol and drug programmes
    o Safety awareness programmes
- Improve physical conditions including:

- o Inspections
- o Hazard correction procedures

METS-2, Chapter 9, p. 185

5 basic steps of system safety	Examples from the mining environment
Design for minimum risk	• Intrinsically safe apparatus • Design of driver cabs – for maximum visibility
Incorporate safety devices	• Think of the various safety devices incorporated in shaft hoisting systems •
Provide warning devices	• Warning before blasting takes place – surface mine • Warning before a face scoop is pulled.
Develop procedures and training	• Procedures for safe operation of equipment •
Understand and expect residual risk	•

(10)

− − − − − −

Other questions (without answers)

Question 9c.2

List and briefly discuss the different elements that may be involved in an accident. Explain how these elements have to combine before an accident will take place. Illustrate your answer with a practical example. (15)

Question 9c.3

There was an accident at your place of work. You have been selected as a member of a team of investigators to do an *in loco* inspection. Explain how you would go about performing this task. (12)

Question 9c.4

Discuss the moral and ethical responsibilities of engineers. (6)

Question 9c.5

Describe how a manager should prepare for an accident investigation. (8)

Or

You are the production manager at a large, underground, deep-level mine. A rail bound accident occurred on the mine earlier today and a worker was fatally injured. All tramming operations on the level, where the accident took place, have been halted. An accident investigation needs to be done as soon as possible. Describe how you will prepare for the investigation. (8)

Question 9c.6

Briefly discuss the concept of system safety. (2)

Question 9c.7

Define the concept of risk assessment. (2)

Question 9c.8

Briefly explain what a safety audit is. (2)

Question 9c.9

The safety standards of a mine, plant, factory or other workplace must include certain critical elements. List four of these elements. (4)

Question 9c.10

You are the production manager at a mine, plant or factory. Provide a checklist of the information that you will have to acquire as soon as you are notified of an accident. (8)

Question 9c.11

Reflect on the legal implications that an accident might have on you, your company and other employees. (8)

Question 9c.12

Briefly differentiate between qualitative and quantitative risk assessment. (4)

Question 9c.13

List ten cost elements that are incurred due to industrial accidents. (10)

Question 9c.14

Briefly discuss the risk matrix and the vertical line graph methods of measuring risk. (8)

Question 9c.15

Technical people are often held responsible for the safety of co-workers and the general public. List and describe both the criminal and the civil proceedings that a company and/or supervisors could be held liable for. (4)

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Section 9D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 9D.1 [Health and safety in the workplace]

Write a report on the management of health and safety at an organisation of your choice.

Method

Study chapter 9 of the prescribed book as well as other sources of information on this topic and identify relevant issues that should be addressed in your report. Also study health and safety practices in your organisation. Speak to people who are responsible for health and safety in the organisation of your choice.

You may want to focus on some of the following issues/topics (this is not a comprehensive list):

- health and safety duties of the employer
- health and safety duties of the employee
- applicable legislation and policy
- health and safety representatives (appointment, duties, responsibilities)
- personal safety equipment
- risk assessment (how is it done at your organisation?)
- (accident) investigations, and so forth

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Section 9E – Case studies

Case 9E.1 - Accident Investigation Case Study – Minerals Industry (Author: Dr Carl Marx)

{Case study with suggested solution}

A worker was fatally injured and two others seriously injured when they were struck by a locomotive in a straight part of the main tunnel of deep gold mine. The accident happened as the worker, who was part of a team of eight, walked the 2.4 km from the workplace to the station at the end of the nightshift.

The overhead trolley locomotive involved had been hauling reef for the full duration of the shift preceding the accident. The accident happened on a Wednesday morning at about 04:50. The workers had come on shift the night before at about 21:00. There were no novices involved or associated with this accident. The locomotive driver had been a driver on the same mine in the same workplace for eight months preceding the accident. He had been employed as a locomotive driver on the same mine for about five years preceding the accident without being involved in any accident. Records of some minor accidents have been discovered in the safety department files.

The accident happened on a large gold mine that employs a certificated engineer to take responsibility for the mechanical and electrical equipment on the mine. The mine also has an in-house training centre where locomotive drivers are trained. The driver of the overhead trolley locomotive did undergo the prescribed training at this training centre.

Required: Analyse and investigate this accident. Hint: Use fig 9.1 in METS-2.

Suggested solution

The accident will be systematically analysed by establishing the presence of the individual fundamental contributing factors at the time of the accident.

1. **ENERGY SOURCE / HAZARDOUS MATERIALS**

A number of commonly occurring energy sources have been identified in the literature. For the purposes of the mining industry the following can be utilized as a guideline:

- Mechanical energy
- Electrical energy
- Thermal energy
- Chemical and Bio-chemical energy

- Electromagnetic energy
- Potential (gravitational) energy
- Kinetic energy
- Acoustic energy

Various elements present prior to an accident may trigger the release of large amounts of energy or hazardous materials. During the investigation it is important to establish the energy source or hazardous materials causing the injury threshold of the injured person's body to be exceeded.

In the accident it is quite clear that the kinetic energy of the locomotive that struck the now deceased and injured exceeded the injury threshold limit of a normal human being substantially and can safely be identified as the energy source of this accident. It regularly happens that more than one energy source is associated with an accident. In some cases it is the combination of more than one energy source that causes the injury threshold to be exceeded. The accident investigator should be vigilant about the combined effect of energy sources.

2. SAFETY MANAGEMENT SYSTEM FAILURE

The role of safety management system failure should be critically reviewed during the accident investigation. The main objective of safety management systems is to effectively manage the identified significant risks by ensuring that control measures for these risks are constantly in place.

During the investigation of the accident, all accident of any nature should be investigated. It may become evident that the same driver had been involved in a number of minor accidents with the same locomotive. The safety management system of the mine should make provision for minor accidents to be reported despite the fact that no person was injured. Records must be looked for of reports by the driver, and whether these have been passed on to management by his supervisor. The safety management system should require that records must be forwarded to the mine's safety department. They should then analyze them and make recommendations in terms of trends and similarities.

The implementation of this part of the system was not done correctly and these records were found filed without the necessary analysis having been done. Apart from other inefficiencies found in the safety management system, the failure to appropriately implement this section of the system was identified as being a failure mode in a fundamental contributing factor.

3. TRAINING DEFICIENCY

A lack of appropriate training has been identified by Leon (1993) as a major contributor to the unacceptably high accident rate in the mining industry in South Africa. To address this problem the South African mining industry agreed to the inclusion of Section 10 in the Mine Health and Safety Act that requires employers to ensure that every employee is properly trained as follows:

Section 10

10. (1) A far as reasonably practicable, every employer must –

(a) provide employees with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health; and
(b) ensure that every employee becomes familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimise those hazards and risks.

(2) As far as reasonably practicable, every employer must ensure that every employee is properly trained –

(a) to deal with every risk to the employee's health or safety that –
   (i)   is associated with any work that the employee has to perform; and
   (ii)   has been recorded in terms of section 11;
(b) in the measures necessary to eliminate, control and minimise those risks to health and safety;
(c) in the procedures to be followed to perform that employee's work; and
(d) in relevant emergency procedures.

   (3) In respect of every employee, the provisions of subsection (2) must be complied with –
   (a) before that employee first starts work;
   (b) at intervals determined by the employer after consulting the health and safety committee;
   (c) before significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material; and
   (d) before significant changes are made to the nature of that employee's occupation or work

During the investigation of the case under review it was found that the locomotive driver had been trained in the mine's training centre in the operation of overhead trolley locomotives. Initially no irregularity could be found with the content or methodology utilised in the training process.

Once the training centre was inspected it was established that the overhead trolley locomotive utilised for training was totally different from the ones in general use underground. The controller on the training unit was in a different location in the cab and the direction that the control lever needs to be moved to bring the unit to a stop was exactly opposite to the one involved in the accident. The normal operation of the locomotive was not affected by this

training deficiency, however, under the emergency situation that occurred at the time of the accident, the training of the driver on a different locomotive layout proved to be a critical failure mode. This explained why the driver accelerated instead of slowing down when the pedestrians on the track, just prior to the accident, surprised him.

This training deficiency clearly constituted a fundamental contributing factor.

4. LATENT DESIGN DEFECTS

Most existing accident investigation models imply that, in any given situation, latent design defects will affect the possibility that an accident may occur. Some models call it ergonomics and others construction failure, structural defects or assembly faults. Irrespective of what it is called, most authors agree that latent design defects play an important part in any accident.

During the investigation of the locomotive accident as described above the search for latent design defects was as difficult as one would expect. Initially the investigation focussed on the locomotive, the combination of hoppers and the locomotive, as well as the communication mechanism from the driver to the guard. The normal problems that exist in all underground trains were found, but nothing that could be classified as a failure mode of a fundamental contributing factor could be isolated. It was only once the investigation team started looking at the layout of the track system that it was realised that this presented a fundamental contributing factor.

The Mine Health and Safety Act require that the tunnel be designed with a 500-millimetre walkway on the one side. During the developing of this specific tunnel, this requirement was conformed to. At the point where the accident occurred the tunnel deteriorated as a result of a pillar that was left in the reef horizon. To correct the situation, steel set supports were installed in the area. As a result of this, the travelling way was separated from the rails, which seemed to be an improvement. Interviews with the workers that regularly travel on foot in this tunnel confirmed that the narrower travelling way made it almost impossible to travel behind the steel set legs while carrying hand tools and therefore most workers did not use it.

It would appear that the group of workers misjudged the speed of the oncoming train and was caught in the narrow portion when the train struck them.

This latent design defect clearly constituted a fundamental contributing factor in this accident.

5. INAPPROPRIATE MAINTENANCE

Most modern accident investigation models have underplayed the contribution of inappropriate maintenance to accidents. Vincoli (1993) identifies maintenance as a factor in

accidents but focuses on the contribution that maintenance personnel can make in identifying potential hazards and risk.

In the accident analysed in the example, an inappropriate maintenance factor that contributed fundamentally to the accident was identified since the locomotive's headlamp was replaced with an inferior quality lamp when a replacement was needed two weeks prior to the accident.

During tests performed on the locomotive after the accident it was found that the illumination of the locomotive lights produced only 6.8 lux average in the direction of travel at a distance of 20 metres. This constituted a contravention of Minerals Act Regulation 15.3.1 and it was clear that it also constituted a fundamental contributing factor.

The correct lamp would have improved the view of the driver and therefore the time he would have had to react as well as prevented the group of workers from misjudging the distance of the oncoming train.

6. IMPERFECT PROCEDURES

According to Vincoli (1993) procedures should be developed to assist personnel to safely operate hazardous systems. He continues that procedures may include the use of personal protective equipment in hazardous conditions. Section 11(2) (d) (i) of the Mine Health and Safety Act also identifies the use of personal protective equipment as a means of minimising the risk to workers under certain circumstances.

During the investigation of the locomotive accident under review the investigators initially did not find any imperfect procedures that constituted fundamental contributing factors.

After careful analysis of the facts it was established that the selection procedures for locomotive drivers had a serious flaw. All the locomotive drivers on the mine had to undergo a stringent medical screening that included an eye test. The driver of the ill-fated train also underwent the eye test and passed with 6/6 vision. Careful analysis of the test indicated that tests for night vision did not form part of the screening procedure, despite the fact that the underground environment mimics constant nighttime conditions. Once tested it was established that the driver involved in the accident had serious night vision problems that clearly contributed to the accident.

7. UNSUITABLE TASK DIRECTIVES

A task directive is a detailed explanation of the steps to be followed to enable a worker to safely conduct the tasks making up a job. In the absence of a task directive the complexities of a task is left to the discretion of the worker. This often, results in tasks being conducted

without the impact of the specific order being considered. For this reason all high-risk tasks should be supported with a suitable task directive.

During the development of task directives it is important to involve a vertical slice of the workforce.

Task directives do not always describe every task. This should not prevent the accident investigator from analysing tasks to establish the need for task directives. In some cases task directives may exist, but may not effectively be communicated to the relevant workers.

The investigation of the locomotive accident example indicated that a number of task directives existed for the hauling of rock by means of locomotives and hoppers. A detailed analysis of the nature and content of these task directives indicated a number of deficiencies. The task directive dealing with the action of the driver when approaching pedestrians did not include slowing down as it was argued that sufficient travelling ways should be provided. This was a fundamental contributing factor to the accident.

8. SUBSTANDARD PHYSICAL CONDITIONS

The physical environment, and especially sudden changes to that environment, should be identified. The situation at the time of the accident is important, not the "usual" conditions, according to A Guide to Accident Investigation by the Canadian Centre for Occupational Health & Safety. Investigators may want to establish, for example, how the conditions at the time of the accident differed from the so-called normal conditions at the scene.

It is important that investigators understand that task directives, procedures and maintenance programmes are based on standard conditions. Should the physical conditions vary from the expected, the task directives, procedures and maintenance programmes may become inappropriate to prevent accidents.

During the investigation of the locomotive accident being analysed, a number of changes in the physical conditions contributed to the accident. The most obvious was ground conditions that required the installation of steel set support units that in turn required the establishment of an unusual travelling way between the set legs and the sidewall, clearly a fundamental contributing factor.

9. UNSAFE ACTS

This contributing factor is the one that most authors use to explain the reason for accidents, but it is also the most controversial and misunderstood factor. Acts or omissions are often utilised to apportion blame and prosecute individuals. It is normally focused on the acts of the

injured or persons in the immediate vicinity of the accident, and in so doing moves the focus away from more remote but equally important unsafe acts.

During the investigation of the accident described above a number of unsafe acts were identified, none of them being more important than the other as each contributed in its own way as a factor to the accident. Acts are normally associated with the existence of other failure modes. These acts include:

- Allowing energy sources to exceed tolerable levels, for example by over-speeding.
- Ignoring requirements of the management system.
- Allowing inappropriate training programmes to be presented.
- Ignoring or allowing latent design defects to continue.
- Conducting or allowing inappropriate maintenance.
- Drafting imperfect procedures.
- Issuing unsuitable task directives.
- Allowing substandard physical conditions to form or continue.

10. BARRIER FAILURE

Barriers are basically of two types, physical or time barriers. The purpose of physical barriers is to physically prevent the energy source to come into contact with persons in the event of other failures. When assessing the effectiveness of physical barriers it is important to establish the capability of the barrier to arrest the energy source in such a way that the energy will be dissipated so that the threshold limit of the person potentially in contact with the energy would not be exceeded. A time barrier aims to ensure the absence of persons during a final event.

In the example the use of time barriers was attempted. A rule was made that no pedestrians were allowed during the main hauling shift. The accident investigation revealed that there was no clarity as to whether the accident occurred during the main hauling shift or not. Conflicting evidence as to the exact time of the end of the main hauling shift was obtained. Some witnesses were of the opinion that the main hauling shift ended at 04:30 and others stated that it ended at 05:00.

This time barrier clearly failed as persons were travelling on foot while hauling was taking place.

oOo

Further reading
(Related to Chapter 9)

- Article by author of this chapter, Dr Carl Marx - http://www.associatedcontent.com/article/2201363/explaining_the_fundamental_contributing.html?cat=5
- http://www.consultnet.ie/**accident**%20reporting%20and%20investigation.ppt

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Question 9E.2 - Mini case study: 1974 crash of Turkish Airlines DC-10 which killed 346 people

Read the following:

The plane had taken off from Paris and reached an altitude of 12 000 feet when its cargo doors flew open. The sudden shift in pressure caused the floor above the cargo hold to collapse, breaking the hydraulic control lines for the rear engine and rear control surfaces, which ran along the floor between the passenger compartment and the cargo hold. The plane plunged groundward and crashed in a forest. There were no survivors.

In the most literal sense, the crash was caused by the unfortunate union of two design flaws: the decision to run the hydraulic lines above the cargo hold, and poorly engineered latches on the cargo doors. The latches were designed so that it was possible for the baggage handlers to believe they had locked the doors even when the lock pins were not fully engaged. … On a deeper level, however, it was the plane's complexity that lay at the root of the disaster. That complexity had prevented the plane's designers from seeing that a number of seemingly unrelated decisions could interact to produce the tragedy. … One of the hallmarks of a complex system is that events can combine in unexpected ways and make the entire system behave unpredictably. … Four years previously, a pressure test of the first DC-10 fuselage caused a cargo door to fly open and the floor to collapse. Not wanting to completely redesign the door, the plane's manufacturer, McDonnell Douglas, tried a series of "Band-Aid" fixes – minor alterations that did little or nothing to make the system safe. … Two years before the Turkish Airlines crash, a nearly identical accident took place on an American Airlines flight from Detroit. At 12 000 feet, a cargo door blew out and caused the floor to buckle, taking out the hydraulic controls for the rear of the plane. But because the plane was lightly loaded, the pilot was able to maintain control and bring it to a safe landing. By chance, the pilot had trained himself on a flight simulator to handle just such a situation, flying a plane without being able to use the rear engine and control surfaces, and he knew exactly what to do when the accident hit. (Pool, R. 1997. *Beyond engineering: How society shapes technology*. New York: Oxford University Press, pp. 133-134)

Use the following figure to explain why the 1974 Turkish Airlines flight crashed. The figure
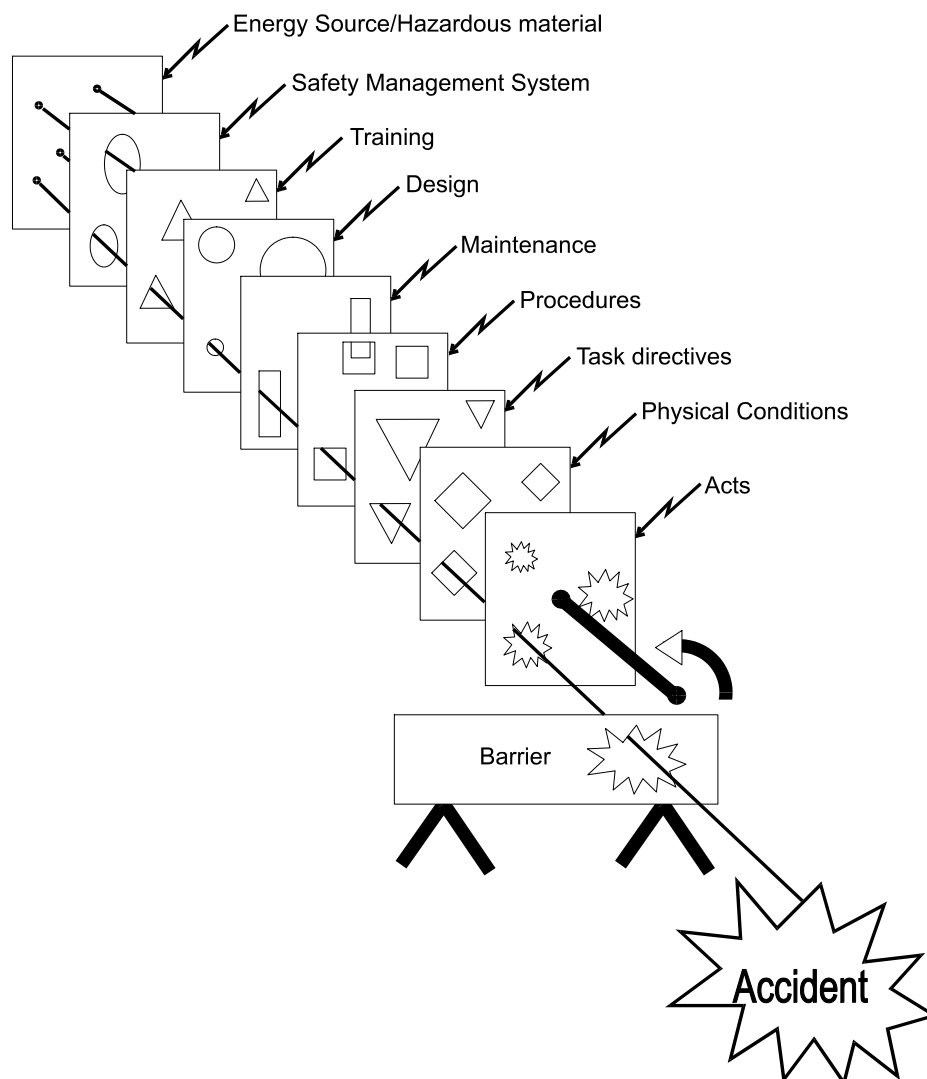
should also be used to explain the theory of accidents. Why do accidents take place?   (15)

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Question 9E.3 – Mini Case study

Read the following:

Compounded errors caused New York crash (New Scientist)

The second-worst crash in US aviation history was caused by "unnecessary and excessive" actions by the plane's co-pilot, who was in control of the plane at the time, the US National Transportation Safety Board (NTSB) concluded on Tuesday.

But the board made it clear that both faulty design and bad training contributed strongly in leading the co-pilot to his tragically incorrect actions, which caused the American Airlines flight 587's tail to break off.

The plane crashed soon after takeoff from New York's JFK airport in 2001, just two months after the September 11 attacks, killing all 260 people on board and five on the ground. There was initial speculation that it might have been another terrorist incident. The board has decisively ruled out that scenario.

Problems began for the plane - an Airbus A300-600 - when it encountered wake turbulence left behind by a 747 jumbo jet that had taken off immediately before - a common occurrence in busy airports. And in this case, the board concluded, the turbulence would have been no problem if the co-pilot had not used the rudder at all, which is the normal course of action.

Extreme maneuvers

But a training programme by American Airlines not only failed to prepare the co-pilot for the true consequences of such turbulence and of various measures to compensate for it, it actually made things worse by leading him to expect far more disruption of the plane's motion than would really have occurred.

This led him to overcompensate, apparently believing that more extreme maneuvers were required to control the plane.

Unknown to either the co-pilot or the airline's trainers, a change in the way the plane's rudder mechanism worked seriously worsened the problem. The change made the rudder control pedals far more sensitive than any other plane's - including other Airbus models - and the sensitivity increased dramatically with speed. This is exactly the circumstance where excessive use of the rudder can cause high stresses on it.

The five-member board were split 3-2 as to whether the design flaw or the "negative training" was the greater factor, with the majority blaming the design more. Pilots know that they cannot use the plane's rudder - normally used only while taxiing on the ground - above a certain speed, known as the maneuvering speed, in this case 250 knots.

But most apparently thought that it was safe to use the rudder to its full extent right up to that speed - something the plane's designers knew was not the case. In fact, pushing the rudder first to one extreme and then the other, as in flight 587's case, exposed it to stresses that were double its design limits.

The Airbus A300 has a tail made of lightweight composite materials, which is still relatively new in commercial airliner design, and some analysts had suggested this accident might point to risks in the use of such materials.

But the board emphatically disputed that conclusion. In fact, NTSB materials engineer Matt Fox, who conducted detailed tests on the remains of the rudder, says he knew of no other aircraft whose rudder could have withstood the forces the tragic flight was exposed to.

Board member Carol Carmody agrees, saying that after reviewing the test results "I was surprised by the strength and durability of the material."

Source:
Chandler, D.L., 27 Oct 2004, Compounded errors caused New York crash, New Scientist.com news service, http://www.newscientist.com/news/news.jsp?id=ns99996589

Required:
Use fig. 9.1, (METS-2), p. 182 of the textbook (The elements present in an accident) to explain what caused American Airlines flight 587's tail to break off. (6)
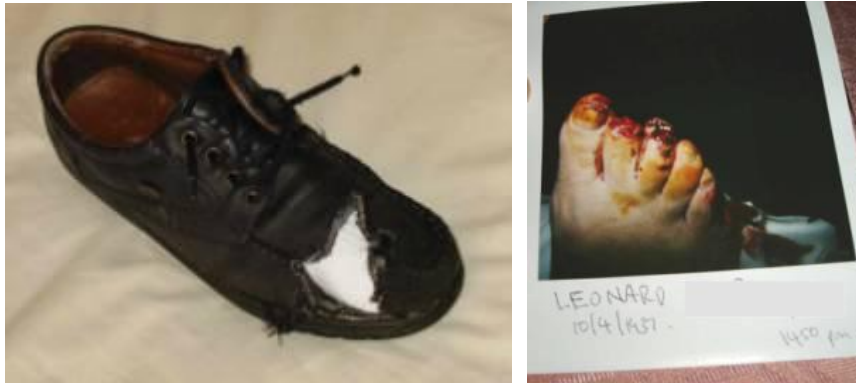
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Question 9E.4 – Mini Case study

Read the short case study below:
(Source: Health and Safety Executive - http://www.hse.gov.uk/slips/experience/mower.htm)

Mower removes slip victim's toes

A gardener/handyman - Leonard - working on a sloping grassed area suffered the loss of two toes as a result of a simple slip. He also had to endure serious lacerations to his foot and surgeons needed to remove much of the affected area in order to be able to close his wounds. Hospitalisation and physiotherapy ensued to try to recover his mobility.

Using a rotary mower on sloping ground to cut an area of grass that had been allowed to become rather too long he slipped on the lush area of grass that he had just cut and his feet slid down the slope. His right foot went under the mower into the moving blades.

When interviewed Leonard said:

"This is the sort of job I have done many times before without having a problem, but looking back on it I suppose it was an accident waiting to happen. The grass, having been quite long, was lush and damp once cut. My shoes were smooth soled ones that I had been wearing whilst doing other odd jobs. I don't suppose they would give any sort of grip on damp grass. Thinking about it, even with better boots on, damp grass is bound to be slippery so it was probably not the best idea to be using a rigid bladed rotary mower when it was possible that I could slip down a slope towards it. When I did slip it all happened so quickly, there was absolutely no time to react. One moment I was standing up - the next instant my foot was in the blade. I think I probably stacked the odds against myself really - better footwear and a strimmer would have been safer choices. Obviously things are always clear in hindsight but I could have seen what was likely to happen, it would have been so little trouble to avoid the risk."

Leonard is now retired and has recovered sufficiently to be looking forward to once again being able to indulge his passion for golf.

Required

Use fig. 9.1, (METS-2), p. 182 of the textbook (The elements present in an accident) to explain what why the accident happened. (3)

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Section 9F – Sources on the world wide web

<u>9F.1</u> Do a google search to obtain information on various models that explain accident causation.

Section 9G – Additional readings / information sources on safety and safety management

- Add paper on safety and safety management to the workbook - NZ coal disaster

- - - - End (Questions on Chapter 9) - - - -

Chapter 10, Maintenance management

Section 10 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)
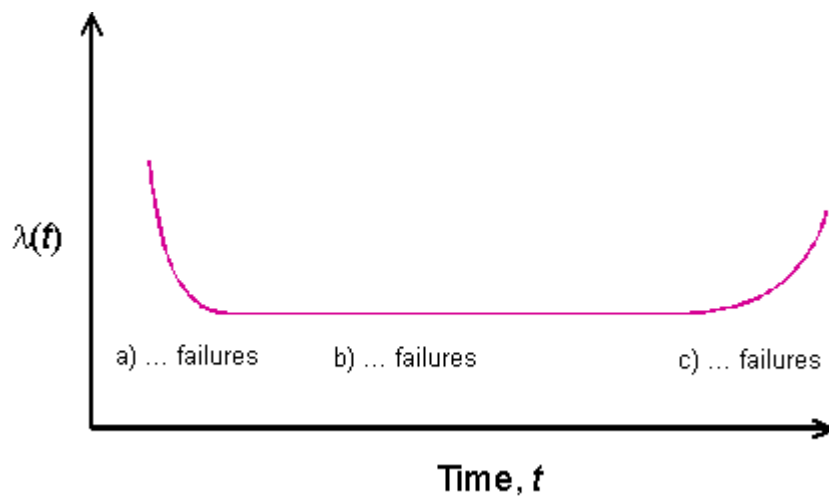
Figure 1

10A.1 Figure 1 is known as the bathtub curve.
     True, METS-2: 206

10A.2 a) in figure 1 is known as wear-out failures.
     False, it is wear-in failures. METS-2: 206

10A.3 b) in figure 1 is known as wear-out failures.
     False, it is random failures. METS-2: 206

10A.4 c) in figure 1 is known as random failures.
     False, it is known as wear-out failures. METS-2: 206

Other True/False questions (without answers)

10A.5 Condition-based maintenance is the maintenance performed after failure of an item
     has occurred.

10A.6 Corrective maintenance is the maintenance that is performed before a failure occurs, to preserve an item or a system in its original condition.

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Section 10 B – Multiple choice questions

This question consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example "10.9 [1]".

Examples (questions and answers)

10.1 Read the following three statements:
a) Condition-based maintenance is the maintenance performed after an item has failed.
b) One of the main objectives of maintenance is to maximise the availability of physical assets.
c) Reliability-centred maintenance was developed to ensure safe and reliable aeroplanes.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the above options (1, 2, 3, or 4) is correct.

10.1 Answer: [1]
a) false,
b) True, METS-2, p. 201.
c) True, METS-2, p. 202

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Other MCQs (without answers)

10B.2 Read the following three statements:
a) The purpose of modelling is to understand, predict, control and, ultimately, to improve.
b) Knowledge of the failure characteristics of an item is important when selecting appropriate maintenance action.
c) Continuous improvement is one of the features of total productive maintenance (TPM).

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the above options (1, 2, 3, or 4) is correct.

10B.3 Read the following three statements:

a) Adjust, calibrate, inspect, etc. are some of the activities that take place during the maintenance transformation process.

b) Workers, spares, tools and information are all examples of resources used during the maintenance process.

c) Availability is the probability that an item will function without failure for a specified time under specified conditions.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] b

[5] None of the above options (1, 2, 3, or 4) is correct.

10B.4 Read the following three statements:

a) The bathtub failure rate model provides for both wear-in as well as wear-out failures.

b) The Weibull distribution is often used to model increasing, constant or decreasing failure rates.

c) Information regarding the failure characteristics of an item are important when selecting an appropriate maintenance policy.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the above options (1, 2, 3, or 4) is correct.

10B.5 Read the following three statements:

a) Reliability is the probability that an item can be returned to a specified functional level within a specified time period.

b) Strategy at the enterprise level is a company's large-scale future-orientated plans for interacting with the competitive environment to achieve company objectives.

c) Maintenance work can be outsourced – it does not have to be done in-house.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a and c

[3] a and b

[4] a, b and c

[5] None of the above options (1, 2, 3, or 4) is correct.
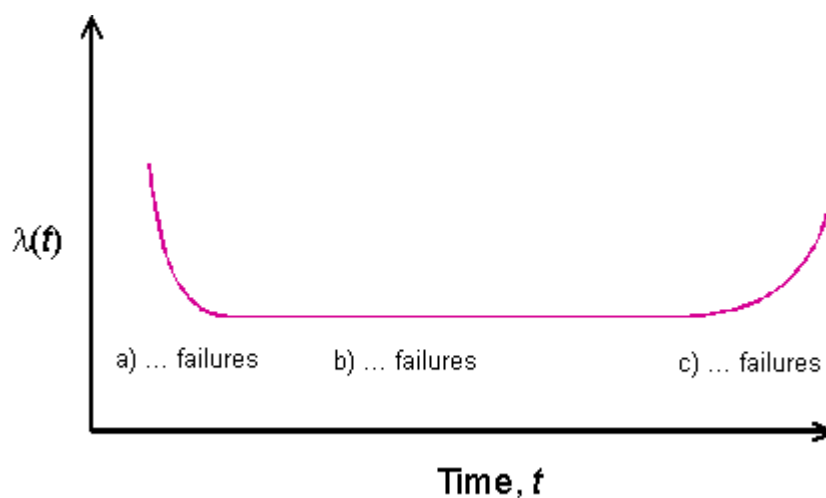
Figure 1

10B.6 Read the following three statements:

a) Figure 1 is known as the bathtub curve.

b) In figure 1, a) is known as wear-out failures.

c) In figure 1, c) is known as random failures.

Which of the above statements is/are **correct**? (2)

[1] b and c

[2] a, b and c

[3] a and b

[4] a

[5] None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _

Section 10 C – short and long questions

Examples (questions and answers)

Question 10c.1

The failure characteristic of a drill bit used in mining operations has a Weibull distribution. The value of the shape parameter is 4 and the characteristic life of the drill bit is 12 days. Calculate the reliability after 8 days and 14 days. Interpret your answers. (6)

(Source: TUT, June 2006, Engineering Management IV)

Answer 10c.1

Reliability of an item is the probability that the item will function without failure for a specified time under specified conditions (METS-2, p. 205).

$$R(t) = e^{-(\frac{t}{\theta})^m} = e^{-(\frac{t}{12})^4}$$

$$R(8) = e^{-(\frac{8}{12})^4} = 0,821$$

The probability that the bit will function (without failure) after 8 days is 0,821

$$R(14) = e^{-(\frac{14}{12})^4} = 0,157$$

The probability that the bit will function after 14 days is 0,157.

The drill bit will be more reliable after 8 days than after 14 days. This is to be expected because m > 1. m = 4 > 1, therefore an increasing failure rate is modelled (METS-2, p. 207) (6)

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Other questions (without answers)

Question 10c.2

Briefly discuss your organisation's maintenance programme. Refer to the following issues:

(a)   How frequently is preventive maintenance performed?

(b)   When should an asset be discarded?

(c)   What spares should be kept in the store, and how many of each type? [10]

Question 10c.3

Define the following:

(a)   Maintainability {2}

(b)   Total maintenance downtime {2}

(c)   Availability   {2}

(d)   Reliability   {2}

                                                                                    (8)

Question 10c.4

Briefly describe each of the following:

(a)   Corrective maintenance   (1)

(b)   Preventive maintenance   (1)

(c)   Improvement maintenance   (1)

(d)   Time-based maintenance   (1)

(e)   Condition-based maintenance   (1)

                                                                                    [5]

Question 10c.5

Explain why maintenance is usually performed at the component level.   [2]

Question 10c.6

Design a maintenance plan for your car, motorcycle or any other item of your choice.   [8]

Question 10c.7

List some resources that are relevant in the maintenance environment.   [4]

Question 10c.8

Briefly describe the following maintenance strategies:

- Business-centred maintenance (BCM)

- Reliability-centred maintenance (RCM)

- Total productive maintenance (TPM)   [9]

Question 10c.9

Briefly describe the functions of maintenance planning, leading, organising, control and staffing.[5]

<u>or</u>

Describe the application of the general management functions to maintenance. You may use the following information.

Planning • Objectives • Strategy • Procedure • Scheduling • Maintenance life planning		**Organising** • Structure • Division of work • Span of control • Resource allocation • Workload	
Leading • Motivation • Influencing • Communication	**Application of general management functions to maintenance**	**Staffing** • Compensation • Recruitment • Training	
	Control • Cost control • Performance • Benchmarks • Audits • Reliability & availability control		

[20]

Question 10c.10

Illustrate the bathtub failure rate model by means of a simple sketch and notes. (4)

Question 10c.11

List at least three typical decisions that managers and supervisors in the maintenance department have to make. (3)

Question 10c.12

Write down the missing sections (at a, b and c) that form part of the input-output model for the maintenance system below: (10)

Inputs   Outputs

Materials,   Capacity, etc.
etc.
a)   Adjust, etc.   c)

                    b)
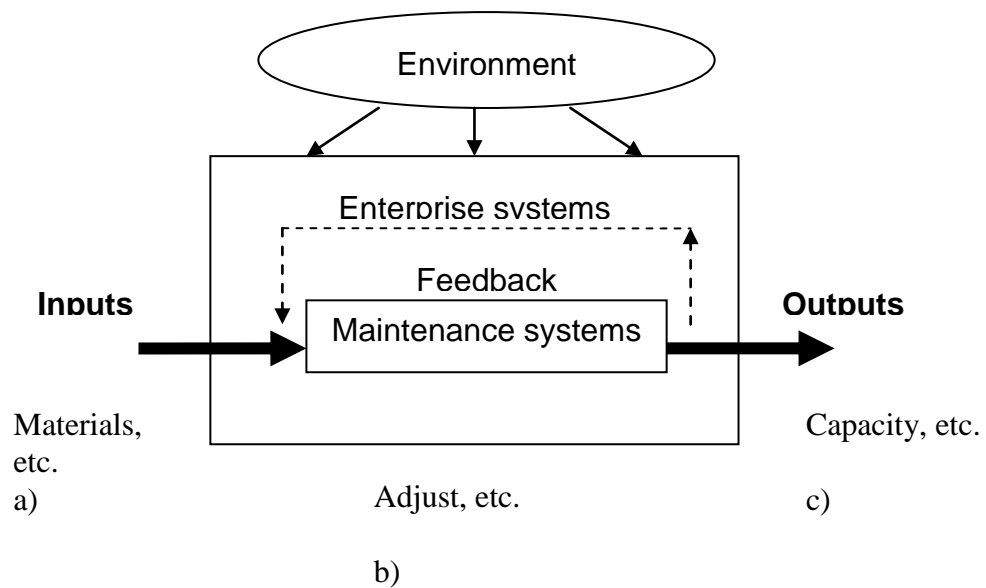
Question 10c.13

Describe what your organisation is doing to improve the quality of products and services offered by it. Explain what can still be done to improve the quality of products and services still further. (6)

Question 10c.14

Define the ISO 9000 quality standards. (2)

Question 10c.15

Match each of the following quality management terms on the left of the table with the correct definition on the right starting with term number 2. In your answer book, write down the number of each term, and next to it the letter representing the correct option, for example 1. z. (12)

1. Corrective maintenance	a. Maintenance that is performed before a failure occurs, to preserve an item or a system in its original condition.
2. Preventive maintenance	b. Objective is the inherent reliability of a system.
3. Business-centred maintenance (BCM)	c. The probability that an item will operate satisfactorily and effectively when used under specified conditions.
4. Reliability-centred	d. The probability that the item will function without failure fo

maintenance (RCM)		specific time under specified conditions.
5. Availability		e. Objective: high equipment effectiveness by having a zero defect, zero loss and zero failure approach
6. Reliability of an item		f. The "top down bottom up" approach forms an integral part of this maintenance strategy
7. Total maintenance downtime		g. The maintenance performed after failure of an item has occurre
1. Total productive maintenance (TPM)		h. The lapsed time required to repair and restore a system to full operational status and/or retain a system in that condition.
2. Maintainability		i. Preventive maintenance performed at regular periods or at a certain period.
3. Improvement maintenance		j. Preventive maintenance based on knowledge of the condition of the item from routine or continuous monitoring.
4. Time-based maintenance		k. Done to improve the reliability of a system or to improve the technical performance of the system (to increase output).
5. Condition-based maintenance		l. This is the probability that an item can be returned to a specified functional level within a specified period.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 10D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Section 10D.1 (Maintenance management in the workplace)

Describe maintenance management and practice at your organisation.

Suggested method:

Use the information in chapter 10 to identify the main issues to be addressed in your report. I suggest that you draft a number of questions and then interview a few people employed by your organisation's maintenance department. Remember to list the names of the people interview in your list of references.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 10E – Case studies

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Section 10F – Sources on the world wide web

- - - - End (Questions on Chapter 10) - - - -

Chapter 11, Marketing for Technical People

Section 11 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

-

Other True/False questions (without answers)

-

$$- - - - - -$$

Section 11 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example "11.9 [1]".

Examples (questions and answers)

11B.1   Read the following four statements:
   a)   Products that are based on advanced technology will always be successful in the market.
   b)   Marketing aims to influence the demand for certain products and services.
   c)   Engineers, technicians and technologists never engage with customers.
   d)   Losing a customer involves much more than loosing a single sales transaction.
   Which of the above statements is/are **correct**?   (2)
   [1]   b and c
   [2]   b and d
   [3]   a and d
   [4]   b, c and d
   [5]   None of the options (1, 2, 3, or 4) is correct.

11B.1 Answer: [2]
   a)   False, METS-2, p. 226.

b) True, METS-2, p. 226

c) False, METS-2, p. 227

d) True, METS-2, p. 228

– – – – – –

<u>Other MCQs (without answers)</u>

11B.2 Read the following four statements:

a) Lengthening product lines is one way of expanding a business.

b) Sales slow down during the maturity stage of a product.

c) The early majority are less conservative than the first adopters of new products.

d) Complex decision making is usually involved when a buyer plans to buy an expensive product that is not frequently bought.

Which of the above statements is/are **correct**? (2)

[1] a and b

[2] b and d

[3] a and d

[4] a, b and d

[5] None of the options (1, 2, 3, or 4) is correct.

11B.3 There are four stages in the product life cycle known as Introduction, Growth, Maturity and Decline. Which of the following describe the Growth stage?

[1] Sales slow down

[2] Better distribution

[3] Lack of interest

[4] High prices (2)

11B.4 Marketers use tools to influence the customers they want to target. These tools are known as the marketing mix. Which one of the following is not such a tool? (2)

[1] Product

[2] Place

[3] Promotion

[4] Price

[5] Product life cycle

11B.5 The five stages (in the correct chronological order) that you would expect a customer to go through when buying a car are ... (2)

[1] need recognition; information search; post-purchasing behaviour; purchase decision; evaluation of alternatives.

[2] information search; need recognition; evaluation of alternatives; purchase decision; post-purchasing behaviour.

[3] information search; need recognition; evaluation of alternatives; purchase decision; post-purchasing behaviour.

[4] need recognition; information search; evaluation of alternatives; purchase decision; post-purchasing behaviour.

11B.6 Read the following three statements:

a) Marketing mix refers to the combination of the Ps (e.g. product, place, promotion and price) to address the needs of a specific group of customers.

b) Business-to-business marketing refers to the marketing of industrial products.

c) Product differentiation is the process whereby customers learn about new products, try them and then buy or reject them.

Which of the above statements is/are **correct**? (2)

[1] a and b

[2] a

[3] a and c

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _ _

Section 11 C – short and long questions

Examples (questions and answers)

Question 11c.1

You are the owner of a quarry that produces building stone (aggregate). Identify at least two market segments within the building stone market. Explain how you would combine the different marketing instruments to form various marketing offerings that will address the needs of the different segments.

Answer 11c.1

Examples of market segments:

<u>Segment 1:</u> Small building contractors that build or repair houses and DIY (do-it-yourself) home owners.

<u>Segment 2:</u> Big construction companies that build blocks of flats, factories, roads, bridges, reservoirs, dams, etc.

Product:

Segment 1 will probably be interested in crusher sand and smaller (6,7 mm and 9,5 mm) aggregate. DIY homebuilders may want to buy a product that is packaged in small quantities (e.g. 40 kg bags). Packaging will be done by the quarry or by wholesale building suppliers and hardware shops.

Segment 2 may want a variety of aggregate sizes, e.g. 6,7 mm; 9,5 mm; 13,2 mm; 19,0 mm; 22 mm and 37 mm. This group may also require a variety of ready-mixed material. They may require SABS-certified aggregate to meet design specifications. They may have specific needs such as larger aggregate that may be required as railway track ballast.

Before you start your quarry you therefore have to determine whether the different properties of the aggregate meet the requirements of your target market.

Price:

The price of your quarry's aggregate must be competitive. It is difficult to differentiate one quarry's product from another. By offering an SABS-certified product you can probably, however, ask higher prices than those quarries that don't. The offering of additional services such as delivery will also impact on the pricing strategy. Pricing may further depend on variables such as quantity ordered and product type.

Distribution:

Aggregate is a low-priced product and is therefore usually sold to a market segment within a relatively short distance from the quarry. Due to transportation cost, an end user will probably find that the aggregate producer closest to him/her will be able to provide the product at the best price (transportation cost included). In the case of market segment 1, a quarry will have to deliver small quantities at a specific address or distribute the product through a hardware shop. If your target market is segment 2, then your customers will probably load the aggregate in big quantities at your quarry or you will have to deliver it per truck. Transport contractors may be used.

Marketing communication:

The appointment of a sales representative may be the most effective way to generate new business if you target segment 2. When you target segment 1, it may however be more effective to make use of advertising in appropriate local newspapers and magazines (e.g. those that target DIY builders).

Question 11c.2 (Market segmentation)
You are the owner of a small company which has developed new technology that can relieve the pain of humans by means of electrical impulses. You obtained patent rights for the invention and plan to develop the concept further and introduce a product that is based on this knowledge. Estimates show that the product will have to be sold at a price in excess of R4 000 to cover development and manufacturing costs. Define 'market segmentation' and explain how the market for alleviating pain could possibly be segmented. (4)

Answer 11c.2
Market segmentation defined (METS-3: 232): Markets are not necessarily homogenous. Segmentation is about dividing the market into smaller segments that may have similar needs that could or should be addressed differently from the other segments. Some of the bases for segmentation are geographical, psychograpical and demographical.

The market for 'killing pain' could probably be segmented in terms of:
- Price – who can afford the product – lower income groups may not have the money to buy the product (R4 000).
- Type of buyer – e.g. individuals, hospitals or health consultancies.

- Medical or physiological needs – effects of painkillers (drugs) versus electronic pain killing. (4)

_ _ _ _ _ _

Other questions (without answers)

Question 11c.3 (Product life cycle)

The following is a <u>list of products</u>: matches, black-and-white TVs, fuel cell bus, cellular phones (dual band), cellular phones (3G), plasma TV screens, LCD TV screens, Betamax video machines, VHS video machines, DVD video machines, hard disk drive video recorder, satellite TV in South Africa, GPS in vehicles, other products of your choice

a) Briefly describe the concept of the product life cycle. (4)

b) Choose four products from the above list that each product matches one of the four stages of the product life cycle. Give brief reasons for your answer. (8)

c) Describe how these four products should be managed, given their product life cycle stages. (4)

[16]

Question 11c.4

Describe the role of technical people in the marketing process. (8)

Question 11c.5

Define the following:
- Marketing (2)
- Marketing management (2)
- Business-to-business marketing (1)
- Marketing mix (2)
- Market segmentation (2)
- Market positioning (2)
- Product differentiation (2)
- Diffusion process (1)
- Adoption process (1)
- Branding (1)

[16]

Question 11c.6

Explain the concept of a value chain and describe the value chain of which your organisation forms part. (5)

Question 11c.7

A number of car manufacturers have built concept fuel-cell cars, buses and motor cycles and are continuing to spend lots of money to further improve it. By the end of 2004 there were about 500 such vehicles in the world and it may still take a while before a fuel cell automobile will become a viable alternative to internal combustion-driven automobiles for a large percentage of customers. Apply your knowledge of the requirements that a new product should meet and the factors that assist the diffusion of a new technology in the market place to specify some characteristics that such a fuel cell automobile will need to compete with traditional (internal combustion engine) cars. You may include supporting infrastructure such as fuel distribution in your analysis. (6)

Question 11c.8

Briefly describe some of the problems that the marketers of new technological products are confronted with and explain how such problems can be overcome. (6)

Question 11c.9

Define 'market segmentation' and explain how any **one** of the following markets could be segmented:

- Computers
- Motor vehicles
- Diamonds
- Any other product of your choice (4)

Question 11c.10

The consumer purchasing decision-making process can be illustrated as follows:

| NEED RECOGNITION | → | INFORMATION SEARCH | → | EVALUATION OF ALTERNATIVES | → | PURCHASE DECISION | → | POSTPURCHASE BEHAVIOUR |

Briefly discuss this process. Use this model to explain the difference in buying behavior when a consumer is buying a car compared to bread. (8)

Question 11c.11

Match each of the following marketing concepts, on the left-hand side of the table below, with the phrase or definition on the right-hand side of the table that best describes it. In your answer book, write down the number of each concept, and next to it the letter representing the correct option, for example "1. j". (7)

1. Marketing mix	a. The marketing of industrial products
2. Adoption process	b. The spreading of the product through society.
3. Diffusion process	c. A company can produce products with features (functionality) that are different from those of its competitors to gain a competitive advantage.
4. Market positioning	d. This is the process whereby customers learn about new products, try them and then buy or reject them.
5. Market segmentation	e. The 5 Ps (product, place, promotion, people and price) are combined in such a way that they address the needs of a specific group of customers.
6. Business-to-business marketing	f. This is about dividing a market into smaller groups of customers with similar needs.
7. Product differentiation	g. This relates to the way a product or service is perceived by consumers. What perceptions do clients have about your product or service? Is it good quality, bad value for money, affordable, too difficult to obtain, etc.?

Question 11c.12

Explain why it is not only important for businesses to promote products to new customers but also for them to keep the current customer base satisfied and to continuously maintain relations with existing customers. Explain how customers can be changed into loyal customers. Describe what technical people, such as engineers, can do to create value for customers. (10)

Question 11c.13

A company such as Samsung or LG can expand its business by making changes to its product mix. Explain how it can do this. Provide examples. (6)

Question 11c.14 (Diffusion of innovation)

a) Study the two graphs below. Why do you think cellular phones diffused so fast globally and in South Africa while it took so long for railways to diffuse in the United States? (4)

Global annual cellular phone sales
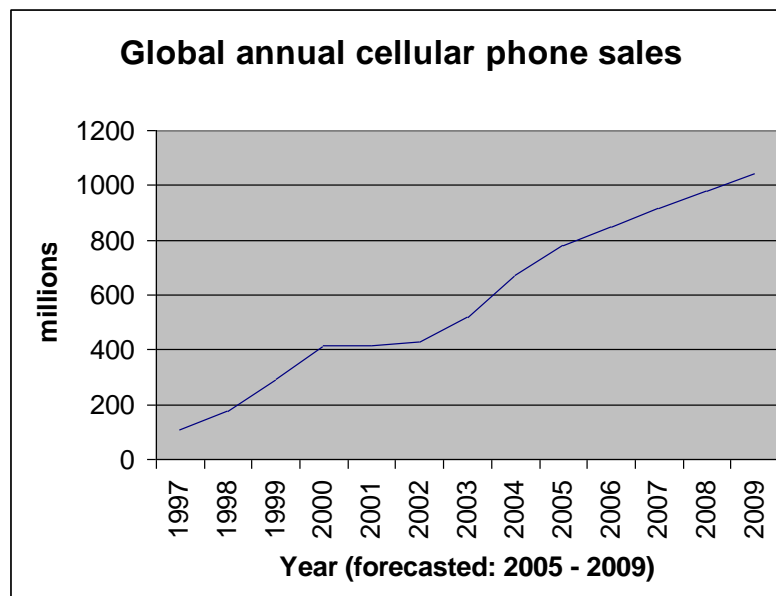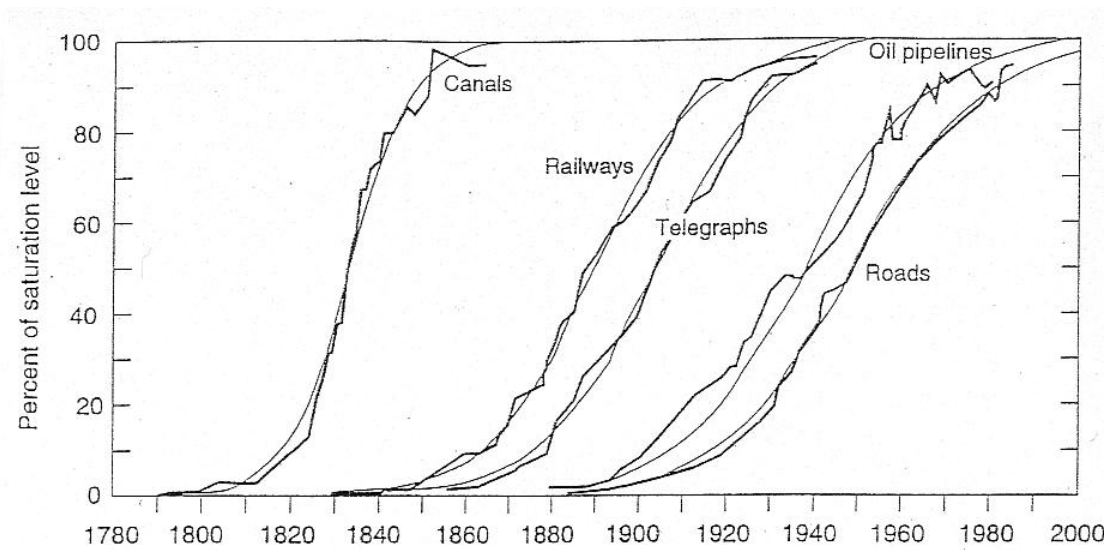
Source: Gardner

b) Your company is planning to introduce a new invention into the market place. Your company's marketing department is trying to determine the size of the market for this product and how fast the market for it will grow to this level. Advise your marketing department of the factors that may influence the diffusion of this product. (5)

c) Use the "diffusion of innovation" body of knowledge to analyse why the diffusion of cellular phones (in South Africa) is so much faster than that of hybrid vehicles. (5)

Question 11c.15

Describe the role of marketing in an organisation. (4)

Question 11c.16

Explain the relationship between product development and the market. (6)

Question 11c.17

In the consumer adoption process of a new product, consumers usually differ in their willingness and readiness to try new products. Briefly discuss the following five adoption groups: Innovators, Early adopters, Early majority, Late majority and Laggards. Which one of the above customer groups is most likely to buy a new technological innovation? (11)

Question 11c.18

Briefly describe various issues that have to be considered by engineers and technologists involved in product development and the marketing and introduction of new products. (6)

Question 11c.19

Seven percent of people with a College education in the USA majoring in engineering and eleven percent of those majoring in the physical sciences are employed in Sales (Carnevale et al: 120, 165).
Why do you think so many of these people are involved in Sales? (4)

Reference

Carnevale, A.P., Strohl, J. & Melton, M. 2011 What's it worth?: The Economic Value of College Majors, Georgetown University, Center on Education and the Work Force.

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Section 11D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 11D.1 [Product life cycle]

Select one to a maximum of five products or services that an organisation of your choice offers. Use the product life cycle model to analyse these products. Explain which stage of the

life cycle each product is at and what the consequences for the company are in terms of research and development spending, marketing, phasing out and so on.

Project 11D.2 [Diffusion of innovation]

Obtain data on the diffusion of a specific technology or product and check whether you obtain the characteristic S-curve shape. Analyse and describe all the various factors/drivers that could have impacted on the diffusion of this product/technology. Assess the technological fitness and competitiveness of this product/technology.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 11E – Case studies

Case 11E.1 ()

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Section 11F – Sources on the world wide web

- - - - End (Questions on Chapter 11) - - - -

Chapter 12

The Engineer, User of Information and Communication Systems

Section 12 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer where appropriate.

Examples (questions and answers)

12a.1 Organisations that adapt methods of experimenting and learning call themselves learning organisations. (1)

True. METS-2: 248.

12a.2 Information should be accurate and provided timely. (1)

True. METS-2: 248.

12a.3 Engineers are knowledge workers. (1)

True. METS-2: 248

12a.4 Information is more useful for decision making than data. (1)

True. METS-2: 248.

12a.4 The backing up of data is one of the responsibilities that must be attended to in an organisation. (1)

True. METS-2: 249

12a.5 Computers are excellent devices for data storage and retrieval. (1)

True. METS-2: 252.

12a.6 Information and communication technologies (ICTs) can assist companies with increasing the rate at which new products are designed. (1)

True. METS-2: 253.

12a.7 Information technology and systems can assist engineers and managers when managing complex systems. (1)

True. METS-2: 253.

12a.8 The purpose of a decision support system is to provide the manager with the necessary information to make intelligent decisions. (1)

True. METS-2: 257.

12a.9 Expert systems can assist decision makers. (1)

True. METS-2: 258

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Other True/False questions (without answers)

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_ _ _ _ _ _

Section 12 B – Multiple choice questions

This section consists of multiple-choice questions. Write down the number of the question, and next to it the number representing the correct option, for example '12.1[4]'.

Examples (questions and answers)

12.1 Read the following three statements:
  a) Organisations that adapt methods of experimenting and learning call themselves learning organisations.
  b) Engineers are knowledge workers.
  c) The backing up of data is one of the responsibilities that must be attended to in an organisation.

  Which of the above statements is/are **correct**?   (2)
  [1] b and c
  [2] a and b
  [3] a, b and c
  [4] b
  [5] None of the options (1, 2, 3, or 4) is correct.

12.1 Answer: [3]; a) correct; b) correct; c) correct   (2)

12.2 The use of CAD (computer-aided design) reduces the time and money spent to produce and update design drawings. In some cases, the CAD is being used to control other computers and machines to manufacture basic components of equipment. Because the CAD software has the capability to perform design checks and make changes to designs as they are approved, there has been …   (2)
[1] a significant reduction in engineering errors
[2] less rework required because of design errors
[3] improved updating of designs over the former manual methods
[4] more timely posting of changes to designs
[5] all of the above

(Adapted from:

Answer 12.2: [5] (2)

_ _ _ _ _ _

Other MCQs (without answers)

12.3 Read the following three statements:
   a)   Computers are excellent devices for data storage and retrieval.
   b)   Information and communication technologies (ICTs) can assist companies with increasing the rate at which new products are designed.
   c)   Expert systems can assist decision makers.

   Which of the above statements is/are **correct**? (2)
   [1]   b and c
   [2]   a and b
   [3]   a, b and c
   [4]   a and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

12.4 Read the following three statements:
   a)   Information should be accurate and provided in good time.
   b)   Information technology and systems can assist engineers and managers when managing complex systems.
   c)   The purpose of a decision support system is to provide the manager with the necessary information to make intelligent decisions.

   Which of the above statements is/are **correct**? (2)
   [1]   b and c
   [2]   a and b
   [3]   a, b and c
   [4]   a and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

12.5 Read the following three statements:
   a)   Some software assists mining engineers with mine design and optimisation.
   b)   A knowledge worker is probably involved in the creation of new information.

c) The purpose of a decision support system is to provide the manager with the necessary information to make intelligent decisions.

Which of the above statements is/are **correct**? (2)

[1]   b and c

[2]   a and b

[3]   a, b and c

[4]   a and c

[5]   none (not a, b, or c)

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Section 12 C – short and long questions

Examples (questions and answers)

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Other questions (without answers)

Question 12c.1

Discuss the importance of information and knowledge. (7)

Question 12c.2

What is done if complete knowledge or information is lacking? (3)

Question 12c.3

Explain the difference between data and information, and list four criteria that information should meet. (6)

Question 12c.4

How are the information needs of decision makers determined? What questions will you ask a decision maker in your company to answer when you try to establish the information needs of the person? (8)

Question 12c.5

Discuss the advantages/benefits of information systems. In other words, how can information systems be used to gain a competitive advantage? (8)

Question 12c.6

Differentiate between the two types of managerial decisions, and the process involved in making these decisions. (4)

Question 12c.7

Briefly describe the purpose of a management information system (MIS). (2)

Question 12c.8 (Minerals industry)

What information is needed by mine management and other staff in the following cases:

- Preparing the mine or quarry's long-term plan
- Preparing the mine or quarry's short-term plan
- Making a decision on upgrading the mine's equipment fleet (6)

Question 12c.9

Explain why you need to receive correct information in good time to function effectively and efficiently at a workplace. (8)

Question 12c.10

Briefly explain how information technology and information systems can be used to improve services, competitiveness and efficiency. (4)

Question 12c.11

Explain why data and information should be gathered. (2)

Question 12c.12

Describe the various activities/jobs that a knowledge (or information) worker may do. (6)

Question 12c.13

Mention the three phases of management decision making. (3)

Question 12c.14

Define the following terms:

- Data (2)
- Information (2)
- Hardware (2)

Question 12c.15

Briefly discuss the purpose of a decision support system. (2)

Question 12c.16

Choose any engineering discipline (e.g. Mining, electrical, mechanical, civil, industrial or chemical engineering) and briefly explain how computers, networks and various types of software are used by engineers in such disciplines. (3)

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Section 12D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 12D.1 ()

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Section 12E – Case studies

Case 12E.1 ()

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Section 12F – Sources on the world wide web

- - - - End (Questions on Chapter 12) - - - -

Chapter 13, Principles of Project Management

Section 13 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

-

Other True/False questions (without answers)

-

_ _ _ _ _ _

Section 13 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '13.9 [1]'.

Examples (questions and answers)

13B.1   Read the following five statements concerning the project network diagram below.
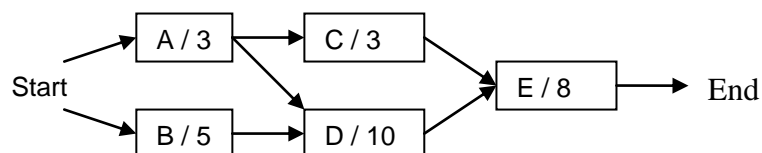
a)   The duration of network path A-C-E is 14 periods (e.g. days).
b)   The duration of network path A-D-E is 21 periods (e.g. days).
c)   The duration of network path B-D-E is 23 periods (e.g. days).
d)   A project's critical path is the network path with the longest duration.
e)   The critical path is B-D-E.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c
[2]   a, b, c and d
[3]   a, b, c, d and e
[4]   a and c

[5] None of the options (1, 2, 3, or 4) is correct.

13B.1 Answer: [3];

a – T; b – T; c – T; d – T; e – T

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Other MCQs (without answers)

13B.2 Read the following four statements:

a)   A project is constrained by its objective, schedule and budget.

b)   The project brief states the solution to the customer's problem.

c)   A person that could in future be affected by the dust and noise from a new quarry

is a stakeholder in a project that involves the establishment of such a new quarry.

Which of the above statements is/are **correct**?   (2)

[1] a, b and c

[2] a and c

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

13B.3 Read the following three statements:

a)   The implementation phase of the project life cycle is usually called the
construction phase in the construction industry.

b)   More uncertainty means more risk.

c)   The more project activities that occur in parallel, the sooner the project will be
finished.

Which of the above statements is/are **correct**?   (2)

[1] a, b and c

[2] a and c

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

13B.4   In a project life cycle, which one of the following defines/describes the close-out phase?   (

[1] The work breakdown structure (WBS) is developed.

[2] Responsibility is handed over to the owner(s). Project accounts are closed. A
project post mortem is conducted.

[3]   Customer requirements are determined. Project's objectives are determined. Stakeholders are identified.

[4]   Stakeholders perform their tasks and project performance is monitored and controlled. Corrective actions are taken where needed.

13B.5 Which one of the following is not a definition or characteristic of a work breakdown structure?

[1]   Defining all work tasks needed to accomplish the project phase

[2]   A time-phased schedule of work tasks

[3]   Assigning responsibility for performing each task

[4]   Defining the deliverables and receivables for each task   (2)

13B.6   Which one of the following tools is used to redirect or stop a project so that the owner(s) of the project is satisfied that project objectives are being met or that the project is still on track as envisaged?

[1]   Work breakdown structure (WBS)

[2]   Decision-making milestones

[3]   Time management tools

[4]   Project life cycle

13B.7 In project time management, which of the following describe "Activity Sequencing"?

[1]   Define specific activities to be accomplished

[2]   Identify dependencies among activities

[3]   Estimate the time needed to complete each activity

[4]   Maintain the project schedule   (2)

_ _ _ _ _ _

Section 13 C – short questions, long questions and calculations

Examples (questions and answers)

Question 13c.1

You have been appointed Project Leader of a project to be undertaken by your company. You have identified the following tasks and made the following time estimates for each task as listed in the table below:

Task	Duration (DAYS)	Predecessor
A	6	-
B	10	-
C	5	A
D	14	A
E	20	B
F	4	C
G	2	D
H	21	E
I	17	E
J	11	G
K	30	I
L	40	F, H, J, K

Use the above mentioned information to do the following:

a)   Construct a project-network diagram.   (4)

b)   Determine all the paths through the diagram, and their duration.   (4)

c)   Determine the critical path and the duration.   (1)

[9]

Answer 13c.1

a) Project Network diagram

Activity on the node network diagram: (4)
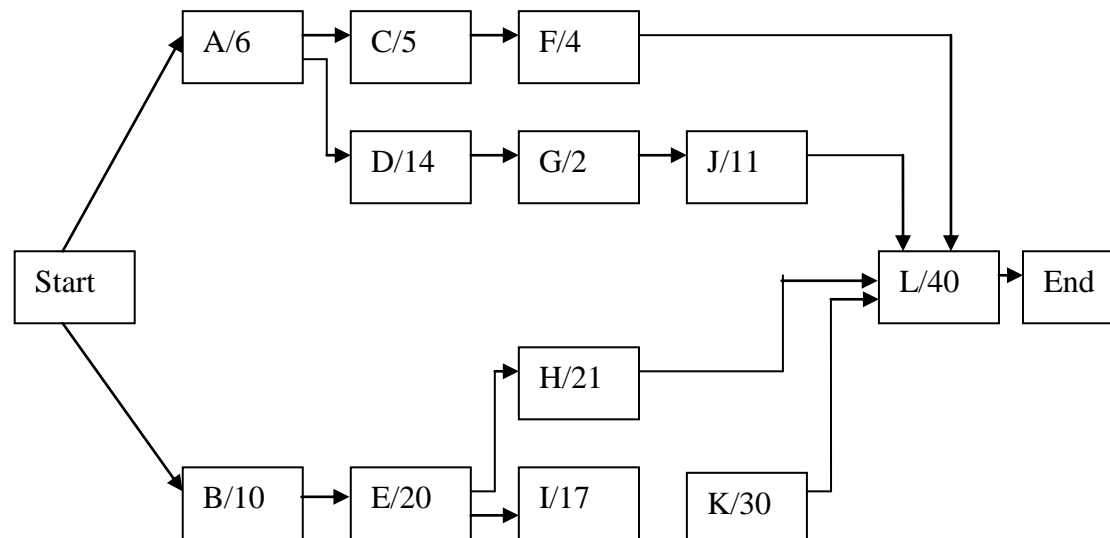
b) Duration of various paths:

    ACFL = 6 + 5 + 4 + 40 = 55 days

    ADGJL = 6 + 14 + 2 + 11 + 40 = 73 days

    BEHL = 10 + 20 + 21 + 40 = 91 days

    BEIKL = 10 + 20 + 17 = 30 + 40 = 117 days (4)

c) Critical path = the path with the longest duration = BEIKL = 117 days (1)

        [9]

Question 13c.2

You have been appointed as the project leader of a project to be undertaken by your company. You have identified the following tasks and made the time estimates for each task as listed in the table below:

Activity	Preceding ("from") activity	Succeeding ("to") activity	Estimated duration (work days)
A	-	B, C, D	3
B	A	E	5
C	A	E	3

D	A	F	10
E	B, C	F	8
F	C, D, E	G	14
G	F	-	7

a)   Use the above table to construct a project network diagram.   (4)

b)   Determine the critical path for the project and its duration.   (2)

[6]

Answer 13c.2

a)
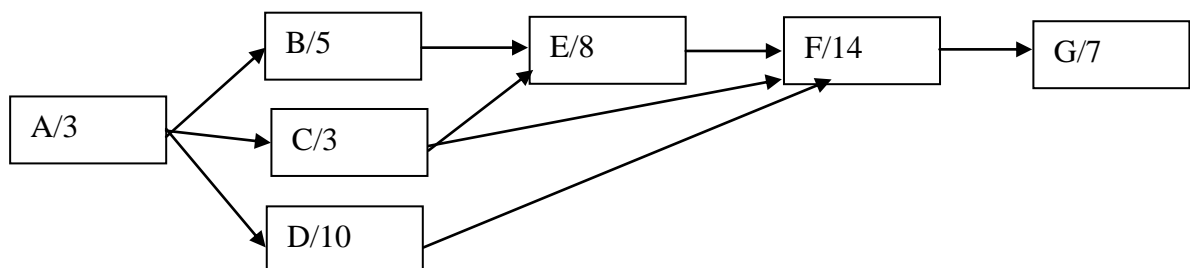
Negative marking: Full marks = 4; subtract half a mark for each wrong connection.   (4)

b) {Any four paths + indication of critical path – maximum of 2 marks will be allocated}

ABEFG = 37 days   {0,5}

ACEFG = 35 days   {0,5}

ADFG = 34 days   {0,5}

ACFG = (3 + 3 + 14 + 7) = 26 days   {0,5}

Critical path = ABEFG (longest)   {0,5}

(2)

[6]

Question 13c.3

Activity	Duration	Preceding Activity
A	15	START
B	5	START
C	12	A
D	14	B

E	8	B
F	12	E
G	22	C
H	24	D,F
I	8	F

Draw the network diagram and determine the critical path(s). (8)

Answer 13c.3
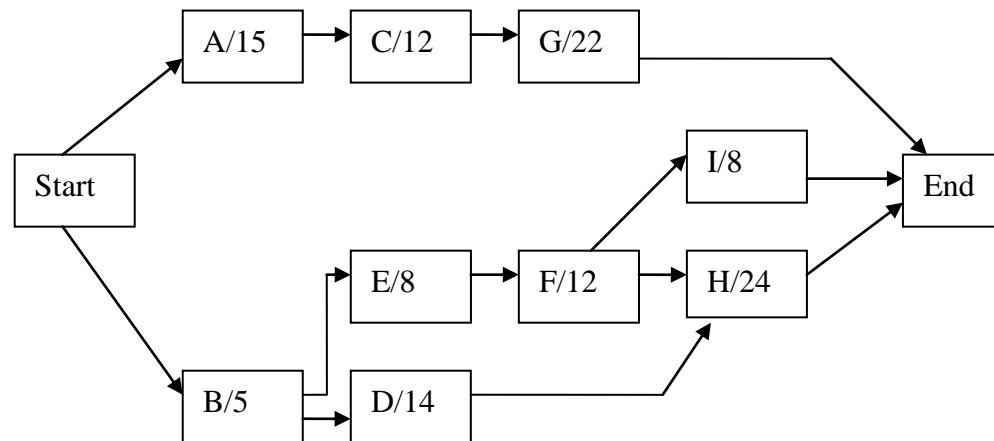
Paths:

A-C-G; Duration = 15 +12+22 = 49

B-E-F-I; Duration = 5 + 8 + 12 + 8 = 33

B-E-F-H; Duration = 5 + 8 + 12 + 24 = 49

B-D-H; Duration = 5 + 14 + 24 = 43

Two critical paths: ACG and BEFH (8)

Question 13c.4

Go to METS-2, p. 290 and work through exercise 13.3.

Answer 13c.4

Expanded network diagram

Exercise 13.3
P. 290
of METS-2
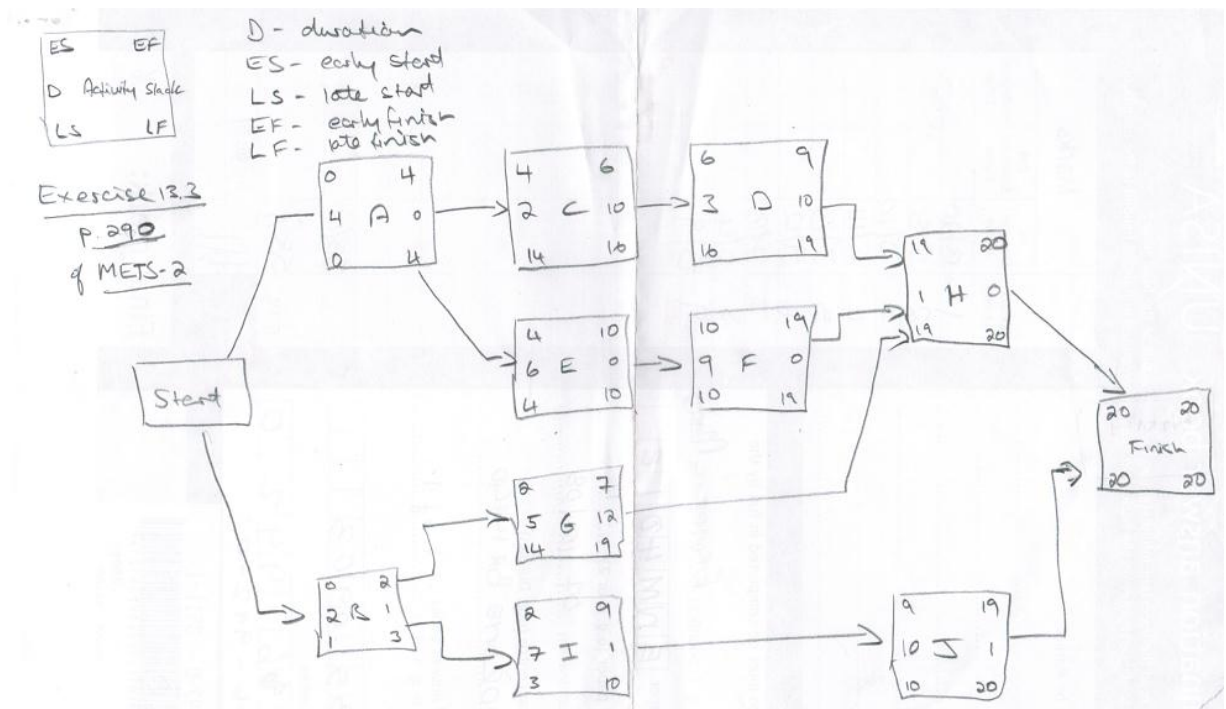
Question 13c.5 (Project life cycle)

a) Mr and Mrs Ncube have expressed their desire that you (a small building contractor) assist them in the designing and building of a new residence.

   i)   Briefly describe the four phases of this project from inception to completion and the various activities that may take place during each of these phases. (8)

   ii) You have to take responsibility for the whole project that involves not only building but also electrical wiring and plumbing for example. Briefly discuss the challenges that you will have to meet when integrating various tasks and issues related to this project. (4)

[12]

Or

b) Match each of the following phases of the project life cycle (on the left-hand side) with the best statement or description (on the right-hand side). In your answer book, write down the number of each phase, and next to it the letter representing the correct option, e.g. 1. j. (4)

Phase of the project life cycle	Description
1. Concept phase	a) Work breakdown structure is developed.

1. Definition phase	b) Responsibility is handed over to the owner(s). Project accounts are closed. A project post mortem is conducted.
2. Implementation phase	c) Customer requirements are determined. Project's objectives are determined. Stakeholders are identified.
3. Close-out	d) Stakeholders perform their tasks and project performance is monitored and controlled. Corrective actions are taken where needed.

Answer 13c.5

a)   Mr and Mrs Ncube's house

   i)   There are four phases in a project's life cycle.

   Concept phase: This is the initial stage which determines customer requirements, defines the project's objective, identifies all the stakeholders, and defines key performance indicators to measure project performance. This is the planning stage. During this phase Mr Ncube and his wife identified the need to have a house build. You will now determine their requirements such as the size of the house, special features, colour etc.

   Definition phase: This phase develops the work breakdown structure - who does what and how. The cost implications of a project and the project schedule are also determined. You will refer Mr Ncube and his wife to an architect to have the plans for the house drawn up. From the plans you will determine all the activities that will be required to construct the house. The WBS will assist you to compile a detailed cost estimate and provide a quotation to Mr Ncube.

   Implementation phase: All the stakeholders perform their tasks in this phase. Project performance is monitored and controlled, and corrective actions are provided where necessary. You assign the various activities to different workers and monitor their progress. You provide them with the necessary materials. Certain activities such as electrification and plumbing may be out-contracted to specialists/sub-contractors.

   Close-out phase: This involves handing over management responsibility to the owner(s) after passing all the acceptance tests. All related project accounts are closed. A project post mortem is conducted. You take Mr Ncube and his wife through the house and make sure that they are happy with everything.

ii)   Any four facts. Students must apply the following (generic) theory to this case:

- The project manager must integrate the project's schedule, cost and objective and satisfy stakeholders.   {1}
- The PM should integrate the contributions from many participants on the project. The PM will for example have to consider that one contractor can only do his/her part when another contractor has finished certain work. The electrician can only pull in wiring when the floor slabs and some walling have been completed, for example.   {2}
- The PM should integrate all life cycle issues which may only materialise later. (e.g. disposal of toxic waste)
- The PM must integrate the project's results into the customer's organisation. (capacity building)   {1}
- All stakeholders' concerns must be integrated into the project plan as far as that is reasonably possible.   {1}

b)   1.   c
       2.   a
       3.   d
       4.   b   (4)

_ _ _ _ _ _

Other questions (without answers)

Question 13c.6

Define:

- Project   {1}
- Project stakeholders   {1}
- Project brief   {2}
- Project risk   {1}

(Source: METS-3: 290, Q13.1)   (5)

Question 13c.7

You have been appointed project leader of a large project to be undertaken by your company. Provide a hypothetical example of a project and create a document (notes) in which you provide a broad outline of the project, describing the duties that you and your team will have to perform during each phase. You may use the following headings:

- Concept phase
- Definition phase
- Implementation phase
- Close-out phase (6)

B. Design a basic work breakdown structure for this project. (6)

[12]

Question 13c.8

Describe how stakeholders should be managed. List some do's and don'ts [3]

Question 13c.9

State the iron law of the project life cycle; give an example of this law in action; and describe the implications of this law for projects and project managers. (3)

Question 13c.10

You have been appointed as the project leader of a project to be undertaken by your company. You have identified the following tasks and made the time estimates for each task as listed in the table below:

Activity	Preceding ("from") activity	Succeeding ("to") activity	Estimated duration (work days)
A	-	C and D	3
B	-	D	5
C	A	E	3
D	A and B	E	10
E	C and D	-	8

Use the information in the tables to do the following:

a) Construct a project network diagram. (4)
b) Determine all the paths through the diagram and their duration. (3)
c) Determine the critical path and the duration. (1)

[8]

Question 13c.11

Explain what a decision-making milestone is and what decisions are taken at such points during the life of a project. (5)

Question 13c.12

Explain the concept 'baseline'. (2)

Question 13c.13

List three (3) ways in which task duration can be predicted. (3)

Question 13c.14

Discuss the purpose of a work breakdown structure (WBS) and list 3 requirements that it should meet (10)

Question 13c.15

Discuss in detail what project time management entails. List and describe the five major processes that project time management consists of. (10)

Question 13c.16

Discuss project risk management. (6)

Question 13c.17

{Source: Tshwane University of Technology, Engineering Management IV, June 2008}

A project consists of 8 activities. The duration in days of each item is as follows:

A = 12, B = 10, C = 20, D = 15, E =14, F = 10, G = 22, H = 6, I = 25, J = 15

The Project flow is as follows:

A is the first item that must be completed.

B and C are preceded by A.

D is preceded by B.

F is preceded by D and E.

H is preceded by F, G and J.

J is preceded by E.

a. Construct a project network diagram (activity on node diagram) (3)

b. Determine the following on every node: Early start, Early finish,
    Late start, Late finish and Slack (5)

c. Determine the critical path and its duration. (2)

d. Draw a Gantt chart of this project. (5)

[15]

Question 13c.18

You have been appointed as the project manager of a project that has to be completed by March 2015. Explain how this project must be time-managed to ensure that it will be completed in time. (5)

Question 13c.19

Briefly discuss the challenges that a project manager has to meet when integrating various project tasks, parameters and issues. (4)

Question 13c.20

Briefly discuss the function/role of the project manager. (2)

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 13D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 13D.1 [Project life cycle and work breakdown structure]

Choose a (real or imaginary) project of your choice. Examples follow:

- planning, designing and building a metallurgical plant for a new mine
- the sinking of a new mine shaft

Describe the various phases of this project in detail and produce a work breakdown structure (WBS) for it. The following should be included in your report:

- the project scope
- the different activities that will be done during the various phases of the project's life cycle
- appropriate numbering of the different WBS tasks
- responsibility assignment
- project budget
- project schedule

You should provide enough background information on the project so that the reader of your report can evaluate the WBS in terms of what the project is supposed to achieve. You should therefore describe the project and provide a project brief.

You will earn good marks if you use project management software to draw a Gantt chart.

Question 13D.2 [Project cost estimating]

Describe project cost estimating:

- in general (theory)
- at a company that you are familiar with
- for a specific project of your choice

The following aspects should be addressed in your report:

- the relationship between project scope and costing
- life cycle costing
- cost estimating techniques
- the link between project cost and project feasibility

The reader of your report should be able to answer the following questions from the information that you provide in your report:

- At what phase of the project life cycle will project costing be done?
- What is the purpose of project costing?

The application of the relevant theory to a specific project would improve your changes of obtaining high marks.

Question 13D.3 (Project constraints)

Choose any project that you are familiar with. Discuss the various project constraints: internal project constraints, internal corporate constraints and external constraints. A good balance between theory and its application is required – you must apply the theory to the specific project that you selected.

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Section 13E – Case studies

Case 13E.1 ()

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Section 13F – Sources on the world wide web

- - - - End (Questions on Chapter 13) - - - -

Chapter 14

Introduction to accounting, economics, financial management and budgeting

Section 14 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

14a.1 The income statement indicates how financially successful an enterprise was over a given period.
True

Other True/False questions (without answers)

-

$$- - - - - -$$

Section 14 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '1.9 [1]'.

Examples (questions and answers)

14.1 Read the following three statements:

   a)   Engineering economics is concerned with the cost of alternative engineering solutions to a problem.

   b)   Value is created when management invests in a project with an NPV that is not negative.

   c)   Value is created when management invests in a project of which the IRR is greater than the hurdle rate of the company.

   Which of the above statements is/are **correct**?   (2)

   [1]   a, b and c

   [2]   a and c

   [3]   a and b

   [4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

14.1 Answer: [1]

a – T; b – T; c – T

_ _ _ _ _ _

Other MCQs (without answers)

14.2 Read the following three statements:

a)   A balance sheet shows the assets and liabilities of the business and owners'
     equity over a period of one year.

b)   A belt conveyor used by a mine in the production process will be classified as a
     non-current asset, while the same type of belt conveyor will be a current asset for
     a company trading in that kind of equipment.

c)   Liabilities are, for example, the sums of money that a company owes to banks
     and other creditors.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   a and c

[3]   a and b

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

14.3 Read the following three statements:

a)   A budget can be regarded as the company's objectives in financial terms.

b)   The sales budget usually forms the basis of most other budgets because it is
     concerned with income.

c)   A production budget usually indicates the number of units that must be
     manufactured.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   a and c

[3]   a and b

[4]   b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

14.4 Read the following three statements:

a)   A budget report should indicate how actual spending differs from forecasted
     spending.

b) Actual sales now may be better than sales forecasted a year ago because of better-than-expected economic conditions.

c) Actual budget items are more likely to differ from the forecasted items in times when a company is experiencing stable growth.

Which of the above statements is/are **correct**? (2)

[1] a, b and c

[2] a and c

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

14.5 Which one of the following is not a current asset?

[1] Inventories

[2] Trade and other receivables

[3] Cash and cash equivalents

[4] Property, plant and equipment (2)

− − − − − −

Section 14 C – short and long questions

Examples (questions and answers)

Question 14c.1

Provide two examples of non-current assets (also called fixed assets) as well as two examples of current assets. (4)

Answer

METS-3:301 (any two examples of each)

Non-current assets	Current assets
property	Inventories
Plant	Cash and cash equivalents
Equipment	

(4)

Question 14c.2

Briefly describe the concept of scarcity, define opportunity cost and explain the consequences of scarcity. (3)

Answer 14c.2 (Suggested answer)

{Any <u>three</u> valid points}

Resources are limited in supply while the needs of people are unlimited. Resources also have alternative uses which means that it can be used for various alternatives. The utilisation of resources for one option means that the same resources cannot be used for another - called the opportunity cost of foregoing the alternative. The concept of scarcity therefore pose the challenge of how to optimise the utilisation of resources. The scarcer a product is and the more it is in demand the higher the price of that product will be relative to products that are not as scarce or less in demand. (3)

<u>Other questions (without answers)</u>

Question 14c.3

List four (4) parameters that determine the quantity of demand (for a product). (4)

Question 14c.4

Briefly **state** the function of the income statement. (i.e. what information does the income statement provide?) (2)

Question 14c.5

List three (3) parameters that determine the quantity of supply. (3)

<u>Or</u>

Choose any product or mineral commodity as an example and briefly describe how the following factors may influence the supply of this product or mineral commodity:

- Price of the product or mineral commodity is increased
- Tax rate is increased
- Salaries are increased (3)

Question 14c.6

You have to put together the sales budget of a small company for the next financial year. This established company manufactures standard products that are not built to the specifications or requirements of specific clients. Explain the method that you would use to estimate the sales volumes of the various products manufactured and marketed by this company. Also list some factors that should be considered when doing a sales volume analysis. (6)

Question 14c.7

b)   List at least three elements that may form part of a budget report.   (3)

ii)   Briefly explain the role of the (operational) budget/budget report in the control process.   (2)

[5]

Question 14c.8

Your company designs and manufactures smart phones. Explain how the demand for your company's smart phones will be affected if:

   a. the price is decreased

   b. the level of household income increases

   c. a competitor decreases the price of its smart phones

   d. your company spends more money on advertising   (4)

Question 14c.9

Briefly explain the difference between a balance sheet, income statement and cash flow statement. Explain why all three are needed to get a true picture of a company's financial state.   (4)

Question 14c.10

Briefly describe how you would prepare an annual budget for your department. Explain how you would control performance against this budget.   (4)

Question 14c.11

Should your company increase or decrease a) stock/inventory levels at the store; b) creditors; to improve the company's cash flow situation? Explain your answer.   (4)

Question 14c.12

Salary expenses in your department are running 16% above budget. Identify three possible causes of the problem.   (3)

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 14D – Project work

<u>Note</u>: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 14D.1 [Mine nationalisation / Mineral resource nationalism]

Write a report on the following topic: Mine nationalisation in South Africa. A good or bad idea?

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 14E – Case studies

Case 14E.1 ()

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Section 14F – Sources on the world wide web

- - - - End (Questions on Chapter 14) - - - -

Chapter 15, Cost Estimation, Cost Engineering and Cost Management

Section 15 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down "true" or "false" and provide a brief explanation for your answer.

Examples (questions and answers)

-

Other True/False questions (without answers)

-

– – – – – –

Section 15 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '15.9 [1]'.

Examples (questions and answers)

15.1 Read the following three statements:
   a)   Producers of unspecialised products are often price takers.
   b)   When the number of autocatalysts produced at a factory increases by 10% a
        month compared with a previous month, then the fixed costs will definitely also
        increase proportionally.
   c)   Different cost structures are one of the results of higher levels of automation. That
        is because the ratio of variable costs to total costs usually increases.
   Which of the above statements is/are **correct**?   (2)
   [1]   a
   [2]   a and c
   [3]   a and b
   [4]   b and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

15.1 Answer: [1]
      a - T;

b – F; Variable costs will definitely increase proportionally. Fixed costs should not increase as long as it is not necessarily to create additional capacity.

c – F; The ratio of 'fixed costs : total costs' usually increases with higher levels of automation. (2)

– – – – – –

Other MCQs (without answers)

15.2 Read the following three statements:

a) The fixed cost component of the total monthly cost of production will increase when you expand the production capacity of a plant, mine or factory through the purchasing of additional machines.

b) If the total production cost for the month was R50 000 and if 1 000 chairs were produced during the month, the unit production cost of a plastic chair is R50.

c) The salaries of cleaning staff employed by a furniture factory are an example of direct costs.

Which of the above statements is/are **correct**? (2)

[1] a, b and c

[2] a and c

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

15.3 Read the following three statements:

a) Activity-based costing is an accounting technique that allocates overhead costs in actual proportion to the overheads consumed by the production activity.

b) Detailed engineering data is used to make order-of-magnitude estimates.

c) Economy of scale is considered in the end-products estimating technique.

Which of the above statements is/are **correct**? (2)

[1] a, b and c

[2] a

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

15.4 Read the following three statements:

a) Pareto's principle can be used in cost estimation.

b) It is possible for production rates to increase over time due to the learning curve effect.

c) Perceived value pricing is practised when a fixed percentage is added to the cost of a product.

Which of the above statements is/are **correct**? (2)

[1] a, b and c

[2] a and c

[3] a and b

[4] b and c

[5] None of the options (1, 2, 3, or 4) is correct.

[5] None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _ _

Section 15 C – short and long questions

Examples (questions and answers)

Question 15c.1 (Cost-Volume-Profit)

Blue Sky Airways provides a daily service between Johannesburg and Durban. The aircraft has a capacity of 220 passengers and each trip costs the company R70 000, regardless of the number of passengers. Additional costs are R60 per passenger (baggage, cabin services and booking costs).

a) If Blue Sky Airways charges R450 per passenger, how many passengers does it need to break even on each flight? (3)

b) Research has shown that planes are actually carrying an average of 80% of their capacity of passengers. What profit (or loss) is realised at 80% capacity and R450 per ticket? (3)

[6]

Answer 15c.1

a) Unit variable cost = UVC = R60 per passenger

Fixed cost = FC = R70 000

Total cost = Fixed cost + variable cost

Variable cost = unit variable cost x number of units

Variable cost = 60 x breakeven number of units, say Z

Variable cost = 60Z

Total cost = 70 000 + 60Z

At breakeven: Total cost = Revenue

Revenue = price of ticket x number of passengers = 450Z

At breakeven: 70 000 + 60Z = 450Z

70 000 = 390Z

Z = 179 passengers (3)

b) Actual average number of passengers = 0,8 x 220 = 176

This is less than the breakeven number, therefore the company will make a loss on its flights at current prices.

Loss = Cost – Revenue

Total cost = 70 000 + 60 x 176 = R80 560,00

Revenue = 176 x 450 = R79 200

Loss = 80 560 – 79 200 = R1 360 (3)

[6]

Question 15c.2 (Cost-Volume-Profit)

Zebra Ltd. wants you to examine the effect of changes in sales on their income before tax.

The costs that the company incurred last year follows:

Fixed costs:

Depreciation	R1 000 000
Plant maintenance	170 000
Salaries	400 000
Office expense	200 000
Advertising	30 000
Interest on debt	200 000
Total	R2 000 000

Variable cost per unit output:

Labour	R40
Materials	60
Total	R100

Assume that Zebra sells its products at R150 per unit.

a) Calculate the break-even volume of sales. (4)

b) Tabulate the variable cost, sales, pre-tax income and net income of Zebra when they produce and sell 10 000, 20 000, 30 000, 40 000, 50 000, 60 000 and 70 000 units. The tax rate is 30%. (8)

c) Illustrate the variables in b) by means of a graph. (4)

[16]

Answer 15c.2

a) Let N = number of units produced and sold

Let N* = break-even number of units produced and sold

Sales = 150N

Total cost = 2 000 000 + 100N

At break-even, no profit is realised – in other words, sales = total costs

Therefore, 150N* = 2 000 000 + 100N*

50N* = 2 000 000; therefore, N* = 40 000 units

b)

Units sold	Total fixed cost	Total variable cost	Total cost	Sales	Pre-tax income (loss)	Net income (loss)
0	2000000	0	2000000	0	-2000000	-1400000
10000	2000000	1000000	3000000	1500000	-1500000	-1050000
20000	2000000	2000000	4000000	3000000	-1000000	-700000
30000	2000000	3000000	5000000	4500000	-500000	-350000
40000	2000000	4000000	6000000	6000000	0	0
50000	2000000	5000000	7000000	7500000	500000	350000
60000	2000000	6000000	8000000	9000000	1000000	700000
70000	2000000	7000000	9000000	10500000	1500000	1050000

Net Income = (1 – tax rate) x Pre-tax income

= (1 – 0.3) x pre-tax income

c)
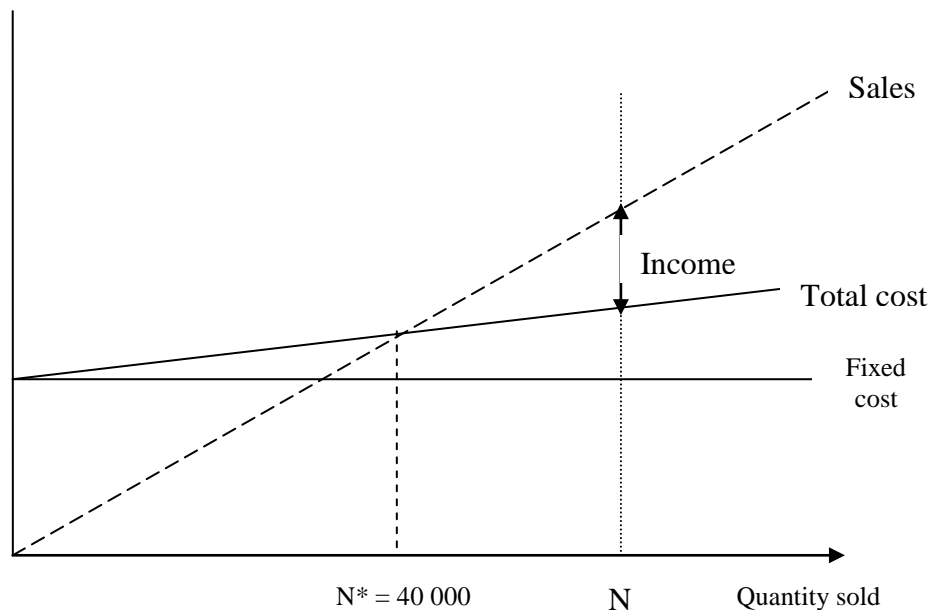
Question 15c.3 (Cost-volume-profit analysis)

You are employed by a coal-fired power plant in Botswana that sells electricity to the national grids of Botswana and South Africa. The plant has the capacity to generate 1800 MW of electricity. Fixed costs incurred amounts to R70 000 000 per month. The variable production cost is 10,5 c/kWh, and you can sell the electricity at an average rate of 21,5c/kWh.

a)   Calculate the break-even MW output for a 30 day month.   (4)

b)   Calculate the monthly profit (or loss) for a 30 day month if the plant operates at an
      average plant-utilisation factor of 89%.   (4)

                                                                                           [8]

Answer 15c.3: Coal-fired power plant in Botswana

a)   Let N = breakeven kWh

      Breakeven revenue = 0,215N

      Breakeven total cost = 70 000 000 + 0,155N

      At breakeven, Revenue = total cost;

      N = 70 000 000 / 0,11 = 636 363 636,4 kWh

      {Remember that 1MW = 1000kW; 1 day = 24 hours (h)}

      Breakeven number of average MW = N / (1000 x 30 x 24) = 883,8 MW   (4)

b)   Average plant output = 0,89 x 1 800 = 1 602MW

      Energy output per month = 1 602 x 24 x 30 x 1 000 = 1 153 440 000 kWh

Profit per month = 1 153 440 000 x (0,215 – 0,105) – 70 000 000

= R126 878 400 – 70 000 000 = R56 878 400

Or

1 602 – 883,8 = 718,2MW

718,2MW x R0,11/KWh x 720h = R56 881 440 (4)

[8]

Question 15c.4 (Cost estimation)

i) Your company constructs ice plants for deep, hot mines. You recently completed an ice plant at a mine at a cost of R4,8m. This plant could produce up to 2 500 tons of ice per day. Make a quick estimate of the likely cost of a new plant with a capacity of 3 000 tons of ice per day. {Note: Y = 0,6} (2)

ii) List the method/steps that you would follow to determine the cost of the plant in 8.1 to a greater degree of accuracy. (4)

[7]

Answer 15c.4

Use formula 15.1, p. 325, METS-2

{See also Annexure A of this book for a summary of formulae}

Cost estimate: $4,8 \times (3000/2500)^{0,6} = R5,35m$ (2)

The following steps should be followed when producing a detailed estimate:

- List materials to be used. Calculate quantities to be used and allow for wastage.
- Determine the design time required.
- Establish the sequence of operations for each component and allocate labour time.
- List subcontract work required.
- List equipment required.
- List special tooling and test equipment requirements.
- Assign a cost to all of the above. (4)

[6]

Question 15c.5

You operate a small cogeneration plant with a capacity of 150 MW. It uses waste gas from a waste disposal site to generate electricity for sale to the national grid. Fixed costs incurred (including interest on capital) amount to R1 250 000 per month. The variable production cost

of producing electricity is 95,5c/kWh and you can sell electricity at an average rate of 118,5c/kWh.

a) What is the **break-even** average MW output for a 31-day month? (6)
b) If the plant operates at an average plant capacity factor of 70%, what would the annual profit (or loss) be? (5)

[11]

15c.5 - suggested solution
Provided:
FC: 1 250 000 p.m.
UVC: R0,955/kWh
UP: R1,185/kWh

a) Let Y = break-even average MW for the month
Energy produced = Power x time = Y x 31 x 24 x 1000kWh = 744 000 Y kWh {2}
Revenue = 1,185 x 744 000Y = R881 640Y {1}
Total cost = 1 250 000 + 0,955 x 744 000Y = 1 250 000 + 710 520Y {1}
At breakeven, revenue = cost; therefore
881 640Y = 1 250 000 + 710 520Y
171 120Y = 1 250 000
Y = 7,3MW {2}

b) Operating power = 0,7 x 150 = 105MW {1}
Energy provided over one year = 105 x 100 x 24 x 365 = 919 800 000 kWh {2}
FC for year = 1 250 000 x 365/31 = R14 717 741,93 {1}
Profit = 919 800 000 x (1,185 – 0,955) – 14 717 741,93 = R196 836 258,10 {1}

[11]

Question 15c.6 (Cost-volume-profit / break-even analysis – Minerals industry)

A copper mine has the following ore reserves categories:

Category	Average grade (% Cu)	Tonnes (millions)
1	1,6	10
2	2,4	20

The mine is at present milling 1 000 000 tpa drawn entirely from category 2 reserves. To evaluate the impact of increasing the milling rate by 10%, the mine's cost structure over the past year was analysed and the information in the following table was established:

Cost centre	Fixed costs (R million)	Variable cost (R million)
Development	5,7	8,5
Stoping	2,8	1,9
Processing	0,5	2,4
Overheads	1,8	0,4

Selling price of copper: R7 200/t

The combined overall mining and milling recovery factor is 80% of the in-situ mineral content.

Assume unit variable cost remains constant.

i) Determine the breakeven tonnage if only category 2 ore reserves are mined at the present milling rate.

ii) Determine the breakeven tonnage if both ore reserves categories are mined in the ratio of their ore reserve tonnages at the increased milling rate. Assume that the costs for mining category 2 and category 1 reserves are the same.

{Source: June 2007 examination paper, Financial Valuation, University of the Witwatersrand}

Answer 15c.6 (Cost-volume-profit / break-even analysis – Minerals industry)

i) Total fixed costs = R10,8m

Total variable costs (1 million tpa) = R13,2m

Therefore, UVC = R13,2 per ton

Let Y = number of tons mined, then

TC = FC + UVC x Y = 10 800 000 + 13,2Y

Revenue per ton = 0,024 x 7 200 x 0,8

Let breakeven tonnage = Y_b, then at breakeven:

10 800 000 + 13,2 Y_b = 0,024 x 7 200 x 0,8 Y_b = 138,24 Y_b , therefore

10 800 000 = 125,04 Y_b ; Y_b = 86 372 tons

ii) Weighted average grade = (1,6 x 10 + 2,4 x 20) / 30 = 2,133%

Revenue = 0,0213 x 7 200 x 0,8

At breakeven:

10 800 000 + 13,2 Y_b = 0,0213 x 7 200 x 0,8 Y_b = 122,69 Y_b

Y_b = 98 641 tons

Question 15c.7 (Hand factors estimating method)

Use hand factors to estimate the cost of building a plant for a company that uses the following hand factors:

Process plant equipment	Hand factor
Electric motors	8,5
Instruments	4,8
Fracturing columns, pressure vessels, pumps	4,0
Heat exchangers	3,5
Compressors	2,5
Centrifuges	2,0

The individual components of a process plant are as follows:

Electric motors @ R72 000

Instruments @ R14 000

Pressure vessels @ R218 000

Heat exchanger @ R48 000

Compressor @ R56 000

Centrifuge @ R32 000   (3)

Answer 15c.7

Estimated plant cost:

R72 000 x 8,5 = R612 000

R14 000 x 4,8 = R 67 200

R218 000 x 4,0 = R872 000

R48 000 x 3,5 = R168 000

R56 000 x 2,5 = R140 000

R32 000 x 2,0 = R 64 000

Total: **R1 923 200**

Note:

Hand factors are multiplied by the cost of individual components of permanent equipment or systems to obtain total cost. The factor is therefore the ratio between total construction cost (including labour, materials, construction equipment, overheads, etc.) and individual components.   (3)

– – – – – –

Other questions (without answers)

Question 15c.8 (Cost-Volume-Profit)

A colliery has the capacity to produce 120 000 run-of-mine tons of anthracite (coal with high carbon content) per month. After washing, about two-thirds of the run-of-mine tonnage is sold as prime. The colliery is currently producing 96 000 run-of-mine tons per month. The fixed cost of the mine per month are R4,2-m and the variable cost per run-of-mine ton amounts to R45. Assume a selling price of R150 per ton of prime. Calculate:

a)   The current profit made per month.
b)   The smallest number of prime tons that has to be sold every month to avoid losses.
c)   The increase in profit and volume (expressed as a percentage) if the mine runs at full capacity.

Question 15c.9 (Cost estimation)

You are employed by a company that manufactures flash drives (memory sticks). Your company currently manufactures USB 2.0 compatible flash drives of 1Gb and 4Gb capacity. Your company is considering manufacturing an 8Gb version soon. Which cost estimation method will you use to do a quick estimate of the likely cost of such a model? Briefly explain why you would use this method and estimate the cost of the 8Gb version.

The costs of manufacturing the 1Gb and 4Gb versions follow:

Capacity of flash drive:	1Gb	4Gb
Manufacturing cost:	R70	R225

Question 15c.10

Differentiate between direct and indirect costs, and give examples of each. (4)

Question 15c.11

State two order-of-magnitude estimating methods. (2)

Question 15c.12

A. List the (general) steps in the (detailed) estimating process. (6)

B. A mining company wants your company, ABC Heating Ltd to design, build and install a large water heating system for their change houses and hostels that are used by about 2 800 workers per day. List the <u>general</u> steps that you will follow to estimate the cost of such a project that will involve a combination of technologies such as electric geysers, solar heating, heat pumps and mine-generated, methane-driven geysers. Certain custom-made components will be manufactured by your company. Most of the plumbing will be out-contracted. (5)

Question 15c.13

List five methods that can be used to determine the price of a product. (5)

Question 15c.14 (CVP analysis for electricity generation)

You operate a small co-generation plant with a capacity 10MW taking waste gas from a waste disposal site and generating electricity for sale to the National Grid.

Fixed costs incurred (including interest on capital) amounts to R950 000 per month. The variable production cost of producing electricity is 65,5c/kWh and you can sell electricity at an average rate of 98,5c/kWh.

a. What is the **break-even** average MW output for a 30 day month? (4)

b. If the plant operates at an average plant capacity factor of 70%, what would the annual profit (or loss) be? (6)

{Source: Tswane University of Technology, Engineering Management IV, June 2008 examination paper, question 5} [10]

Question 15c.15 (Cost-volume-profit / break-even analysis – Minerals industry)

A stone quarry has fixed costs of R200000 per month. The variable cost component varies according to discrete production ranges, as a result of work shifts and equipment utilisation, as follows:

Production rate tpm	Variable cost	Selling price
10000-20000	R150/tonne	R240/tonne
20000-30000	R130/tonne	R220/tonne
30000-40000	R120/tonne	R190/tonne
40000-50000	R115/tonne	R175/tonne
50000-60000	R112/tonne	R160/tonne

The table also shows that the selling price varies according to the volume. This is because at low volumes he produces only high quality stone, whereas at the higher volumes, lower quality stone has to be mined and sold.

The owner wishes to apply a mark-up (profit margin) of 50%.

    I.   Plot the Cost/Volume/Profit relationship for the operation, and make a recommendation on which volume the owner should operate at. (Explain your answer). (4)

   II.   What is the breakeven price at each volume of production? (3)

  III.   He realises afterwards that 20% of the stone quarried cannot be sold, due to damage and breakage, but it still has to be quarried. What does this do to the breakeven prices? (3)

{Source: University of the Witwatersrand, Mine financial valuation, May 2008 examination paper, question 2b} [10]

Question 15c.16

Mine Detectors (Pty) Ltd manufactures (metal) landmine detectors that are powered by wound metal coils. Most of the metal detectors are exported to African countries. The metal detectors are sold at R450 each. The variable cost per unit is R280 and fixed costs for annual production of up to 1 000 units are R90 000. Mine Detectors sells 800 units currently per year. Determine the following:

    a.   The break-even quantity (per year) (3)

    b.   The profit made by Mine Detectors (Pty) Ltd (per year) (2)

Question 15c.17

It is late afternoon and you have just returned from a meeting with local government officials of a large city. The city is contemplating constructing a 500-unit public housing project. The officials need a rough estimate for a meeting with the Mayor the following morning. You know that a 350-unit housing project has just been completed at a total cost of R22,75 m.

The cost capacity factor for large public housing projects is 0,8. The preliminary information that you received from the local government officials indicate that the design of the proposed project will be similar to the one recently completed. What figure will you give to the officials? (3)

Question 15c.18
Explain the difference between costing and pricing. (2)

Question 15c.19

Zebra (Pty) Ltd manufactures a product which it sells at R100. Variable cost per unit is R40, and fixed costs for annual production of up to 1 500 units are R70 000.

    a)   Calculate the break-even quantity of sales. {3}

    b)   Calculate the price that Zebra (Pty) Ltd has to charge to break even at 900 units. {3}

    (6)

Question 15c.20
You are a member of a close corporation that manufactures and sells photovoltaic (PV) cells and related components. State whether the following expenses are examples of direct or indirect costs:

    a.   The cost of material that is used to manufacture the PV cells {1}

    b.   The salary of the supervisor who oversees the activities in the small PV cell manufacturing plant. {1}

    (2)

Question 15c.21
Ensoft, a developer of engineering software, has a high fixed cost structure because of the big investment that must be made to produce the first version of a new software application. Because of the low cost of CD ROMs, copies of the software can be made at relatively low cost and therefore the variable costs of Ensoft are low. Which one of the following two cost structures describes Ensoft best. Explain the impact of Ensoft's cost structure on its break-even point. (3)

Cost structure 1 — Income, Total cost (Quantity on horizontal axis, R on vertical axis)

Cost structure 2 — Income, Total (Quantity on horizontal axis, R on vertical axis)
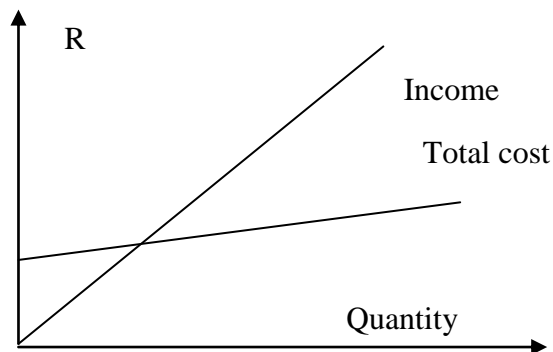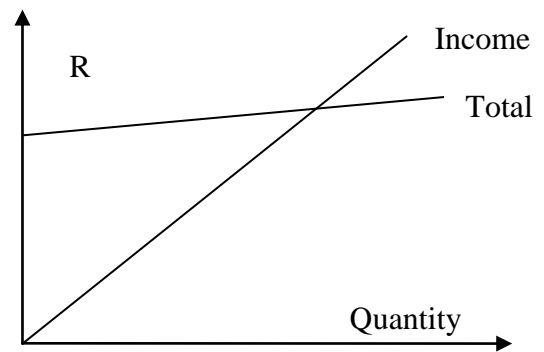
Question 15c.22

Your company designs and constructs power generation units for coal power stations. You recently completed a 400 MW power generation unit at a cost of R150 million. Use the following formula to make a quick estimate of the likely cost of a new 600 MW power generation unit: (2)

$$C_2 = C_1 \times (Q_2/Q_1)^Y \qquad \textbf{Where:}$$

C_2 = Cost of desired plant or piece of equipment

C_1 = Known cost of plant or piece of equipment

Q_2 = Capacity of desired plant or item

Q_1 = Capacity of known plant or item

Y = 0,6 (in this case)

Question 15c.23

Explain the difference between fixed and variable costs and list an example of each. (6)

Question 15c.24 (Breakeven analysis)

You are the project manager for the Prime Destination Group of Hotels. You are considering two locations for building one new hotel, Gauteng and Cape Town. The initial, estimated cost of the hotel in Cape Town is R12 million, with expected net positive cash flows of R500 000 per month. The estimated payback period of the hotel in Gauteng is three years. Determine where the new hotel should be built. (2)

Question 15c.25 (Cost-Volume-Profit)

Zebra Ltd wants you to examine the effect of inflation and the weakening of the rand on its income before tax by means of cost-volume-profit analysis. The costs that the company incurred during 2013 and 2014 are as follows:

Fixed costs	2013	2014
Plant maintenance	1 170 000	1 521 000
Salaries	1 400 000	1 520 000
Office expenses	200 000	212 000
Advertising	30 000	31 800
Interest on debt	200 000	200 000
Total	R3 000 000	R3 484 800

Variable cost per unit output

	2013	2014
Labour	R40	R44,00
Fuel	20	26,00
Materials	40	44,00
Total	R100	R114,00

Remarks:

Plant maintenance increased in 2014 by 30% owing to a weaker rand and imported parts used for maintenance.

Salaries and wages have increased by 10% since 2013 owing to a strong unionised workforce.

Office expenses and advertising increased by 6% which was roughly in line with inflation.

Fuel increased by 30% owing to a weaker rand and higher international oil prices

Materials increased by 10% owing to inflation and because some materials are imported at a weaker rand.

Zebra Ltd has not increased the capacity of its production facilities since 2013.

a) Calculate the break-even volume of sales in both 2013 and 2014. Assume that Zebra sold its products at R150 per unit in both 2013 and 2014. This means that the company has absorbed all cost increases in 2014 - it did not pass some of the higher costs of doing business on to the buyers of its product.   (6)

b) Calculate Zebra's pre-tax income in both 2013 and 2014 when 80 000 units are sold.   (4)

[10]

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Section 15D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 15D.1 ()

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Section 15E – Case studies

Case 15E.1 ()

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Section 15F – Sources on the world wide web

- - - - **End (Questions on Chapter 15)** - - - -

Chapter 16 Introduction to Time Value of Money and Project Selection

Please note. You can assume that reference is always made to compound interest unless otherwise stated or implied. Compound interest is used most of the time in the financial sector.

Section 16 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

16A.1   In an environment where inflation is fairly stable one can expect the price of a car to be R106 000 in a year's time when its current price is R100 000 and the current inflation rate is 6%.   (1)
        True

16A.2   R1 038,74 invested for a period of 5 years at an interest rate of 14% will grow to R2 200 by the end of the 5-year period.   (1)
        False; FV = R2 000

16A.3   A company should invest in a project when the project's NPV is positive.   (1)
        True

Other True/False questions (without answers)

– – – – – –

Section 16 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '16.9 [1]'.

Examples (questions and answers)

16B.1   Read the following three statements:

a) Engineering economics is concerned with macro-economic issues such as the monetary policy of a country.

b) Due to limited resources, the implementation of one project may prevent a company from implementing another project(s) as well.

c) Money that is paid by companies to ordinary shareholders is called interest.

Which of the above statements is/are **correct**? (2)

[1] a, b and c

[2] b and c

[3] a and b

[4] b

[5] None of the options (1, 2, 3, or 4) is correct.

16B.1 Answer: [4]

a) False, METS-2, p. 334

b) True, METS-2, p. 334

c) False, METS-2, p. 335. It is called dividends.

16B.2 Peter plans to retire in ten years' time. He plans to contribute R36 000 towards a unit trust (collective investment scheme) at the end of each year for the next 10 years. If Peter can earn 12% on his contributions, approximately how much will he have earned at the end of the tenth year? (1½)

[1] R631 750

[2] R203 410

[3] R111 810

[4] R403 200

16B.2 Answer: [1]

This is an example of an annuity (equal annual contributions are made). Use the FVA equation because the future value of the ten equal contributions must be calculated.

FVA = A x FVIFA(i, n); where FVIFA(i, n) = $\left[\dfrac{(1+i)^n - 1}{i}\right]$ (from list of formulae)

FVA = 36 000 x $\left[\dfrac{(1+0,12)^{10} - 1}{0,12}\right]$ = 36 000 x 17,5487 = R631 754,46

16B.3 Read the following three statements:

    a) Mr A invested R1000 at bank XYZ. He received R1 070 from bank XYZ one year later. The R70 is called the interest rate.

    b) Inflation causes the purchasing power of money to decline.

    c) According to the principle of equivalence, R1000 at present is equivalent to R1295,03 three years into the future if interest at an interest rate of 9% p.a. can be earned on money invested.

Which of the above statements is/are **correct**? (2)

    [1] a, b and c

    [2] b and c

    [3] a and b

    [4] a and c

    [5] Not 1, 2, 3 or 4

16B.3   Answer: [2]

    a) False, The R70 is called the interest. The interest rate would be 7%.

    b) True, METS-2, p. 335.

    c) True, $1\,295,03 = 1000\,(1,09)^3$

16B.4 Read the following three statements:

    a) Money is usually spent and not earned during the project phase when a new mine, factory or plant is established.

    b) A project is considered in totality when the payback period is applied.

    c) Hurdle rates are usually less than the interest rates on fixed deposits with a bank.

Which of the above statements is/are **correct**? (2)

    [1] a, b and c

    [2] a and c

    [3] a and b

    [4] a

    [5] None of the options (1, 2, 3, or 4) is correct.

16B.4 Answer: [4]

    a) True, METS-2, p. 346

    b) False, METS-2, p. 347

    c) False, METS-2, p. 352

16B.5 Read the following three statements that are based on the diagram below:
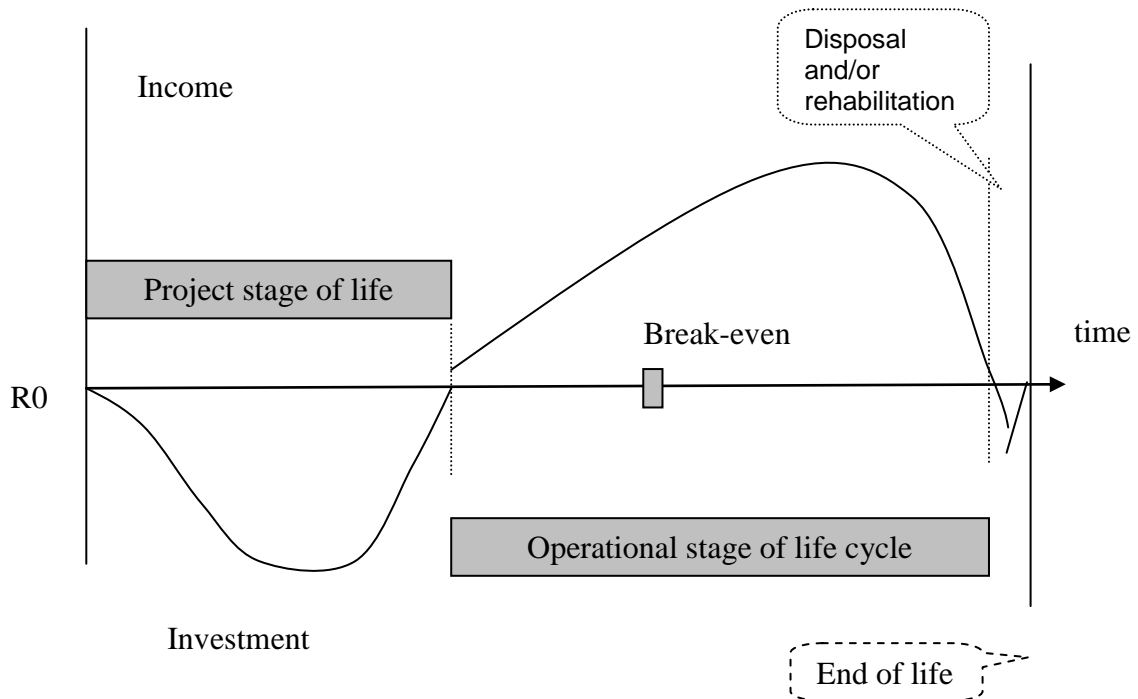
a) During the project stage of the life cycle of a mine, factory or plant, income is generated from operations.

b) At the end of the life of a mine, plant or factory some money may have to be spent on disposal and/or rehabilitation.

c) More money is usually earned during the life of a successful mine, plant or factory than what was spent during the project stage.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   b and c

[3]   a and b

[4]   b

[5]   Not 1, 2, 3 or 4

16B.5   Answer: [2]; a) F; b) T; c) T

16B.6   Read the following three statements:

a)   R1 038,74 invested for a period of 5 years at an interest rate of 14% will grow to R2 200 by the end of the 5-year period.

b)   In an environment where inflation is fairly stable one can expect the price of a car to be R106 000 in a year's time when its current price is R100 000 and the current

inflation rate is 6%. (No other information except the current inflation rate is available.)

c) A company should invest in a project when the project's NPV is positive.

Which of the above statements is/are **correct**? (2)

[1]   b and c

[2]   a and c

[3]   c

[4]   b

[5]   None of the options (1, 2, 3, or 4) is correct.

16B.6   Answer: [1]; a) F ; b) T c) T

16B.7   R10 000 is invested in a savings account at 20% per annum compound interest for 10 years. Calculate the end value of the investment. Select the value closest to your answer. (2)

[1]   R61 740

[2]   R61 920

[3]   R62 290

[4]   R62 470

Suggested solution (16.7): [2]; FV = 10 000 x $1,2^{10}$ = R61 917,36

16B.8   You invest R3 600 per year for 10 successive years (at the end of each year) in a savings account at 15% per annum compound interest. Which one of the following is closest to the end value in the savings account? (2)

[1]   R73 094

[2]   R74 391

[3]   R83 094

[4]   R93 941

Suggested solution (16.8): [1]; FVA = 3 600 x PVIFA(I = 15%, n = 10) = R73 093,39

16B.9   R10 000 is invested in a savings account for 10 years at 20% per annum compound interest, but the interest is calculated semi-annually. What is the end value of the investment? (2)

[1]   R27 670

[2]   R47 860

[3]   R67 270

[4]   R87 410

[5]   None of the options (1, 2, 3, or 4) is correct.

Suggested solution (16.9): [3]; FV = 10 000 x $(1 + 0,2/2)^{10 \times 2}$ = R67 275

16B.10 What amount must be invested today so that it will be worth R1 700 8 years from now. You will earn 8% interest per annum on the amount.   (2)

[1]   R819

[2]   R918

[3]   R1 564

[4]   R1 700

Suggested solution (16.10): [2]; PV = 1 700/$1,08^8$ = R918,46

Other MCQs (without answers)

16B.11 Which one of the following most closely represents the present value of R25 000 received for 10 successive years using a discount rate of 17%?   (2)

[1]   R29 250

[2]   R207 500

[3]   R116 475

[4]   R292 500

16B.12 What amount should be invested annually (at the end of each year) for five successive years at 12% per annum compound interest in order to yield approximately R25 000?   (2)

[1]   R3 935,15

[2]   R4 199,72

[3]   R4 167,58

[4]   R4 400,00

[5]   None of the options (1, 2, 3, or 4) is correct.

16B.13 Calculate the interest or growth rate of the following stream of cash flows:

1992: R1 517

1991: R1 312

1990: R1 210

1989: R1 080 (2)

[1]   6%

[2]   8%

[3]   10%

[4]   12%

[5]   None of the options (1, 2, 3, or 4) is correct.

16B.14 Mpho plans to fund his individual retirement account with a maximum contribution of R2 000 at the end of each year for the next 10 years. If Mpho can earn 10 percent on his contributions, approximately how much will he have at the end of the tenth year? (2)

[1]   R12 290

[2]   R20 000

[3]   R31 875

[4]   R51 880

[5]   None of the options (1, 2, 3, or 4) is correct.

16B.15 Find the present value of the following stream of cash flows assuming that the company's opportunity cost is 9%.

Year	Amount
1 to 5	R10 000
6 to 10	R16 000

(2)

[1]   R10 972

[2]   R13 252

[3]   R79 348

[4]   R141 588

[5]   None of the options (1, 2, 3, or 4) is correct.

16B.16 The rate of return earned on an investment of R50 000 today to guarantee an annuity of R10 489 for 6 years is approximately … (2)

[1]   5%.

[2]   7%.

[3]   30%.

16B.17 What is the average growth rate of the following stream of cash flows?

    2010: R1 575

    2009: R1 312

    2008: R1 210

    2007: R1 100

    2006: R1 000   (2)

    [1]   11%

    [2]   12%

    [3]   13%

    [4]   14%

    [5]   None of the options (1, 2, 3, or 4) is correct.

16B.18 The underlying annual interest rate if the future value of R1 900 invested today
        grows to R2 206 in three years' time will be …   (2)

    [1]   3,6%

    [2]   4,1%

    [3]   4,6%

    [4]   5,1%

    [5]   None of the options (1, 2, 3, or 4) is correct.

16B.19 Which one of the following statements is **incorrect?**   (2)

    [1]   The payback period is the length of time required to recover the initial investment.

    [2]   The NPV and IRR techniques consider the time value of money.

    [3]   When the net present value is negative, the internal rate of return is greater than
           the cost of capital.

16B.20 The initial investment of a project is R150 000. Using a discount rate of 16%, the
        present value of cash inflows is expected to total R150 000 the internal rate of return
        (IRR) of the project is …   (2)

    [1]   equal to 16%.

    [2]   greater than 16%.

    [3]   less than 16%.

    [4]   None of the above.

16B.21 ABC Ltd is evaluating two projects that are mutually exclusive with initial investments
        and cash flows as follows: (2)

Year	Project A (Net cash flows)	Project B (Net cash flows)
0	-R40 000	-R90 000
1	R20 000	R40 000
2	R20 000	R40 000
3	R20 000	R80 000

If ABC Ltd has a required payback period of 2 years, it should …

[1]   accept projects A and B.

[2]   accept A and reject B.

[3]   reject A and accept B.

[4]   reject both projects.

16B.22   XYZ Ltd is evaluating two projects that are mutually exclusive with initial investments and cash flows as follows: (2)

Year	Project A (Net cash flows)	Project B (Net cash flows)
0	-R40 000	-R90 000
1	R20 000	R40 000
2	R20 000	R40 000
3	R20 000	R80 000

If the firm's required rate of return is 15 percent, it should …

[1]   accept projects A and B.

[2]   accept A and reject B.

[3]   reject A and accept B.

[4]   reject both projects.

_ _ _ _ _ _

Section 16 C – short and long questions + calculations

Examples (questions and answers)

Question 16c.1 - Future value of a single sum

An amount of R1 142 is invested for 25 years at a rate of 6% per annum. What is the future value of this investment at the end of 25 years?   (2)

Answer 16c.1

      $FV = 1142(1,06)^{25} = R4\ 901,32$ (2)

Question 16c.2 - <u>Calculation of investment period</u>

      How long will it take your investment of R4 113,00 to grow to R14 469,03 if the applied rate is 15% per annum?   (3)

Answer 16c.2

In this case you should adjust the following formula:

$FV = PV \ \times \ (1 + k)^n$

The time period (n) should be made the topic. Divide both sides by the principal value. Then:

$FV / PV \ = \ (1 + k)^n$

Take logarithms on both sides of the above equation. This results in the following:

$Log(FV / PV) \ = \ nLog(1 + k)$

Therefore $n = Log(FV / PV) / Log(1 + k)$

Therefore $n = Log(14469.03 / 4113.00) / Log(1 + 0.15)$

Therefore $n = 9.00$ years

Question 16c.3 - <u>Present value of an annuity</u>

A mining company plans to purchase a small loader for R240 000 which will be paid for in 24 equal monthly instalments at an annual interest rate of 18%. What will the monthly instalment amount be?   (3)

Answer 16c.3

Note that the R240 000 is the current (present) value of the loader. A number of equal payments (no single sum as in 16c.1) have to be made to the bank – annuity. The Present value of Annuity (PVA) formula must therefore be used.

      $PVA = 240\ 000 = A \times PVAIF(18/12\%,\ 24) = 20,0304 \times A$

      $A = 240\ 000 / 20,0304 = R11\ 981,78$ (3)

Question 16c.4   - <u>Future value of annuity</u>

You pay instalments of R824 at the end of each year into a savings account yielding 9% p.a. interest, compounded annually. What should the future value of the investment be at the end of 23 years? (3)

Answer 16c.4

Note that the future value of annuity (FVA) formula must be used. That is because a number of equal amounts are regularly paid (annuity) into a savings account.

$$\text{FVA} = I \times \frac{(1+i)^n - 1}{i}$$

Or

FVA = I x FVIFA(r, t)

9% = 9/100 = 0,09; n = 23

$$\text{FVIFA(r, t)} = \frac{(1+0,09)^{23} - 1}{0,09} = 69{,}5319$$

FVA = 824 x 69,5319 = R57 294,32 (3)

Question 16c.5 - Sinking fund

The head of a department wishes to create a sinking fund to replace old equipment used by his/her department. He/She has estimated that it will cost R3 679 253,60 to replace the equipment in three years' time.

Given:

- The estimated return for the next three years is 6 %.
- Compounding is done monthly.
- The estimated salvage value of old equipment in three years' time is R80000.

Required:

What amount must be set aside monthly to make the purchase of the equipment possible? (4)

Answer 16c.5

The installment of an annuity that will compound to a future value must be calculated. The future value of the annuity equals the estimated price minus the estimated salvage value of the old equipment. Therefore:

FVA = R3679253.60 - R80000.00 = R3599253.60.

The monthly interest rate = nominal yearly rate / 12

therefore:

The monthly interest rate (as a fraction) = 0.06 / 12 = 0.0050.

The period = no. of years x 12 = 3 years x 12 = 36

therefore

FVA = R3599253.60 = I x FVIFA(36, 0.50%)   therefore

I = 3599253.60 / 36,3168   therefore

I = R99 107   (4)

Question 16c.6

It is estimated that R105 000 will be required to implement a project. Once implemented, the facility that was established during the project will generate the following cash flows:

(End of) year	Cash flow
1	R35 000
2	R35 000
3	R35 000
4	R35 000

    a)   Determine the payback period for the project.   (1)

    b)   Determine the return on investment for the project.   (2)

    c)   Calculate the net present value (NPV) of the project. Use a discount rate of 14%.   (3)

    d)   Will you invest in this project? Explain.   (1)

Answer 16c.6

a)   Three years; (35 000 + 35 000 + 35 000 = 105 000)   (1)

b)   Average annual profit of the project = (140 000 - 105 000)/4 = R8 750 per year

    ROI = 8 750 / 105 000 x 100 = 8,33%   (2)

c)   <u>NPV (Project A, r= 14%)</u> = -105 000 + 35 000/(1,14) + 35 000/(1,14)^2 + 35 000/(1,14)^3 +

    35 000/(1,14)^4 = -R3 020,07   (3)

d)   The investment should not be made – The NPV is negative.   (1)

0.14

Year   CF   PV

		-
0	-105000	105000.00
1	35000	30701.75
2	35000	26931.36
3	35000	23624.00
4	35000	20722.81
	35000	-3020.07

Question 16c.7

Pete recently bought a house at a price of R650 000. He obtained a (100%) mortgage bond for the whole amount from XYZ bank. The interest rate that XYZ charged him was recently reduced from an annual rate of 15% to 14%. How much less will Pete have to pay each month? Pete has 20 years to pay the bank.

Answer 16c.7

Step 1: Decide whether this is a single sum or annuity – In this case it is an annuity since 240 equal monthly payments have to be made by Pete. (n = 20 x 12 = 240 periods)

Step 2: Is it a PVA or FVA? In this case it is a PVA since the current purchasing price of the house is known. Therefore the following equation has to be used:

PVA = A x PVIFA(i, n); where PVIFA(i, n) = $\left[\dfrac{(1+i)^n - 1}{i(1+i)^n} \right]$

Step 3: How often does compounding takes place? In this case it is monthly. Convert annual interest rate to a monthly one.

iold = 0,15/12 = 0,0125, whereas inew = 0,14/12 = 0,011667

$$PVIFA(0,0125;240) = \frac{(1+0,0125)^{240} - 1}{0,0125(1+0,0125)^{240}} = 75,9422$$

similarly, PVIFA(i = 0,011667; n= 240) = 80,4168

Old monthly payment = 650 000 / PVIFA(i = 0,0125; n = 240) = R8559,13

New monthly payment = 650 000/80,4168 = R8082,89

Saving = R476,24 per month

Question 16c.8

Susan buys a house at a price of R500 000. She obtains a mortgage bond from XYZ Bank. Assume that Susan will be charged a fixed interest rate of 12% (Note: the 12% is an annual percentage rate or a 1% monthly rate.) Susan has 20 years to repay the loan.

a) Calculate the monthly payment (instalment) that Susan has to make to the bank. (3)

b) Three years later, Susan sells the house after paying 36 monthly instalments to the bank. She wants to cancel the 20-year loan that she obtained from the bank and settle the outstanding amount that she owes. Susan did not pay much attention to the statements that she received from the bank over the 3-year period and is horrified when she discovers that she still owes the bank R478 227,62. She expected the amount to be a lot smaller. Explain to Susan why she still owes such a large sum of money to the bank.

Hints:

- Calculate how much of the first month's payment to the bank was interest and by how much the loan amount was reduced after the first month.
- Calculate how much Susan paid to the bank over the 3-year period.
- Make use of the graph below. (4)

Graph A – Breakdown of mortgage payments between interest and amortisation. Monthly payments within each year were summed, so the graph shows the annual payment on the mortgage.

Home mortgage amortisation
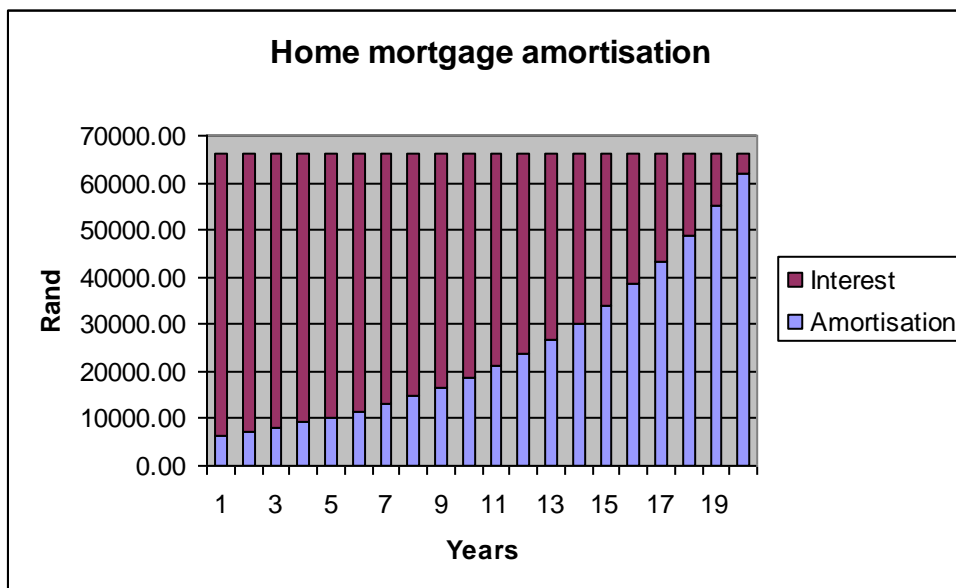
Suggested solution for 16c.8

Current monthly payment:

N = 20 x 12 = 240 periods

Monthly interest rate = 0,12/12 = 0,01 {Because, the 12% is an annual percentage rate (APR) and not an effective annual interest rate}

Current monthly payment = 500 000 / PVIFA

$$PVIFA(i, n) = \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] = \left[\frac{(1+0,01)^{240} - 1}{0,01(1+0,01)^{240}}\right] = 90,8194$$

= 500 000 / 90,8194 = R5 505,43 (3)

b)   See spreadsheet on workbook's CD

After 3 years Susan paid 36 monthly installments to the bank of R5505,43 each or R198 195 in total. Initially only a small part of the monthly installment goes towards reducing (amortising) the amount of the loan. Most of it is paid as interest to the bank. For example, R5000 (0,1 x R500 000) of the first month's payment to the bank is interest and only R505,43 is deducted from the loan amount. The outstanding amount on the loan therefore reduces slowly, initially, but eventually speeds up as the loan amount gets smaller.

It is for this reason that Susan still owes the bank R478 227,62 (see spreadshead) after three years. (4)

Question 16c.9

(Adapted from the following source: Question 2, Mine Manager's Examination, Mine Management and Industrial Law, Nov 2005)

You are the mine manager of Mine X and you want to expand your operations. The feasibility study shows that you have two options to consider. Option A is to sell your product to a local consumer. Option B is to export your product. The feasibility study yielded the following results for Options A and B.

Option A

Total reserve base	80 million tons
Capital required	R1 000 million
Mining rate	8 million tons per year
Yield	100%
Production cost	R35,00 ROM per ton
Sales price	R80,00 per ton
Tax rate	30%
NPV	47,09 million
IRR	22%

Option B

Total reserve base	80 million tons
Capital required	R2 000 million
Mining rate	8 million tons per year
Yield	70%

Production cost	R35,00 per ROM ton
Beneficiation cost	R45,00 per ROM ton
Transport cost	R30,00 per sales ton
Sales price	US$ 40 per ton
Exchange rate	R7,00 per US$
Tax rate	30%
NPV	R192 million
IRR	23%

a) Which option will you choose? Give reasons for your answer. (2)

b) What is the payback period in years for both options? (5)

Suggested solution for 16c.9

a) Both options are acceptable under the rule that only a project for which the NPV is larger than 0 should be chosen. These options are however mutually exclusive – both cannot be implemented since there is only one ore reserve. Assume that the hurdle rates for both options are 20%, then the IRR of both projects are bigger than the hurdle rate. In such a case option B should be used since it has the higher NPV and IRR of the two options. {In the case of capital rationing, where say only R1bn is available, option A should be implemented. (2)

b)

Option A (Assumption: no depreciation or capital redemption)

Life of mine	10 years
CAPEX (capital expenditure)	R1bn
Sales (p.a.)	R640m
Production cost (p.a.)	R280m
Earnings before tax (EBT)	R360m
Tax (30%)	R108m
Profit after tax	R252m

Option B

(Assumption: The yield is a beneficiation yield. This means that the total tonnage is mined and beneficiated but only 70% thereof is transported.)

| Life of mine | 10 years |
| CAPEX | R2bn |

Sales (p.a.)	R1 568m (0.7 x 8 x 7 x 40)
Production cost (p.a.)	R808m [8 x (35 + 45) + 8 x 0.7 x 30]
Earnings before tax (EBT)	R760m
Tax (30% of EBT)	R228m [760 x 0,3]
Profit after tax	R532m

Payback period for option A is about 4 years (1000/252 = 3,97)

Payback period for option B is about 4 years (2000/532 = 3,76)   (5)

Question 16c.10

Your company is investigating the possibility of erecting a wind farm in the Western Cape. The details follow:

Capacity of wind farm: 6 000 kW

Capital cost: R21 000 000

Life of wind farm: 20 years

Utilisation of capacity: 30% of the time

Duration of month: 30 days

Table 1 - National Energy Regulator (NERSA) renewable energy feed-in tariff (REFIT) for 2009 (http://www.nersa.org.za)

Technology	Tariff (R/kWh)
Wind	R1,25
Small hydro	R0,94
Landfill gas	R0,90
Concentrated solar	R2,10

a) What monthly amount will your company have to pay during the life of the wind farm to a bank from whom they obtained the money (R21m) to built the wind farm? The annual interest rate is 12%.   {3}

b) In addition to the monthly cash outflow of the above amount (calculated in a)), other fixed costs of R75 000 per month are also incurred. Will the wind farm be profitable if the unit variable cost is 15c per kWh? Calculate the monthly profit or loss.   {5}

c) How will an increase in interest rates affect the viability/feasibility of the wind farm?   {1}

[9]

Suggested solution for 16c.10

a) $$PVA = A\left[\frac{(1+k)^n - 1}{k(1+k)^n}\right] = A \times PVIFA_{r,t}$$

R21 000 000 = A x $\left[\dfrac{(1+0,01)^{240} - 1}{0,01(1+0,01)^{240}}\right]$ = 90,819 x A; therefore

A = R231 228,09 p.m.   {3}

b)   FC = 231 228 + 75 000 = R306 228 p.m.

Energy generated per month = 6 000kW x 0,3 x 30 days/month x 24 hours /day = 1296

000 kWh   {2}

Revenue = 1 296 000 x 1,25 = R1 620 000.   {1}

Variable cost = 1 296 000 x 0,15 = R194 400   {1}

Monthly profit = 1 620 000 – 306 228 – 194 400 = R1 119 372   {1}

c)   The monthly fixed cost will increase and the chances of having a feasible project will

decrease.   {1}

                                                                                 [9]

Question 16c.11

A company plans to purchase a small delivery truck for R120 000, which will be paid for in 36
equal monthly instalments at an annual interest rate of 18%. What will the monthly payment
amount be?   [3]

Suggested solution for 16c.11

This is an annuity (36 equal payments are involved)

It is a present value annuity because you have the present value (R120 000 = current price of
delivery truck)

PVA = 120 000 = A x PVAIF(18/12%, 36) = 27,66 x A

A = 240 000 / 27,66 = R4 338,29

Or $$PVA = A\left[\frac{(1+k)^n - 1}{k(1+k)^n}\right] = A \times PVIFA_{r,t} = A \times \frac{(1+0,015)^{36} - 1}{0,015(1,015)^{36}}$$

Where: k = 0,18/12 = 0,015

n = 3 x 12 = 36   [3]

Question 16c.12

A manufacturing company is comparing two machines for its production line: the deluxe model, which costs R30 000 and will raise net estimated cash flow by R9 000 per year for the next five years, and the economy model, with a smaller capacity, which costs R20 000 and will raise net estimated cash flow by R6 100 per year for the next five years. Which machine should management choose? Use a discount rate of 10% (Schall, L.D. & Haley, C.W., 1991, 6th ed., Introduction to financial management, p. 250). (5)

Suggested solution for 16c.12

NPV (Deluxe machine) = -30 000 + discounted cash flow over next five years

Use the PVA formula to obtain this discounted cash flow over the next five years – this follows from the definition of an annuity

NPV (Deluxe machine) = -30 000 + PVA(9000, 10%, 5)

= -30 000 + 9 000$[(1,1^5 - 1)/(0,1(1,1)^5)]$ = -30 000 + 9 000 x 3,7908 = R4 117   {2}

NPV (economy model) = -20 000 + PVA(6100, 10%, 5)

= -20 000 + 6 100$[(1,1^5 - 1)/(0,1(1,1)^5)]$ = -20 000 + 6 100 x 3,7908 = R3 124   {2}

The deluxe model should be purchased since its NPV is positive and bigger than that of the economy model.   {1}

(5)

Question 16c.13

Determine the replacement cost of a piece of equipment in five years' time. The current cost of this equipment is R302 000 and the escalation rate is projected to be 7,8%. What uniform sum must be set aside each year if you want to establish a sinking fund that will retire this obligation in five (5) years' time? Your company receives an interest rate of 14% per year from the bank on money invested.   (4)

Suggested solution for 16c.13

Replacement cost in 5 years' time = 302 000$(1 + 0,078)^5$ = R439 643,59   {1}

FVA = R439 643,59 = FVAIF(5, 14%) x annual payment

FVAIF(5, 14%) = $[(1,14)^5 - 1]/0,14$ = 6,6101

Annual payment = 439 643,59 / 6,6101 = R66 510,84   {3}

(4)

Question 16c.14

Year	Project A	Project B	Project C
0	(880 000)	(450 000)	(1 600 000)
1	220 000	50 000	400 000
2	220 000	100 000	450 000
3	220 000	200 000	400 000
4	220 000	50 000	350 000
5	220 000	50 000	320 000
6	220 000	120 000	280 000
7	180 000	100 000	290 000

Note: 'Year 0' is the same as the beginning of year 1. Assume that all cash flows are realised at the end of year 1, 2, 3, … 7.

a) Determine the payback periods for projects A, B and C.   (3)
b) Determine the return on investment (ROI) for each project (A, B and C).   (6)
c) Calculate the net present value (NPV) for each project (A, B and C). Use a discount
    rate of 14% and 18%.   (12)
d) Determine the internal rate of return (IRR) for each project (A, B and C).   (9)

                                                                                                  [30]

Suggested solution for 16c.14 - Payback period, ROI, NPV, IRR

a)

Payback period for project A = 4 years.

Payback period for project B = 5 years.

Payback period for project C = 4 years.

b)

Average annual profit (A) = (1 500 000 - 880 000)/7 = R88 571,43 per year

ROI (A) = 88 571,43 / 880 000 x 100 = 10,06%

Average annual profit (B) = (670 000 - 450 000)/7 = R31 428,57 per year

ROI (A) = 31 428,57 / 450 000 x 100 = 6,98%

Average annual profit (C) = (2 490 000 – 1 600 000)/7 = R127 142,86 per year

ROI (C) = 127 142,86 / 1 600 000 x 100 = 7,95%

c)   See spreadsheet on Workbook CD

NPV (Project A, r= 14%) = -880 000 + 220 000/(1,14) + 220 000/(1,14)^2 + 220 000/(1,14)^3 + 220 000/(1,14)^4 + 220 000/(1,14)^5 + 220 000/(1,14)^6 + 180 000/(1,14)^7 = R47 441,57

Or

<u>c) (NPV)</u>   r = 14%

Year	Project A	Discount Factor	PV of cash flow
0	-880000	1	-880000
1	220000	0.877193	192982.46
2	220000	0.7694675	169282.86
3	220000	0.6749715	148493.73
4	220000	0.5920803	130257.66
5	220000	0.5193687	114261.11
6	220000	0.4555865	100229.04
7	180000	0.3996373	71934.718
		NPV =	47441.57

NPV (Project A, r= 18%)

<u>c) (NPV)</u>   r = 18%

Year	Project A	Discount Factor	PV of cash flow
0	-880000	1	-880000
1	220000	0.8474576	186440.68
2	220000	0.7181844	158000.57
3	220000	0.6086309	133898.79
4	220000	0.5157889	113473.55
5	220000	0.4371092	96164.028
6	220000	0.3704315	81494.939
7	180000	0.313925	56506.506
		NPV =	-54020.93

NPV (Project B, r= 14%)

<u>c) (NPV)</u>   r = 14%

Year	Project B	Discount factor	PV of cash flow
0	-450000	1	-450000
1	50000	0.877193	43859.649
2	100000	0.7694675	76946.753
3	200000	0.6749715	134994.3
4	50000	0.5920803	29604.014

5	50000	0.519368 7	25968.433
6	120000	0.455586 5	54670.386
7	100000	0.399637 3	39963.732
		NPV =	-43992.73

NPV (Project B, r= 18%)

c) (NPV)   r = 14%

Year	Project B	Discount factor	PV of cash flow
0	-450000	1	-450000
1	50000	0.877193	43859.649
2	100000	0.769467 5	76946.753
3	200000	0.674971 5	134994.3
4	50000	0.592080 3	29604.014
5	50000	0.519368 7	25968.433
6	120000	0.455586 5	54670.386
7	100000	0.399637 3	39963.732
		NPV =	-43992.73

NPV (Project C, r= 14%)

c) (NPV)   r = 14%

Year	Project C	Discount factor	PV of cash flow
0	-1600000	1	-1600000
1	400000	0.877193	350877.19
2	450000	0.769467 5	346260.39
3	400000	0.674971 5	269988.61
4	350000	0.592080 3	207228.1
5	320000	0.519368 7	166197.97
6	280000	0.455586 5	127564.23
7	290000	0.399637 3	115894.82
		NPV =	-15988.69

NPV (Project C, r= 18%)

c) (NPV)   r = 18%

Year	Project C	Discount	PV of

		factor	cash flow
0	-1600000	1	-1600000
1	400000	0.8474576	338983.05
2	450000	0.7181844	323182.99
3	400000	0.6086309	243452.35
4	350000	0.5157889	180526.11
5	320000	0.4371092	139874.95
6	280000	0.3704315	103720.83
7	290000	0.313925	91038.26
		NPV =	-179221.46

<u>d) (IRR)</u>

Year	Project A	Project B	Project C
0	-880000	-450000	-1600000
1	220000	50000	400000
2	220000	100000	450000
3	220000	200000	400000
4	220000	50000	350000
5	220000	50000	320000
6	220000	120000	280000
7	180000	100000	290000
IRR	16%	11%	14%

Question 16c.15

{Adapted from: Unisa, Financial Management MNF2023}

You plan to retire exactly 20 years from today. Your goal is to create a fund that will allow you to receive R20 000 at the end of each year for the estimated 30 years between retirement and death. You estimate that you will be able to earn 11% per year during the 30 year retirement period.

a) How large a fund will you need *when you retire* in 20 years' time to provide the 30-year, R20000 retirement annuity? (3)

b) How much will you need *today* as a single amount to provide the fund calculated in part (a) if you earn only 9% per year during the 20 years preceding retirement? (2)

c) What effect would an increase in the rate you can earn both during and prior to retirement have on the values found in parts (a) and (b)? Explain. (1)

[6]

Suggested solution for 16c.15

a) Calculate the present value of the annuity with the formula, PVA = A x PVIFA(i, n);

where PVIFA(i, n) = $\left[\dfrac{(1+i)^n - 1}{i(1+i)^n}\right]$

PVA = 20 000 x $\left[\dfrac{(1+0,11)^{30} - 1}{0,11(1+0,11)^{30}}\right]$ = 20 000 x 8,6938 = R173 875,85

b) Use the formula, PV = FV/(1 + i)^n = 173 875,85 / (1,09)^{20} = R31 024,82

c) Both values would be lower. A smaller sum would be required in 20 years and a smaller amount would have to be saved today to accumulate to the required future sum.

Question 16c.16

James is considering buying a car for R140 000. The bank has quoted him an interest rate of 12% per annum, compounded monthly. If he wishes to repay the principal amount over 50 months, what is his monthly instalment?

Answer 16c.16 (Buying a car)

PVA = 140 000

Monthly interest rate = 1%

n = 50

Use the formula: PVA = A x PVIFA(i, n); where PVIFA(i, n) = $\left[\dfrac{(1+i)^n - 1}{i(1+i)^n}\right]$

140 000 = A x $\left[\dfrac{(1+0,01)^{50} - 1}{0,01(1+0,01)^{50}}\right]$ = A x 39,1961

A = R3 571,78

Question 16c.17 (NPV and IRR)

A company has an opportunity to invest in a machine at a cost of R2 500 000. The net cash flows after taxes from the machine will be R700 000 per year and will continue for five years, after which the machine will have no value. The applicable cost of capital for this project is 12 %.

a)	Calculate the net present value (NPV) for the investment.	{3}
b)	Calculate the internal rate of return (IRR) for the investment.	{2}
c)	Should the investment be made?	{1}
		(6)

Suggested solution for 16c.17

a)	This is a simple NPV exercise with one initial cash outflow at the beginning of the project. The following equation could therefore be used: $NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+k)^t} - I$ {Equation 16.8, p. 349, METS-2}

The calculation of the NPV is further simplified since the cash inflow for each one of the following five years is exactly the same amount {Do you will remember the definition of an annuity?}. The "$\sum_{t=1}^{n} \frac{CF_t}{(1+k)^t}$" part could therefore be calculated by means of the "present value of an annuity" (PVA) formula, {PVA = A x PVIFA(i, n); where PVIFA(i, n) = $\left[\frac{(1+i)^n - 1}{i(1+i)^n} \right]$, equation 16.4, p. 340, METS-2}.

NPV = 700 000 x $\left[\frac{(1+0,12)^5 - 1}{0,12(1+0,12)^5} \right]$ - 2 500 000

= (700 000 x 3,6048) – 2 500 000 = R23 343,34

Note: see spreadsheet, worksheet 16c.16 on the CD .	(3)

b)	The following equation can be used since only one initial cash outflow takes place:

$\sum_{t=1}^{n} \left[CF_t (1+r)^t \right] - I = 0$ {Equation 16.9, p. 350, METS-2}

The following methods can be used to calculate/estimate the IRR:
- Use a spreadsheet (not possible in the examination)
- Use a calculator with an "IRR" function
- Use a calculator to determine the IRR by means of trial and error (see below)
- Use a graph (see below)

Trial and error
- Only answer such a section (on IRR) when you have done everything else – it could be time-consuming.
- Results should be tabulated and plotted if necessary – it may help you to (visually) better understand what you are doing.

- The key is to find the interest rate in the equation, $\sum_{t=1}^{n}\left[CF_t(1+r)^t\right] - I = 0$ so that the NPV

  = 0

- In answer (a) you have already calculated the NPV when i = 12 and it was positive. This means that i could be increased in order to find an NPV = 0.

- Try i = 14, then you will find that the NPV is negative.

- This means that the IRR is somewhere between 12 and 14%. Try various values between 12 and 14 as tabulated below:

I (%)	NPV
12.0	23343.34
12.1	17104.71
12.2	10890.98
12.3	4702.004
12.4	-1462.33
12.5	-7602.16
12.6	-13717.6
12.7	-19808.8

- This can be plotted (optional) as below. The IRR is where the graph cuts the X-axis (or where the NPV = 0)
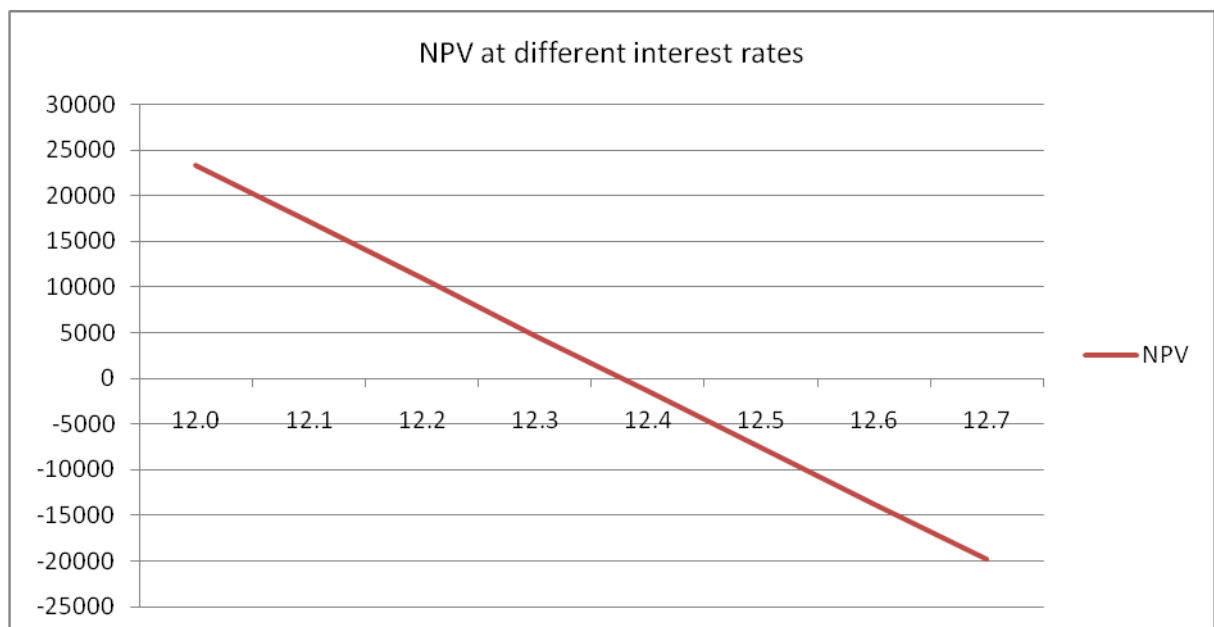
(3)

c)   The investment should be made since the NPV is positive and the IRR of 12,376% is greater than 12 percent, the cost of capital.   (1)

Question 16c.18 (Choosing between alternatives)

Sometimes engineers have to evaluate alternatives by means of time value of money analysis. Which one of the following two machines will you purchase? Assume that they are similar in terms of performance. Also assume a 10-year life for each machine, no salvage values and an interest/discount rate of 12%. The initial purchasing prices and annual maintenance costs follow: (5)

	Machine A	Machine B
Initial cost	R200 000	R150 000
Annual maintenance cost	R40 000	R50 000

Adapted from: Grisky, R.G., 1997, Chemical Engineering for Chemists, American Chemical Society: Washington DC, Chapter 8, Engineering Economics and Process Design, pp. 286 (example 8.1)

Answer 16c.18 (Choosing between alternatives)

<u>Proposed methodology</u>: take all costs to the same point in time (year 0 / beginning of year 1) and compare.

Use the following formula: PVA = A x PVIFA(i, n); where PVIFA(i, n) = $\left[\dfrac{(1+i)^n - 1}{i(1+i)^n} \right]$ to

calculate the present value of all maintenance costs.

PVIFA(i = 12%, n = 10) = $\left[\dfrac{(1+0,12)^{10} - 1}{0,12(1+0,12)^{10}} \right]$ = 5,65022 {2}

Present value of a machine's life cycle cost = PV of purchasing price + PV of all maintenance costs.

PV of machine A's life cycle cost = R200 000 + 5,6022 x R40 000 = R426 009 {1}

PV of machine B's life cycle cost = R150 000 + 5,6022 x R50 000 = R432 511 {1}

Choose machine A because its life cycle costs is lower. {1}

(5)

Question 16c.19

The following two pieces of equipment, A and B, both costs R10m and generate the same total net cash flow over a period of 5 years. Which one of the two will you select if the discount rate is 10%. Hint: Calculate the NPV for both cash flow streams.

Year	Equipment A Cash flow	Equipment B Cash flow
0	-10000000	-10000000
1	2000000	500000
2	2500000	1000000
3	3500000	3500000
4	3500000	5000000
5	3500000	5000000
	5000000	5000000

(Adapted from: SACMA, 2005, Surface Strip Coal Mining Handbook, p. 8-8)   (5)

Answer 16c.19

Year	Equipment A Cash flow	PV of CF Equipment A	Equipment B Cash flow	PV of CF Equipment B
0	-10000000	-10000000	-10000000	-10000000
1	2000000	1818182	500000	454545
2	2500000	2066116	1000000	826446
3	3500000	2629602	3500000	2629602
4	3500000	2390547	5000000	3415067
5	3500000	2173225	5000000	3104607
	5000000	1077671	5000000	430267

{4}

Option A is preferred because its NPV (R1,0777m) is greater than that of equipment B
(R0,4303m). Select A.   {1}

(5)

_ _ _ _ _

<u>Other questions (without answers)</u>

Question 16c.20

You are 24 years old, and an entrepreneur. You wish to provide for your old age. Imagine that
you invest R36 000 per year at an effective rate of return of 9% per year for the next 40
years, with the first deposit beginning one year hence. How much money will you have after
40 years?   (3)

Question 16c.21

Mr Saving deposits R100 in an account for 5 years. Calculate the interest earned on his investment, if he earns:

    i)   13% simple interest per year, or   {2}

    ii)   13% compound interest per year   {2}

                                                                    (4)

Question 16c.22

You want to buy an annuity that generates R18 700 per year for the next 23 years. How much must be invested today if the bank is prepared to pay interest at 10% p.a.? Payments are to accrue at the end of each year.   (4)

Question 16c.23

The following cash flow stream is estimated for an engineering project. Should your company invest in this project if the required discount rate for the project is 27%?

Initial investment (at the beginning of year 1):   R850 000

Cash inflow (at the end of year 1):   R200 000

Cash inflow (at the end of year 2):   R350 000

Cash inflow (at the end of year 3):   R450 000   (3)

Question 16c.24

Calculate the replacement cost of a piece of equipment in five years' time. The current cost of this equipment is R3 500 000 and the escalation rate is projected to be 6%. What uniform sum must be set aside each year if you want to establish a sinking fund that will retire this obligation in five (5) years' time? Your company receives an interest rate of 7% per year from the bank on money invested.   (4)

Question 16c.25

Mr and Mrs Khumalo plans to buy a house and stop renting. Their total take-home pay and household expenditure follows:

	Per month
Total take-home pay:	R18 600
Current rent paid:	R4 600
Food and clothing:	R2 600
Water and electricity:	R750
Short term insurance:	R700

Transportation:	R4 200
School fees:	R800
Entertainment:	R500

b)   Determine the maximum price of the house that they can afford today if interest rates are currently 12% per year. Assume that they will pay the bank monthly instalments over a period of 20 years. State all assumptions that you may make.   (4)

c)   How will the value of the house that the Khumalos can afford change if they buy a number of items on credit and consequently an amount of R2 400 per month is deducted from Mr Khumalo's salary as a result of a garnishee order that has been issued?   (3)
["…when an individual owes money but has for a source of income only a salary, a creditor might initiate garnishment proceedings. If the creditor is successful, a certain portion of the debtor's salary will be automatically sent to the creditor from each paycheck." (Source: http://legal-dictionary.thefreedictionary.com)]

[7]

Question 16c.26

Which amount is worth more at 8 per cent interest: R1 000 today or R2 000 after seven years?   (2)

Question 16c.27

The current production target for the five-year plan of Diggers Platinum Mining Company is to increase output by 6 % per year. If the 2005 production was 1,2 million oz of Platinum, what is the target for 2010?   (2)

Question 16c.28

At an interest rate of 7 per cent, how long does it take for a sum of money to double?   (3)
At an interest rate of 7 per cent, how long does it take for a sum of money to double when invested at this interest rate?   (3)

Question 16c.29

Television sets need to be recycled after 10 years of use. Kenwood televisions estimated that they will have to spend R650 per set on the rehabilitation of television sets and wants to make financial provision for that. Calculate the uniform series of equal payments at the end of each year for 10 years that are equivalent to a R650 payment 10 years from now, if the interest is 9 % per year compounded annually.   (4)
Source: TUT, June 2006

Question 16c.30 (Note: first do question 16.17, before you attempt this question)

A company has an opportunity to invest in a machine at a cost of R2 500 000. The net cash flows after taxes from the machine would be R700 000 per year and would continue for five years, after which the machine will be sold for R600000. The applicable cost of capital for this project is 12 per cent.

a) Calculate the net present value (NPV) for the investment. (5)

b) Calculate the internal rate of return (IRR) for the investment. (5)

c) Should the investment be made? (1)

[11]

Question 16c.31

A certain bank offers an interest rate of 9% per annum (year) compounded monthly. What is the effective annual rate of interest? (2)

Question 16c.32

An amount of R100 is invested for 5 years at an interest rate of 14% per annum. What is the future value of this investment at the end of the 5 years? (2)

Question 16c.33

You wish to invest a sum of money which will accumulate to R1 000 in 5 years time. How much must be invested today, if a rate of 15% per annum is obtained from a bank? (2)

Question 16c.34

Prepare a presentation with two to three graphs to illustrate time value of money to students. (6)

Question 16c.35

Complete the following table by calculating present value, future value, periods or interest rate for the missing cell on each line. (6)

Present value	Future value	Periods	Interest rate
R1 900	a) **************	5	10
b) **************	R2 500	4	12
R5 000	R10 000	c) **************	10
R5 000	R10 000	7	d) **************

Question 16c.36

Susan buys a house at a price of R500 000. She obtains a mortgage bond from XYZ Bank. Assume that Susan will be charged a fixed interest rate of 12% (Note: the 12% is an annual percentage rate or a 1% monthly rate.) Susan has 20 years to repay the loan.

a) Calculate the monthly payment (instalment) that Susan has to make to the bank. (3)

b) Three years later, Susan sells the house after paying 36 monthly instalments to the bank. She wants to cancel the 20-year loan that she obtained from the bank and settle the outstanding amount that she owes. Determine this amount (Call it Y). Susan did not pay much attention to the statements that she received from the bank over the 3-year period and is horrified when she discovers that she still owes the bank Y rand. She expected the amount to be a lot smaller. Explain to Susan why she still owes such a large sum of money to the bank. Make use of a graph. (6)

[9]

Question 16c.37

Suppose that a company has bought a new R300 000 machine and obtained a 4-year loan at 10 per cent interest from a bank to finance this. Complete the following table showing the loan repayment. Also check whether you agree with the annual payment of R94 641,24 (Show all calculations).

(End of) Year	Loan balance (at end of year)	Interest (per annum) on outstanding loan balance	Annual payment at the end of the year	Amortisation of loan (amount by which the loan amount is reduced)
0	R300 000			
1	R235 358,76	R30 000	R94 641,24	R64 641,24
2	**************	**************	R94 641,24	**************
3	**************	**************	R94 641,24	**************
4	**************	**************	R94 641,24	**************
Total		**************	**************	**************

Note: 'Year 0' is the same as the beginning of year 1. (9)

Question 16c.38

Use figure 16.6 (METS-3: 341) to explain the typical cash flow during the life of a factory, plant, mine, hospital or any other type of facility. (7)

Question 16c.39

Your municipality charges households 45c per kWh. By installing a solar geyser at an initial price of R7 000 you will save up to 250kWh of electrical energy per month. Determine the payback period (in months) of the solar geyser. Explain how the breakeven period will be affected by an increase in the price of electricity.

Question 16c.40

John received a 13th cheque of R7 000. He can use this money to buy a solar geyser that should last at least 15 years or he can save this money and earn interest at a rate of 9%. Advise John on whether he should select the solar-geyser option if that will save his household 3 000 kWh of electrical energy per year. John currently pays 45 c/kWh to the municipality. Base your advice on the net present value (NPV) technique. How will the NPV be affected if the price of electricity increases? (5)

Question 16c.41

A project is expected to generate the following cash flow stream:

Year	Cash flow
0	(1 500)
1	900
2	700
3	300

Calculate the NPV at discount rates 0%, 5%, 10% 15% and 20%. Plot a graph of NPV (y-axis) against discount rate. Is the project acceptable, if the company has a cost of capital of 12%? If so, what is the NPV?

Question 16c.42

A gold mine has an estimated life of 15 years. A capital project having a cost of R41,1m would reduce working costs by R0,75 per ton and increase recovered grade by 0,05 g/t. The milling rate is 120 000 tons per month. What gold price must prevail to give a return of 5% before tax?

Question 16c.43

A project with a capital cost of R100 000 is expected to generate profits of R20 000, R30 000, R40 000, R40 000 and R20 000 over its five year life. Tax will be payable at a rate of 40%. What is the NPV of the project at a discount rate of 10%?

Question 16c.44

Two investment opportunities are available to you. Project X is expected to pay R500 a year for the first 4 years, R300 per year for the next 8 years and nothing thereafter. Project Y is expected to pay R700 per year for 11 years and nothing thereafter. Risk considerations make appropriate an 8 percent yield for Project X, and a 10% yield for Project Y. Which project has the highest present value?

[Answer: PV of X = R2 923; PV of Y = 4 547 - highest. Project Y is riskier since a higher yield is required]

Question 16c.45

A close corporation (CC) is considering two mutually exclusive investments, each requiring an initial outlay of R50 000, with the following net cash flows:

Year:	Project A	Project B
1	R20 000	R30 000
2	R30 000	R20 000
3	R15 000	R15 000

The CCs cost of capital is 10%. Calculate the net present value of each project. Which project will you invest in if you could raise only R50 000 to invest in one of the two projects?

Question 16c.46

Your municipality charges households 55 c/kWh. You consider installing a photovoltaic system that will save your household 3 600 kWh of electrical energy per year. Such a system consists of batteries, an inverter, a charge regulator and photo voltaic modules. The whole system, **except** the batteries, will last 24 years and will cost R170 000. The batteries will have to be replaced every six years at a cost of R80 000. Do a net-present-value (NPV) calculation and determine whether such a project (that is installing the photovoltaic system) is economically viable or not. Use a discount rate of 9% per year.   (7)

Question 16c.47

The global economy used an average of 84,7m barrels of oil per day during 2006. Estimate how many barrels of oil will be used per day by 2014. Assume that oil demand will grow by 2% every year.   (2)

Question 16c.48

You have just borrowed R40 000, which must be repaid in 3 equal installments. The annual interest rate is 9,5%. What are the annual installments?   (3)

Question 16c.49

A person lends R100 000 at 9% simple interest for 4 years. At the end of this time the entire amount (principle + interest) is invested at 11% compounded annually for 10 years. How much will have accumulated at the end of the 14-year period?

Question 16c.50

Joe Smart is offered the alternative of receiving R40 000 today or R67 000 at the end of 10 years. If he accepts the 40 000 today, he will deposit it in a savings account. If the bank pays 5% interest (compounded), which alternative will Joe prefer?   (2)

Question 16c.51

You have to establish a sinking fund that will retire an outstanding obligation of R2 000 000 due in four years. What uniform sum must be set aside each year to accomplish this if money can be invested at a rate of 12%?   (3)

Question 16c.52

It is estimated that a quarry will have to spend R1 650 000 in 10 years' time on rehabilitation when it closes. Calculate the uniform series of equal payments that this quarry will have to make at the end of each year for a period of ten years in order to have saved up the R1 650 000 that is required for rehabilitation. An interest rate of 12% per year, compounded annually, applies.   (3)

Question 16c.53

Company XYZ Ltd estimates that two projects may consume and generate the following cash flow streams:

Year	Project A	Project B
0	(980 000)	(450 000)
1	320 000	80 000
2	360 000	120 000
3	300 000	200 000
4	260 000	70 000
5	220 000	60 000

a)   Calculate the net present value (NPV) for project A. Use a discount rate of 24%.   {3}

b)   Advise Company XYZ Ltd. on whether it should invest in project A (base your advice on the NPV calculation in question (a).   {1}

(4)

Question 16c.54

Predict the future price of a delivery truck. The current price is R150 000. What will the likely price be in five years' time if the price is likely to increase at an annual rate of 7%?   (2)

Question 16c.55 (Replacement decision)

You are required to evaluate whether the present manual control system of the flotation circuitry should be replaced with a centralised monitoring and control system. The present system employs 18 personnel per shift and a 3 shift per day cycle. The centralised process control system will employ 3 attendants, 1 instrument technician and an additional 2 operators at the central control room per shift. The capital cost of CCTV cameras monitors and process controls installed and commissioned is estimated to be R1 870 000. Use the following information and the NPV method to determine whether the old (manual) system must be replaced by the centralised control (CCTV) system:

- Manual control employees' cost per month = R6 500 each
- Process control attendants' cost per month = R8 500 each
- Control room operators' cost per month = R12 000 each
- Instrument technician's cost per month = R15 000
- Use a discount rate of 12 % per annum
- Assume that the centralised monitoring and control (CCTV) system has a life of 6 years.
- Assume that the centralised monitoring and control system is just as effective as the manual control system.

(7)

Question 16c.56

The estimated dividends of a JSE-listed company for the next 10 years are expected to be as follows:

Year	Cents / share
1	26
2	34
3	42
4	48
5	48
6	48
7	42

8	42
9	42
10	42

Calculate the present value of this flow of dividends. Use a discount rate of 9%. (5)

Question 16c.57

Use a weighted scoring model to choose between three mining projects (A, B and C). The ore reserves are in three different countries. Each country consumes only a small percentage of the product that they have in abundance. A score of 1 to 10 has been allocated to each project for each criterion in the table below. A weight has been allocated to each criterion by a panel of experts. The materials involved are bulky (e.g. iron ore or coal) and therefore transportation infrastructural capacity to a harbour for the export of the minerals is important.

Criterion	Weight	Project		
		A	B	C
Risk of mineral resource nationalism. A score of 1 indicates that there is a high probability that the ruling political party may implement policies such as mine nationalisation, indigenisation or windfall taxes.	0,3	7	2	5
Labour supply and productivity. A score of 10 means that experienced and skilled labour is available and that little labour unrest and disease impacts on labour productivity.	0,15	8	6	5
Transportation and other infrastructure. A score of 1 means that the country is land-locked and little rail, road and other infrastructural capacity exists for transport to the nearest harbour.	0,15	7	5	8
Financials. A score of 10 means that the quality of the ore body is such that good profit and return on investment can be realised if the above factors are not considered.	0,4	6	9	7

A score of 1 means high risk, least favourable return on investment or least favourable conditions and investment climate. A score of 10 means least risk, most favourable return on investment or most favourable conditions and investment climate. Determine in which project your company should invest. Motivate your answer and show all calculations. (8)

{Similar to Example 16.9, (METS-3: 340)}

Question 16c.58 (Mountain pass versus tunnel?)

You are employed as an engineering manager by a national roads agency that constructs new roads and maintains existing roads. The organisation is considering the replacement of 11km of an existing mountain pass by a 3,9km long tunnel. The tunnel will improve the safety of users and save them some time and fuel. Once constructed, a toll of R25 per vehicle will be implemented for the use of the tunnel. Assume the following:

- 3 million vehicles will use the tunnel per year.
- The cost of developing the tunnel is R120 000 per metre.
- The operating cost of the tunnel is R25 million per year (assume this will remain constant – ignore inflation)
- The cost of capital is 8% per year
- The useful life of the tunnel is 25 years

Do an NPV analysis to determine whether your employer should implement the tunnel-project or not. If implemented, the construction of the tunnel will take a number of months. For calculation purposes you may assume that the total development cost is incurred at the beginning of year 1 of the 25 year period that the tunnel will be in operation. (6)

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Section 16D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Examples (projects and answers)

Project 16D.1 [Financial valuation of a quarry – by means of a spreadsheet]
(Source: Financial Valuation, MINN7004, University of the Witwatersrand, April 2010)
You are considering the purchase of a small dimension stone quarry. The operation is a going concern, which can be purchased immediately for R85 million. You would then have to spend R65 million and R40 million in the first two years to recapitalise the quarry. (This is in escalated terms).
You estimate that the production will be as follows from the quarry:

Year	0	1	2	3	4	5	6
Tons (millions)		3	4	5	5	5	5

From the tons mined from the quarry, only 30% is recoverable. This quantity is then cut and polished, and this results in 80% of the recovered tons being saleable.

The sales price is estimated to be R400 per ton in year 1, rising by R10 per annum.

The mining cost is R40 per ton mined, the cutting and polishing cost is R10 per ton cut, and the distribution and marketing cost of the product is R120 per ton moved.

Operating costs are expected to inflate at 7%.

The real cost of capital is 5%, and the tax rate is 26%. Assume that capital (including the purchase price) is appropriated.

Using a Discounted Cashflow analysis, is this worth pursuing or not. Explain your answer.

(40 marks)

Suggested solution

Real cost of capital = 5%   Inflation (op cost): 7%
Nominal cost of capital: 1,05x1,07 - 1 =   0.1235

Year:	0	1	2	3	4	5	6		
Mined Tonnes (million)		3	4	5	5	5	5	Tax shi	
Capital Expenditure (Rm)	-85	-65	-40					0	
Recoverable tonnes (million)		0.9	1.2	1.5	1.5	1.5	1.5	1	
Saleable tonnes (million)		0.72	0.96	1.2	1.2	1.2	1.2	2	
Sales price (R/t)		400	410	420	430	440	450	3	
Mining cost (R/t)	40.00	42.80	45.80	49.00	52.43	56.10	60.03		
Cutting and polishing cost (R/t)	10	10.70	11.45	12.25	13.11	14.03	15.01		
Distr & Marketing Cost (R/t)	120	128.40	137.39	147.01	157.30	168.31	180.09		
Sales (Rm)		288	393.6	504	516	528	540		
Total costs (Rm)									
Mining (Rm)		128.400	183.184	245.009	262.159	280.510	300.146		
Cut & Pol (Rm)		9.630	13.739	18.376	19.662	21.038	22.511		
Dis & Mark (Rm)		92.448	131.892	176.406	188.755	201.967	216.105		
Total costs (Rm)		230.478	328.815	439.790	470.576	503.516	538.762		
Pre-tax profit (Rm)		57.522	64.785	64.210	45.424	24.484	1.238		
Taxable profit		0.000	0.000	0.000	41.941	24.484	1.238		
Tax (26%) Rm		0.000	0.000	0.000	10.905	6.366	0.322		
Cash inflow (Rm)	0	57.522	64.785	64.210	31.036	18.118	0.916		
Net CF (Rm)	-85	-7.478	24.785	64.210	31.036	18.118	0.916		
NPV (Rm)	R								

| | 3.31 |
| IRR (%) | 14% |

Other projects (without answers)

Project 16D.2 [Financial valuation of a gold project]

(Source: Financial Valuation, MINN4005, University of the Witwatersrand, Jan 2008)

a)   Calculate the Net Present Value (NPV) in R million for a small gold project called GoldMin with the following details. Use year-end convention and year 0 as the base year for calculations.

b)   If there is an alternative investment opportunity with the same capital requirements as GoldMin but with a NPV of R70 million, will you advise your company to invest in GoldMin? Support your answer using the calculated NPV value.

Information provided

Measured reserves (recoverable): 1 110 000oz

Annual production starting in year 3 (Refer to table below for more information on production)

Inflation rate (CPI): 5%

Both Rand price and Rand cost per oz will rise with inflation, adjusted for escalation.

Additional escalation for price per oz: 2%

Additional escalation for cost per oz: 3%

Nominal gold price at end of year 0: US$ 600/oz

Estimated operating costs at end of year 0: R3 500/oz

Exchange rate at end of year 0: R7,5:$1

Royalties will be paid at 5% of revenue.

Nominal development capital in year 1: R150 000 000

Nominal development capital in year 2: R120 000 000

Capital is depreciated using straight line depreciation over 3 years starting in the subsequent year after expenditure.

Debt/equity ratio: 60:40

Mortgage type loans will be used to finance the debt component of development capital. Repayment of loans starts in year 3 and will be done over 3 years. Interest is charged on the outstanding loan balance.

Nominal loan interest rate: 15%

Cost of equity funding: 20%

Corporate tax rate on taxable income: 30%

Table – production schedule

Year	3	4	5	6	7
Production (oz)	180 000	250 000	250 000	250 000	180 000

Notes

Work to 2 decimal places and report your cashflows in R million.

Development capital should be split as per debt:equity ratio.

Capex is redeemed in each year of expenditure and any unredeemed capex is carried over.

Project 16D.3 [(Economic) Feasibility study]

Conduct a feasibility study for a project that your company is considering. Your report should include a financial/economic evaluation of the project. The focus should be on that. **Do not report** extensively on the **technical** part of the feasibility study.

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Section 16E – Case studies
Case 16E.1 ()

Section 16F – Sources on the world wide web

- - - - End (Questions on Chapter 16) - - - -

Chapter 17, Business and Technology Strategy

Section 17 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

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Other True/False questions (without answers)

-

_ _ _ _ _ _

Section 17 B – Multiple choice questions

This section consists of multiple-choice questions. In your answer book, write down the number of the question, and next to it the number representing the correct option, for example '17.9 [1]'.

Examples (questions and answers)

17.1 Read the following three statements:
   a)   An organisation's vision usually states where an organisation wants to be in the future.
   b)   Unisa's vision is: "Towards the African university in the service of humanity"
   c)   The reason for an organisation's existence is usually described in its mission statement.

   Which of the above statements is/are **correct**?   (2)
   [1]   a, b and c
   [2]   b and c
   [3]   a and b
   [4]   b
   [5]   None of the options (1, 2, 3, or 4) is correct.

17.1 Answer: [1]; a) Correct. METS-2, p. 358; b) Correct; c) Correct. METS-2, p. 359

_ _ _ _ _ _

17.2 Strategic management is the process whereby managers:

   a) establish an organisation's long term direction.

   b) establish short term objectives

   c) implement chosen action plans.

Which of the above statements is/are **correct**? (2)

   [1] a, b and c

   [2] b and c

   [3] a and c

   [4] a and b

   [5] None of the options (1, 2, 3, or 4) is correct.

17.3 Which one of the following is not one of the five competitive forces in Porter's model for analysing an industry environment.

   [1] Competition between industries.

   [2] Threat of new entrants

   [3] Bargaining power of buyers

   [4] Threat of substitute products or services

   [5] Bargaining power of suppliers

17.4 Read the following three statements:

   a) One of the steps in the strategic management process is for an organisation to "select from possible alternative courses of action".

   b) A SWOT analysis is about analysing the strengths and weaknesses of an organisation and the opportunities and threats in the business environment in which the organisation operates.

   c) Some of the components of the external environment of a business follow: political and regulatory, social, economic, technological and ecological.

Which of the above statements is/are **correct**? (2)

   [1] a, b and c

   [2] b and c

   [3] a and c

   [4] a and b

   [5] None of the options (1, 2, 3, or 4) is correct.

_ _ _ _ _ _

Section 17 C – short and long questions

<u>Examples</u> (questions and answers)

-

_ _ _ _ _ _

<u>Other questions (without answers)</u>

Question 17c.1

List four critical tasks and responsibilities of strategic management. (4)

Question 17c.2 (Mission statement)

Define a 'mission statement' and discuss the reasons why an organisation should have a mission statement. (3)

Question 17c.3
Name the steps in the strategic management process (6)

Question 17c.4 (Vision statement)
List the four (4) benefits of management with vision (i.e. the reason why management should have a vision). (4)

Question 17c.5 (SWOT analysis)
   A. Briefly explain what a SWOT (strengths, weaknesses, opportunities and threats) analysis is and describe its purpose. (4)
   B. Discuss SWOT analysis as a planning tool (5)

Question 17c.6
List and very briefly describe 5 components of the external environment of a company. (6)

Question 17c.7 (also see chapter on marketing)
Explain the link between business strategy and technology strategy. Describe the elements of a technology strategy and explain how the "first-to-market" and "fast follower" strategies influence each of these technology strategy components. [10]

Question 17c.8

Differentiate between strategic planning and strategic thinking. (8)

Question 17c.9 (Porter's Five Forces Model)

a)   Briefly describe Porter's Five Forces Model for industry environment analysis. (6)

or

b)   List four of the five forces upon which the nature and intensity of competition in industry hinges. (4)
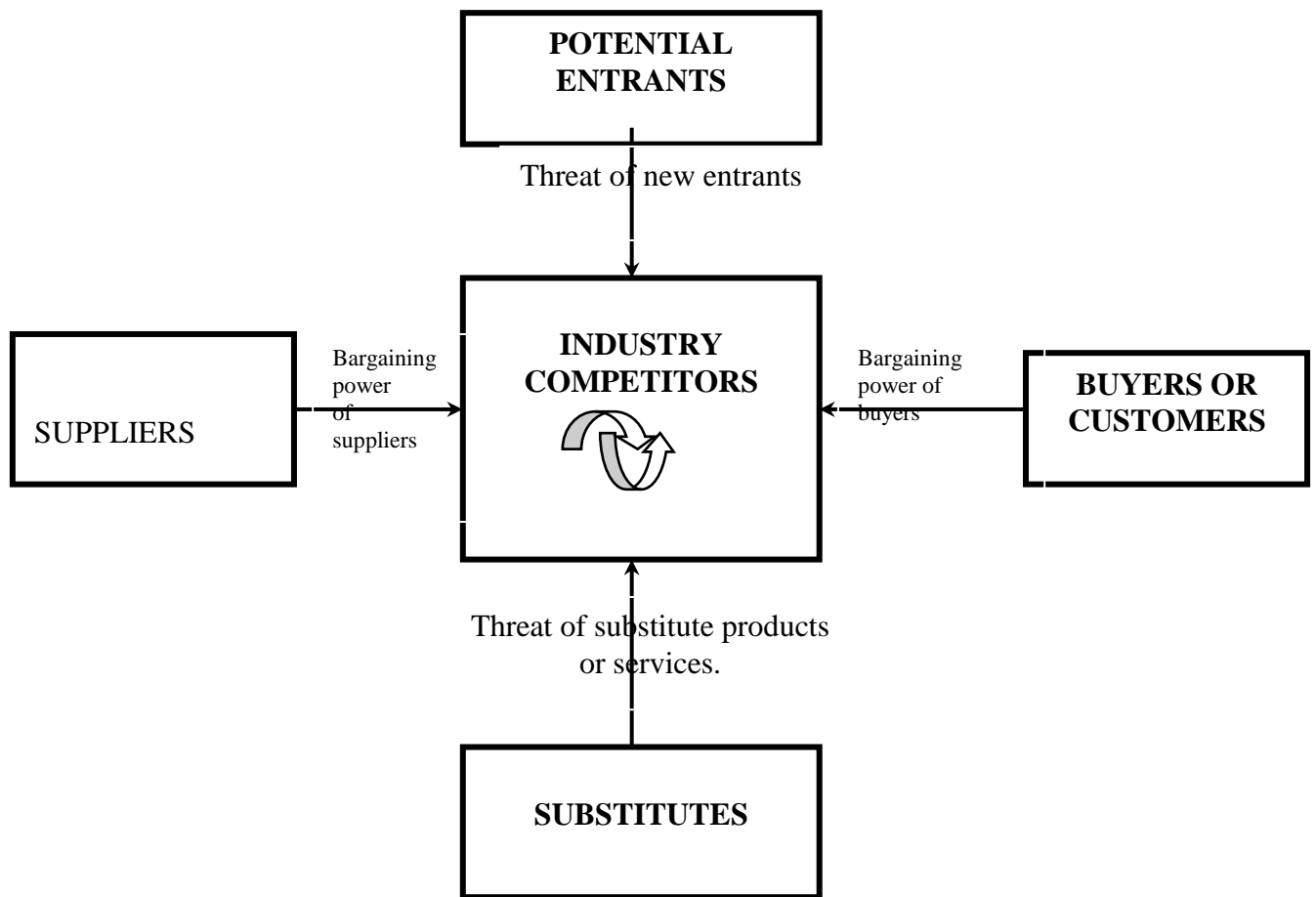
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Section 17D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 17D.1 [Industry analysis]

Do an extensive analysis of the current state of any industry of your choice. (Examples of "industries": gold mining industry, car industry, energy industry, pump [manufacturing] industry and manufacturing industry.) You must use Michael Porter's Five Forces Model in this analysis. This should ensure that part of your analysis is of a strategic nature. You may also use other tools and methodologies to do this analysis. You may also briefly refer to technological trends that impact on this industry if you want to refer to the technology strategies of different role players in this industry.

```
                        ┌─────────────────┐
                        │   POTENTIAL     │
                        │    ENTRANTS     │
                        └─────────────────┘
                                │
                        Threat of new entrants
                                │
                                ▼
┌─────────────┐        ┌─────────────────┐        ┌─────────────┐
│             │ Bargaining│   INDUSTRY    │ Bargaining│ BUYERS OR  │
│  SUPPLIERS  │─power of→ │  COMPETITORS  │←power of─│  CUSTOMERS  │
│             │ suppliers │               │  buyers  │             │
└─────────────┘        └─────────────────┘        └─────────────┘
                                ▲
                        Threat of substitute products
                                or services.
                                │
                        ┌─────────────────┐
                        │   SUBSTITUTES   │
                        └─────────────────┘
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Section 17E – Case studies

Case 17E.1 ()

Section 17F – Sources on the world wide web

- - - - End (Questions on Chapter 17) - - - -

Chapter 18, Managing Technology and Innovation

Section 18 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer where appropriate.

Examples (questions and answers)

18a.1 "Innovation" and "invention" are synonyms.

False. Innovation also involves the commercialisation of inventions. This is explained by the "innovation process". METS-2: 384

18a.2 Basic research is usually based on one of the natural sciences and entails studies that involve the understanding of how the laws of nature regulate the world around us.

True. Definition of basic research. METS-2: 384.

18a.3 Applied research is usually based on one of the natural sciences and entails studies that involve the understanding of how the laws of nature regulate the world around us.

False. This is the definition for basic research. METS-2: 384.

18a.4 An electrical rock drill (for hard rock) that replaces the pneumatic (compressed-air) rock drill is an example of a radical innovation.

True. The electric rock drill can be considered a radical innovation since it is powered by electricity whereas the pneumatic rock drill is powered by compressed air. If used in an underground mine, pneumatic rock drills require a compressor and network of piping throughout the mine to distribute the compressed air to various working places in the mine. METS-2: 385

18a.5 The invention and commercialisation of the manufacturing of materials with functionality at a nano-scale is an example of transformational innovation.

True. The functionality of some metals and alloys change at such a small scale which results in new applications which was not previously possible. METS-2: 385.

18a.6 The Windows operating system is an example of a dominant design in the personal computer (PC) operating system market.

True. The majority of PCs uses the Windows operating system. METS-2: 387

18a.7 The replacement of mechanical watches with quartz watches is an example of a technological discontinuity.

True. METS-2: 387.

18a.8 A technological discontinuity occurs when an old technology is replaced by a new dominant technology.

True. METS-2: 387.

18a.9 The replacement of passenger propeller-driven aircraft by jet engine-driven aircraft is an example of a technological discontinuity.

True. METS-2: 387

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Other True/False questions (without answers)

18a.10 The evolution of technology often follows the pattern of an S-curve.

18a.11 The improvement in performance of a new technology during the early stages is often slow because the fundamentals may be poorly understood.

18a.12 Dominant designs meet the needs of most users.

18a.13 As industries evolve, one would expect components to become more specific to a product. For example, the wheels of the first cars still looked much like those of wagons, but were changed later.

18a.14 As industries evolve, one would expect organisational structures to become more rigid and controlled.

18a.15 As industries evolve, one would expect competition to shift from being functionality based towards being price based.

18a.16 Companies that follow a first-to-market strategy have a temporary monopoly.

18a.17 The application of engines and power trains by Honda in various products such as motorcycles, lawnmowers, cars, snow equipment and electricity generators is an example of a core technology.

18a.18 A fast follower aims to achieve early market entry to the growth phase of the market by imitating the innovation of others.

18a.19 One method of sourcing (obtaining) technology is to buy out the essential personnel from a rival firm.

18a.20 Tasks that are unstructured, complex and dynamic are generally best performed in loose organisational structures.

18a.21 A champion is a team member in a technologically innovative company that provides the communication channel between members of the team, the rest of the organisation and other organisations.

18a.22 Motorcycle enthusiasts that modify standard models to obtain additional performance are examples of lead users.

18a.23 (Technology) portfolio balance is about the balance between high-risk and low-risk types of projects.

18a.24 The appropriability problem deals with the problem of how innovators can protect their innovations and enjoy the benefits of the money that can be generated from such intellectual property.

18a.25 Patenting is the only mechanism for protecting intellectual property.

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Section 18 B – Multiple choice questions

This section consists of multiple-choice questions. Write down the number of the question, and next to it the number representing the correct option, for example '18.1 [4]'.

Examples (questions and answers)

18B.1   Read the following four statements:

a)   "Innovation" and "invention" are synonyms.

b)   An electrical rockdrill that replaces the pneumatic (compressed-air) rockdrill is an example of a radical innovation.

c)   The Windows operating system is an example of a dominant design in the PC operating system market.

d)   Companies that follow a first-to-market strategy have a temporary monopoly.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   b, c and d

[3]   b and c

[4]   c and d

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 18.1: [2]

a)   False, (METS-2: 384; METS-3: 379)

b)   True, (METS-2: 385; METS-3: 381)

c)   True, (METS-2: 387; METS-3: 384)

d)   True, (METS-2: 390; METS-3: 387)

– – – – – –

Other MCQs (without answers)

18B.2   Read the following four statements:

a) The application of engines and power trains by Honda in various products such as motorcycles, lawnmowers, cars, snow equipment and electricity generators is an example of a core technology.

b) Tasks that are unstructured, complex and dynamic are generally best performed in loose organisational structures.

c) Motorcycle enthusiasts that modify standard models to obtain additional performance are examples of lead users.

d) The appropriability problem deals with the problem of how innovators can protect their innovations and enjoy the benefits of the money that can be generated from such intellectual property.

Which of the above statements is/are **correct**?   (2)

[1] a, b, c and d

[2] b, c and d

[3] b and c

[4] c and d

[5] None of the options (1, 2, 3, or 4) is correct.

18B.3   As industries evolve, one would expect …

a) components to become more specific to a product. For example, the wheels of the first cars still looked much like those of wagons, but were changed later.

b) organisational structures to become more rigid and controlled.

c) competition to shift from being functionality based towards being price based.

Which of the above statements is/are **correct**?   (2)

[1] a, b and c

[2] b and c

[3] a

[4] a and b

[5] a and c

18B.4   Read the following three statements:

a) The replacement of mechanical watches with quartz watches is an example of a technological discontinuity.

b) A technological discontinuity occurs when an old technology is replaced by a new dominant technology.

c) The replacement of passenger propeller-driven aircraft by jet engine-driven aircraft is an example of a technological discontinuity.

Which of the above statements is/are **correct**?   (2)

[1] a, b and c

[2] b and c

[3] a

[4] a and b

[5] a and c

18B.5   Read the following three statements:

a)   The evolution of technology often follows the pattern of an S-curve.

b)   The improvement in performance of a new technology during the early stages is often slow because the fundamentals may be poorly understood.

c)   Applied research is usually based on one of the natural sciences and involves studies that involve the understanding of how the laws of nature regulate the world around us.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   b and c

[3]   a

[4]   a and b

[5]   a and c

18B.6   Read the following three statements:

a)   Patenting is the only mechanism for protecting intellectual property.

b)   (Technology) portfolio balance is about the balance between high-risk and low-risk types of projects.

c)   Dominant designs meet the needs of most users.

Which of the above statements is/are **correct**?   (2)

[1]   a, b and c

[2]   b and c

[3]   b

[4]   c

[5]   a and c

18B.7   Which one of the following statements is **incorrect**?   (2)

[1]   In order to be adopted, technology must be compatible with the values, norms and experience of consumers.

[2]   A fast follower aims to achieve early market entry to the growth phase of the market by imitating the innovation of others.

[3] A champion is a team member in a technologically innovative company that provides the communication channel between members of the team, the rest of the organisation and other organisations.

Figure 1 - The top speeds of a number of aircraft have been plotted on the graph below.
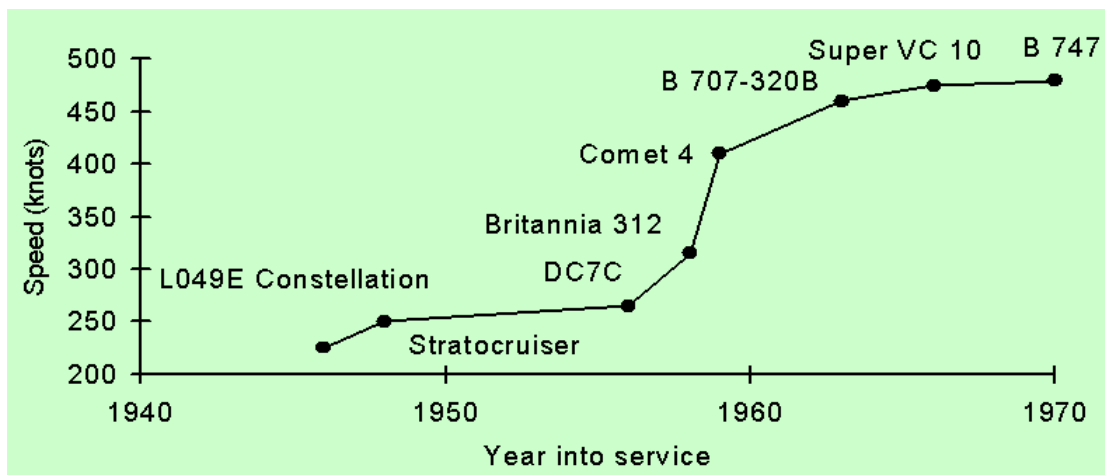
{Please note: 1 knot = 1,852 km/h; and Mach 1 is about 1 225 km/h at sea level.}

18B.8   Read the following three statements:
a)   Figure 1 is an example of a Foster S-curve.
b)   The physical constraint in this example is that of the speed of sound (Mach 1).
c)   The graph illustrates that engineering effort were invested in improving the speed of aircraft in the 1950s and 1960s.
d)   It took a while for engineers in the late 1940s and early 1950s to improve the speed of aircraft.
Which of the above statements is/are **correct**?   (2)
[1]   a, b and c
[2]   a, c and d
[3]   a, b, c and d
[4]   c and d
[5]   a and d

18B.9   Read the following three statements:
a)   Increasing the memory capacity of a flash memory stick from 4GB to 8GB is an example of radical innovation.
b)   Radical innovation usually makes the competencies in old technology obsolete.

c) Product innovation will result in an improved process.

Which of the above statements is/are **correct**? (2)

[1] a and c

[2] a and b

[3] a, b and c

[4] b and c

[5] b
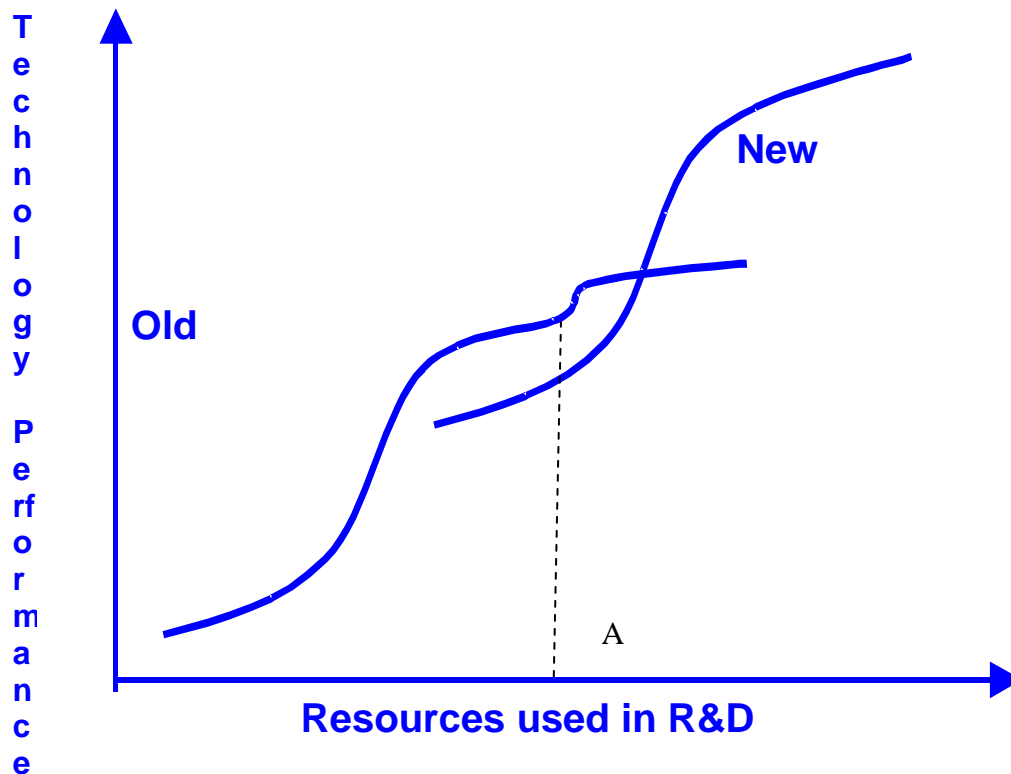
18B.10 Read the following three statements regarding the above figure:

a) The above are known as the Foster, S-curves of the old and new technologies.

b) "Time", measured in years for example, can be used as an x-axis variable in some curves of this nature instead of "resources used in R&D".

c) The old technology's performance is still superior at point A (compared to the new technology).

Which of the above statements is/are **correct**? (2)

[1] a and c

[2] a and b

[3] a, b and c

[4] b and c

[5] a

_ _ _ _ _ _

Section 18 C – short and long questions

Examples (questions and answers)

Question 18c.1

Differentiate between product innovation, process innovation and service innovation AND give examples of each type of innovation. Draw the following table in your answer book and fill in the missing information:

Innovation type	Function/Definition	Example
Incremental		
Radical		
Product		
Process		
Service		

(10)

Answer 18c.1

Suggested answer (not comprehensive):

Inno-vation type	Function / definition	Result / purpose	Examples
Incremental	Small improve-ments are made to a product or process	Extend the compe-tencies of the innovator	1) A flash memory stick with 16GB memory is introduced (previously the largest was 8GB) 2) A new car model is introduced that is slightly more energy efficient 3) an ice cream manufacturer changes the recipe of one of its products slightly.
Radical	Major improve-ments are made to a product	Normally make the compe-tencies in old techno-	1) Quartz watches replaced mechanical watches 2) Landlines versus (vs) cellular phones 3) Thermionic valves vs transistor radios 4) Replacing coal-fired power stations with nuclear power. 5) Replacing the theodolite with a total station (mine

	or process	logy obsolete	surveying) 6) Introduction of the continuous coal miner (replacing explosive coal breaking) 7) Introduction of tubeless tyres. 8) Computer with word processing software replacing type writers. 9) Introduction of an electric handheld hard rock drill as an alternative to the pneumatic rock drill. 10) Replacing analogue telecommunication networks with digital. 11) The development of the automatic gearbox as an alternative to the manual gearbox (radical?) 12) Replacing the old film cameras with a digital ones. 13) Substituting concrete headgears for steel headgears (Radical?)
Product	New or improved product	New or improved product.	1) New type of razor blade that is sharper and last longer. 2) new cellular phone that includes a camera. 3) A company introduces a new flavour of cool drink. 4) The introduction of airbags in cars. 5) The introduction of the data projector (It is a substitute for the overhead projector and white boards.) 6) Windows XP (replacing Vista and Windows 98 – is this also an example of incremental innovation?)
Process	New or improved process	New or improved process	1. Introduction of the carbon-in-pulp gold extraction process. 2. Introducing bio-leaching as an alternative for cyanide leaching. 3. Milk bottled by machine instead of by hand. 4. Using CAD instead of using a drawing board for doing engineering drawings. 5. Traditional vs mechanised mining. 6. The introduction of dryers in a process (to speed-up the process). 7. Introduction of statistical process control.
Service	New way	Better	1. Internet banking instead of over-the-counter banking.

of deliverin g service	service	2. Bank ATM machines that provide certain banking services. 3. Cellular phone banking. 4. The provisioning of water to a central point is replaced by the provisioning of water to each stand (house) 5. Trucking (road transportation) substituting railway transportation of certain goods. 6. Online shopping as an alternative to shopping at a shopping mall. 7. Email partially replacing the physical sending of letters via the postal services. 8. Unisa offering online registration to its students. 9. Wimpy and McDonalds offering drive-through fast service to its customers	

(10)

Question 18c.2

Briefly explain how a Foster "S-curve' is constructed. Explain why the evolution of technology may follow such a pattern. . You may use an example to explain your answer. You will earn one mark for including a graphical illustration. (4)

Answer 18c.2

METS-2, p. 387

Foster S-curve

'Technology performance' (e.g. number of transistors or microprocessor components per cm^2) is plotted on the y-axis and resources used in R&D (e.g. expenditure on R&D over time) is plotted on the x-axis.

Foster proposes that the performance of a particular technology increases at a very slow rate in its initial stages, much faster in later stages, and then slows again as that particular technology reaches its technical limits (microprocessor miniaturisation will eventually reach physical limits). At the beginning stages of a new technology, there may be many variations to that technology. Once the market has decided which variation satisfies the most needs, the dominant design will emerge and performance of that technology will increase rapidly. When newer technologies emerge (e.g. fuel cell car and/or hybrid electric vehicle), it may overtake the incumbent technology (e.g. traditional spark or compression ignition internal combustion engine-powered vehicle) and eventually replace it. This is called a discontinuity.

Towards the end of a technology's life there may not be that many opportunities left to improve its performance.

Evolution of clock speed - Intel microprocessors

Intel Microprocessor Transistor Density over Time

Source: Schilling MA, 2005, Strategic Management of Technological Innovation, Boston: McGraw-Hill, p. 42

Transistor density vs cumulative R&D expense
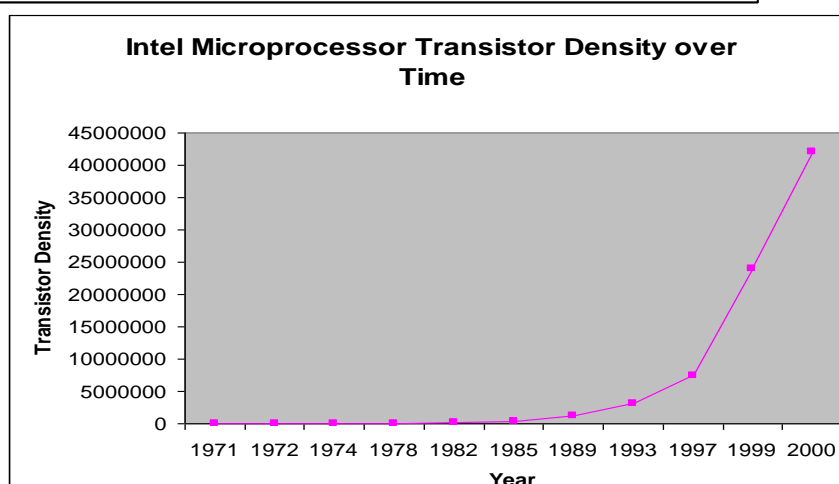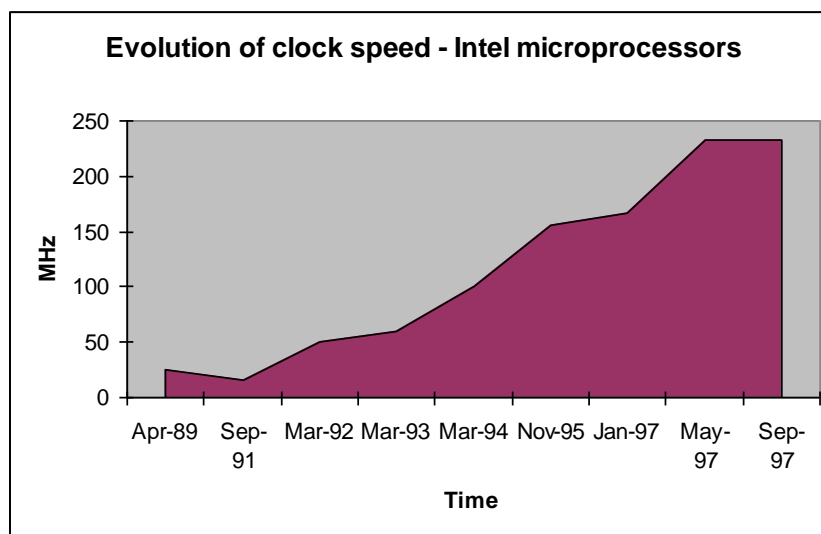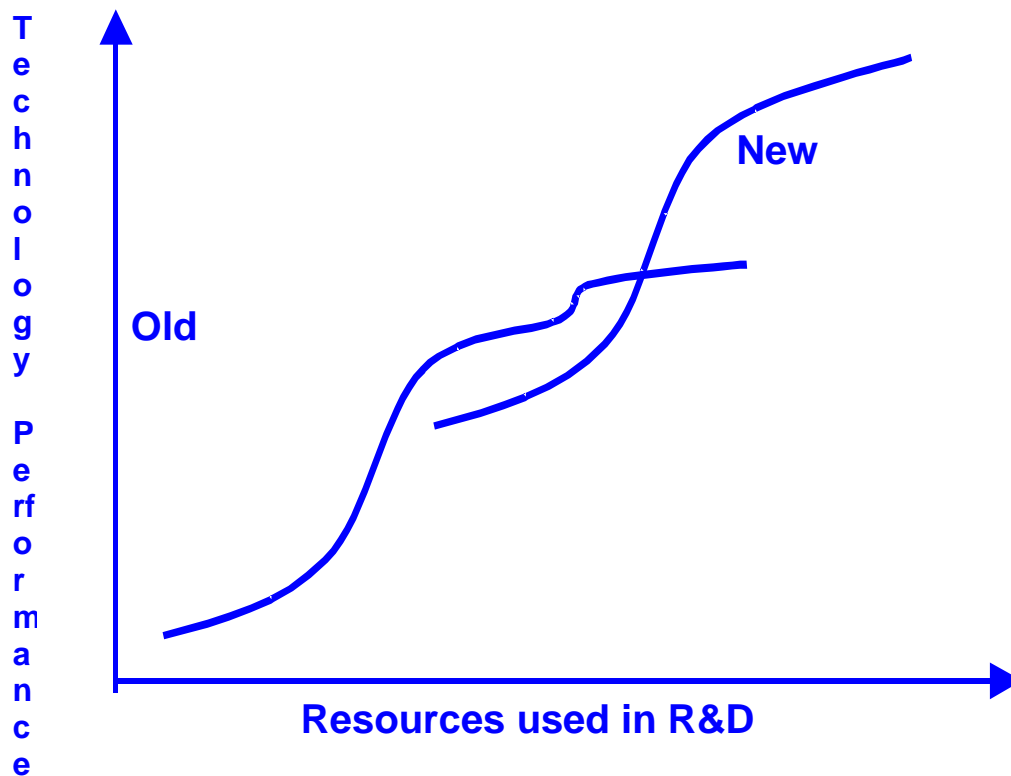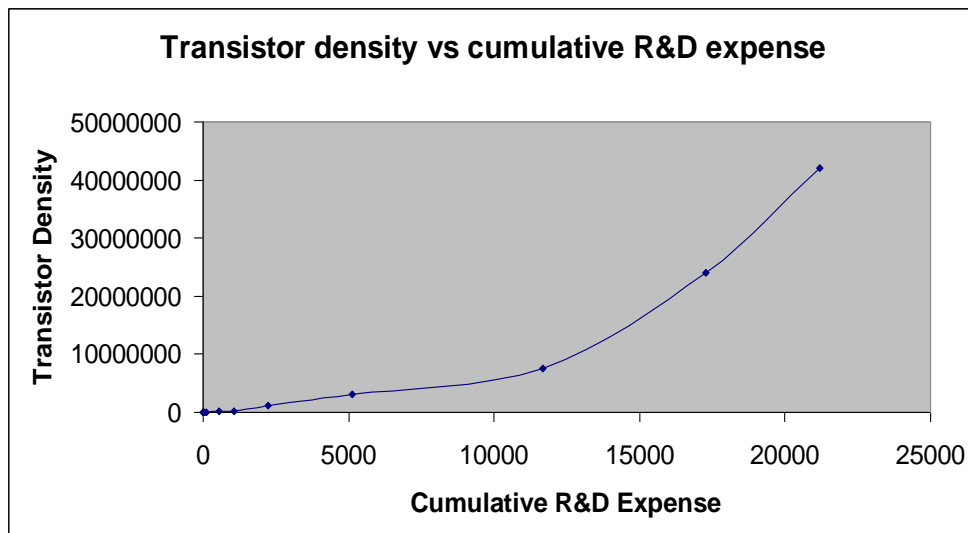
Source: Schilling MA, 2005, Strategic Management of Technological Innovation, Boston: McGraw-Hill, p. 43
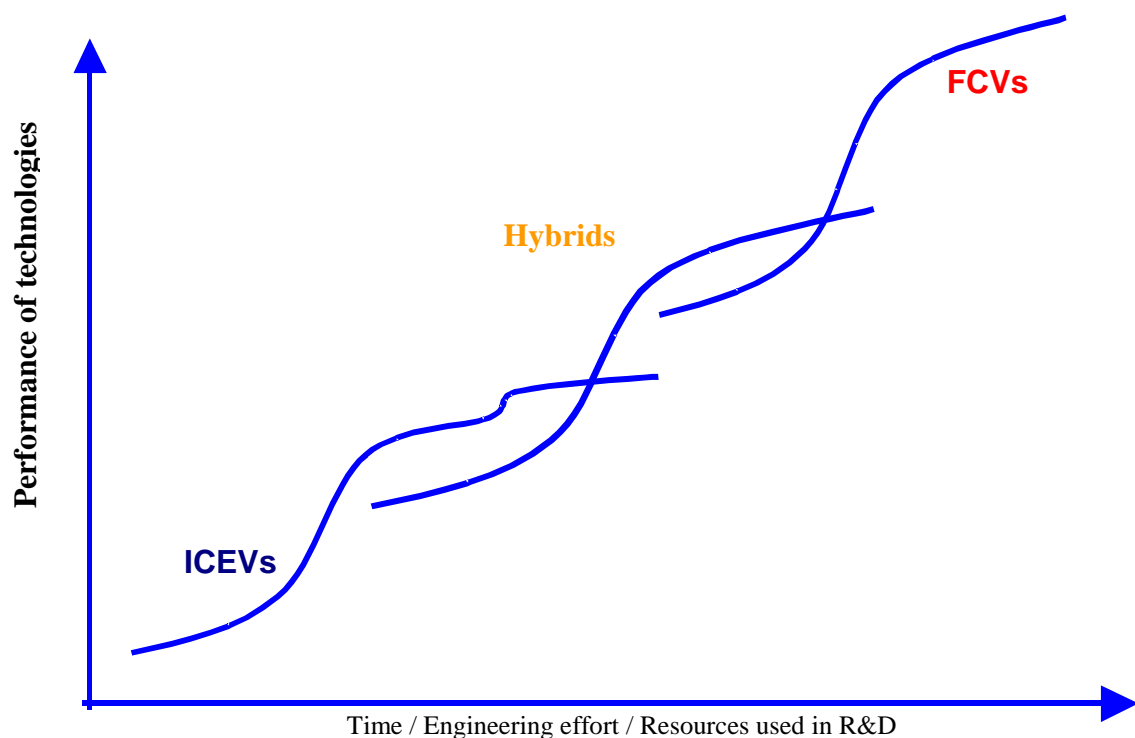
(Nel, W.P., 3-7 Oct 2004, The diffusion of fuel cell vehicles and its impact on the demand for platinum group metals: Research framework and initial results, International Platinum Conference, 'Platinum adding value', Sun City, South Africa, pp. 287-328, SAIMM Symposium Series S38 - http://www.platinum.org.za/Pt2004/Papers/287_Nel.pdf.)

Question 18c.3

As young industries mature, changes tend to take place in areas such as: manufacturing processes, components, nature of competition, organisational structures and industry structure. Compare young with mature industries in a table like the one below. Redraw the table in your answer book, and fill in the missing information. (10)

Evolution of …	When industry is young	When industry is mature
Manufacturing processes		
Components		
Nature of competition/Basis for competition		
Organisational structures		
Industry structure		

Answer 18c.3

How industries generally change

See METS-3: 386, 'Evolution of industries'. (10)

Evolution of …	When industry is young	When industry is mature
Manufacturing process	General tools	Specific tools
Components	Generic 'off-the-shelf' E.g. first car wheels were similar to wagon wheels.	Specific to product.
Nature of competition / Basis for competition	Basis for competition: Functionality of product (usually associated with a differentiation strategy). Level of competition is usually low.	Basis for competition: price (Cost leadership is important). Level of competition is high.
Organisational structures	Loose (team based) and flexible.	Rigid. Innovation sometimes takes place in separate units (skunk works).
Industry structure	Many small companies	Few (consolidated) giants

Remember that these are general guidelines. Exceptions do exist.

Question 18c.4

Study the graph below. What is a graph like this generally called? Explain why technology may generally evolve along the lines indicated below. The graph serves as an example of a technological discontinuity. Discuss the consequences of technological discontinuity for companies producing incandescent lamps.
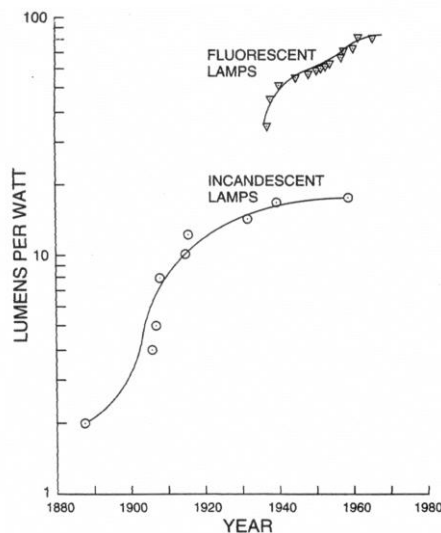
(Source: unknown)

Answer 18c.4

This is a Foster "S-curve' that plots one characteristic of two competing technologies against a time scale (in this case) or engineering effort over time.

Foster proposes that the performance of a particular technology increases at a very slow rate during its initial stages, much faster in later stages, and then slows again as that particular technology reaches its technical limits.

At the beginning stages of a new technology, there may be many variations to that technology. Once the market has decided which variation satisfies the most needs, the dominant design will emerge and performance of that technology will increase rapidly. When newer technologies (fluorescent lamps in this example) emerge, it may overtake the incumbent technology (incandescent lamps in this example) and eventually replace it. When this happens, it is known as a technological discontinuity. Towards the end of a technology's life there may not be that many opportunities left to improve its performance.

Such companies may be marginalised if the new technology dominates the old incumbent technology. Such companies may eventually disappear unless they embrace the new

technology and acquire the skills and competencies to compete in the new technology. Very few of the old companies that produced prop-driven aircraft survived the transition to jet-driven aircraft for example. In South Africa, the shortage of electricity is favouring lamps that are more (energy) efficient. Incandescent lamps may soon be replaced by compact fluorescent lamps. The increasing price of electricity may also favour more energy efficient technologies.

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Other short and long questions (without answers)

Question 18c.5

Briefly differentiate between innovation and invention.   (2)

Question 18c.6

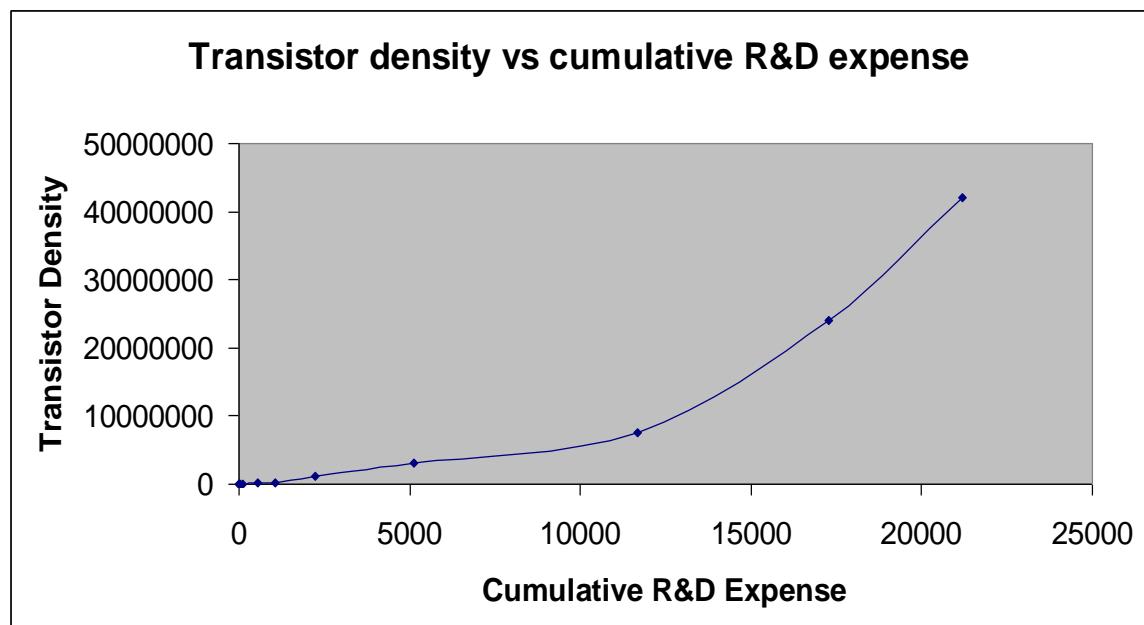Explain what your current employer, or another company that you are familiar with can do to improve innovation.   (6)

Question 18c.7 (Foster S-curves)

Study the graph below and answer the questions:

Transistor density vs cumulative R&D expense

i) What type of graph is this (in general)?   {1}

ii) Predict how this graph may continue in the future and explain why.   {2}

(3)

<u>Or</u>

Briefly explain how a Foster "S-curve' is constructed. Explain why the evolution of technology may follow such a pattern. (4)

Question 18c.8

Describe one area where innovation is required for the mining or energy industry (or a specific mining company) to grow or to survive. Some information/ideas can be obtained from:

- http://deepmine.csir.co.za
- Deep Sea exploration of oil – up to 3 km
- Further developments in mineral processing equipment
- Technology needed to reduce pollution
- Better exploration techniques
- Improved underground communication and information gathering

Question 18c.9

Give an example of a technological discontinuity and illustrate its consequences for established companies. (3)

Question 18c.10

Match each one of the following critical roles in a technologically innovative company with the appropriate description thereof. In your answer book, write down the number of each term, and next to it the letter representing the correct option, for example, "1. f". (6)

1. Idea generator	a. A person who promotes an idea enthusiastically.
2. Champion	b. A person who provides the communication channel between members of the team, the rest of the organisation and other organisations.
3. Project leader	c. A creative person who is generally an expert in his/her field and enjoys solving problems.
4. Gatekeeper	d. A senior person who can guide a project through organisational politics.
5. Sponsor	e. A pragmatist who focuses on planning and making decisions to get the job done.

Question 18c.11

The top speeds of a number of aircraft have been plotted on the graph below. What are such graphs generally called? Explain why the evolution of technology may generally follow such a pattern. Also explain the shape of the pattern for this specific example. (5)

{Please note: 1 knot = 1,852 km/h; and Mach 1 is about 1 225 km/h at sea level.}
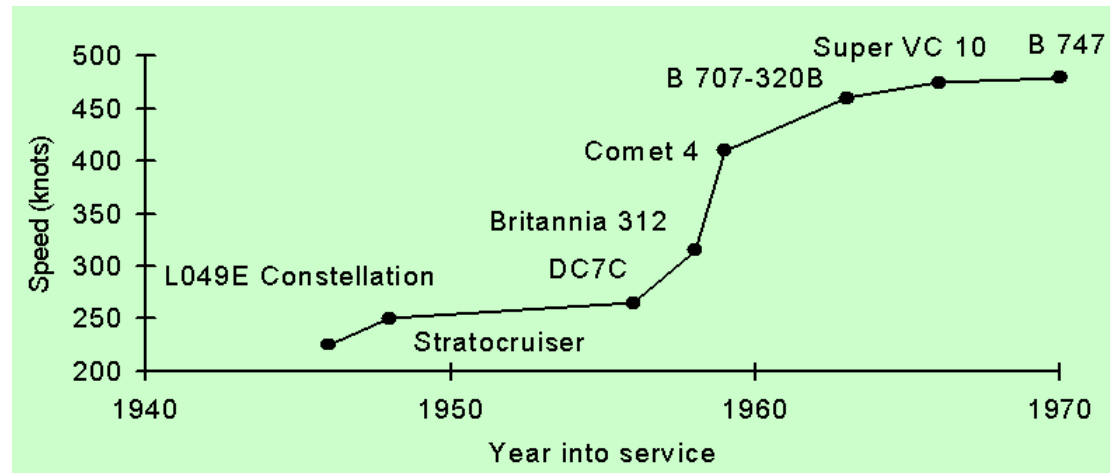
(Source: unknown)

Question 18c.12

Give an example of a fast-follower technology strategy. (2)

Question 18c.13

List four methods of sourcing (obtaining) technology and briefly evaluate each method. (8)

Question 18c.14 (Innovative organisational environment)

List ten organisational factors that support the creation and maintenance of an innovative organisational environment. (10)

Or

You are the manager of the research and development department at an organisation. Briefly explain how you would create and maintain an innovative environment for your subordinates to work in. (5)

Question 18c.15

List five sources of idea generation when developing a new product. (5)

Question 18c.16

Define technology management. (2)

Question 18c.17 (Innovation cycle)

List and briefly describe the components of the innovation cycle.

Or

Describe the (linear) process of innovation - from the point of basic research to where a new product or service is successfully introduced in the market.

Or

Choose an appropriate example of an innovation [for example 1) E-commerce via the Internet or 2) Nano-technology*] and demonstrates the innovation cycle by means of the development of this example of innovation from basic research to the successful introduction of the product or service in the market. (10)

* The word nano-technology was used for the first time in 1974 by Taniquchi in a paper (Source: A Short History of Nanotechnology – https://www.foresight.org/nano/history.html)

Question 18c.18

Differentiate between product innovation, process innovation and service innovation AND give examples of each type of innovation. (6)

Question 18c.19

A number of car manufacturers have built concept fuel-cell cars. Small numbers of fuel-cell powered cars may be on the roads within the next few years. According to Ford's Group Vice-President of Global Product Development and Quality, it may take at least a decade before fuel-cell cars will become viable for a larger percentage of customers. (http://www.sae.org/automag/features/fordfc/index.htm).

Apply your knowledge of the requirements of a new product and your knowledge of the factors that assist the diffusion of a new technology in the market place to specify some characteristics that such a car will need so that it can compete with traditional (internal combustion engine) cars. You may include supporting infrastructure such as fuel distribution in your analysis. (6)

Question 18c.20

Match each of the following terms on the left of the table with its correct definition, description or example on the right of the table below. In your answer book, write down the number of each term, and next to it the letter representing the correct option, e.g. 1. a. (5)

1. Basic reasearch	a. Usually involves the understanding of how the laws of nature regulate the world around us.
2. Incremental product innovation	b. Meets most of the users' needs.
3. Dominant design	c. Automatic teller machines (ATMs) replacing some human tellers at banks.
4. Service innovation	d. Small improvements are made.
5. Core competency	e. This can be protected by means of patents, copyright, registered designs and trademarks.
6. Intellectual property	f. Knowledge, patents and skills regarding engines and power trains can help a company to produce various products (e.g. automobiles, motorcycles, lawnmowers, snow equipment and electricity generators) where that can be used.

Question 18c.21

Briefly discuss any five of the following six aspects of technology strategy listed below: (10)

- Timing of market entry
- Technology portfolio
- Level of expertise in each technology
- Sourcing of technology
- Level of investment in R&D
- Organisation policies and practices supporting a work environment that encourages innovation

Question 18c.22

List and discuss a number of (statutory and non-statutory) mechanisms that a firm (or individual) can use for protecting intellectual property. (12)

Question 18c.23

Discuss (technology) portfolio management by referring to strategic alignment, portfolio balance and resource requirements. (6)

Question 18c.24

Briefly explain why technological innovation is important for businesses and the economy? (5)

Question 18c.25

Explain why the model T Ford has become a collector's item. Why it is no longer bought and used by most car owners. (1)

The model T Ford

Question 18c.26

In a competitive business environment where new products and services constantly have to be developed and introduced to the market, it is important for employees to work fast, especially if they want to be and stay the market leader. In such a work environment employees will often be forgiven for making mistakes and they are expected to learn and develop themselves continuously. The culture in such a work environment is characterised by various mottos and slogans, for example:

"Innovate or evaporate" (Haour, 2004: 1)

"Move fast and break things" Facebook's Mark Zuckerberg

"Done is better than perfect" Facebook's Mark Zuckerberg

Source:

http://www.freemake.com/blog/mark-zuckerberg-quotes-8-remarkable-sayings-of-facebook-ceo/

Required:

   a) Briefly add to the characteristics (already mentioned) of the fast-moving, very competitive and innovative business environment. (4)

b) Do you think this culture (that is to be found among Silicon Valley companies) is also applicable to the motor industry where the safety of a car is an important characteristic or the producers of devices and components used in mine hoisting systems or the construction industry? (2)
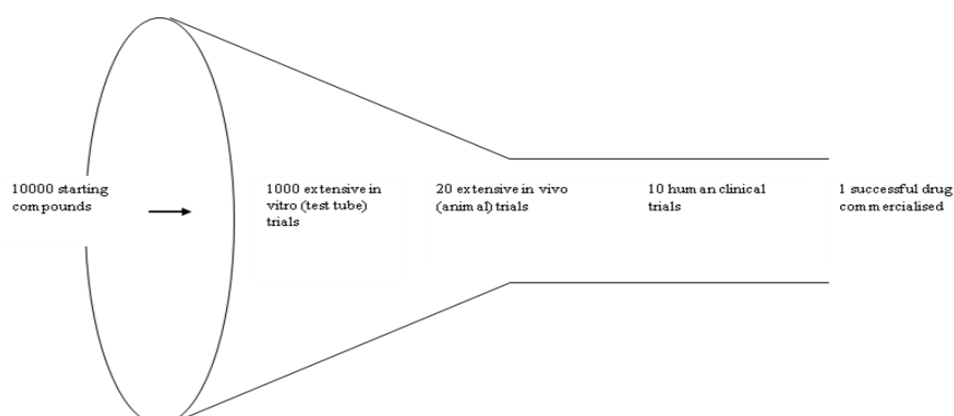
[6]

– – – – – – – – – – – – – – – – – – –

Section 18D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 18D.1 [Management of Innovation at a specific organisation or industry]

Write a report on the management of innovation at an organisation that you know well. You may refer to one or more of the following aspects related to the management of innovation:

- How does the company generate or obtain new ideas, innovation and technology? (Does it buy it, develop it [through its own RD&D], or obtain it from collaborative networks and joint venture partners? See fig 17.5, METS-2:380)
- Provide a short description of some of the projects/innovations in this organisation's "innovation funnel". (See example of the innovation funnel for the pharmaceutical industry below.)

10000 starting compounds → 1000 extensive in vitro (test tube) trials | 20 extensive in vivo (animal) trials | 10 human clinical trials | 1 successful drug commercialised

- Describe the management of the technology/innovation portfolio.
- Identify the core technologies of this organisation.
- Describe the management of organisational structure, creativity and talent – creating the right organisational climate for innovation

- How are the necessary capacity for technical competencies/capabilities for innovation developed?
- How is the translation from creativity to innovation managed?
- How are the collaborative networks (eg strategic alliances, JV partners, licensing arrangements, outsourcing of production, etc) managed?
- How is the timing of market entry managed?
- What is the technology strategy of this organisation?
- Which distinctive technological competences and capabilities are necessary to establish and maintain competitive advantage?
- Which technologies should be used to implement core product design concepts and how should these technologies be embodied in products?
- What should the investment level in technology development be?
- How should various technologies be sourced: internally or externally?
- When and how should new technology be introduced to the market?
- How should technology and innovation be organised and managed?
- How are innovation projects selected (or chosen) by this organisation?
- How does this organisation protect its intellectual capital/property (patents, trademarks, copyrights, keeping it secret)?
- How is the management of new product development and teams executed?
- Is this organisation benefitting optimally from its intellectual property?
- What is this organisation's capacity to do technology forecasting?
- Benchmark this organisation's competencies and technologies against that of its competitors.
- Scanning the environment and. Does this organisation scan the environment for new technologies that are in the process of being developed elsewhere and what is their absorptive capacity?
- Does it have the capacity to evaluate the impact of such technologies on its core business processes and future competitive environment?

Project 18D.2 [New product development]

The purpose of innovation is to develop new products, services or processes. This mini-project will therefore contain many of the elements in question 18D.1

The development of new products and services that are well received by the market can do wonders for a company. Just think of how Apple's share price improved under Mr Steve Jobs'

leadership since 1997. Since then Apple developed the iMac, iPod, iPad, MacBook Pro, new iMac with Intel processors, iPhone and opened the online iTunes store and App Store.

Describe the new product development process at your company or a company that you are familiar with. Alternatively you may write a case study on the development of a specific product, service or process. Remember that the focus should not be on technical aspects (e.g. how the product works) but on the commercialisation thereof – the whole process of taking the new invention to the market and making money from it.

Good examples of products that you may write such a case study on follow:
1. Detnet's products – See http://www.electronicinitiation.com
2. The Xmplar-dr, Digital X-ray Scanner. More information is available at http://www.engineeringnews.co.za/article/sa-company-designing-manufacturing-unrivalled-digital-x-ray-scanner-2013-07-04 .

Project 18D.3 [Managing a specific innovation]
Select an innovation and describe the influence of this innovation on the industry or relevant company(ies). A list of examples follow:

- The development of the Hilti electric (hard) rock drill

- Sasol's gas to liquids (GTL) and Coal to liquids (CTL) processes:
  - Petrol from coal processes – see http://www.sasol.com/sasolprocesses/
  - Diesel from natural gas – see http://www.sasol.com/sasolprocesses/

- Mintek's miniature process as applied at Harmony Gold

- The Joint Venture (JV) between AngloGold Ashanti and De Beers to use marine mining technology to explore for and mine marine deposits off the continental shelf. (See: Faurie J, 30 October 2009, Miners eye sea as land resources diminish, *Mining Weekly Online -* http://www.miningweekly.com)

- MineCorex and Midrex processes, Saldanha Steel

- Billiton's (Gencor) bio-technological processes

- The possibility of using DebTech's (research and development arm of De Beers) full body scanning technology (originally developed to detect diamonds on miners) at airports. (See: Pringle C, 5 Jan 2010, De Beers scanning technology could be used at airports. *Engineering News Online -* http://www.engineeringnews.co.za)

- Sasol Coal's adaptation of a standard oil drilling technique to obtain better geological information in coalfields – see *SA Mining, Coal, Gold & Base Minerals*, October 1992, p.15

Explain whether this innovation provides the company with a competitive advantage over its competitors or not. Explain the advantages and disadvantages of being the first to market with an invention. Describe the process the company has to go through from having an idea to the point where it is successfully introduced into the market. In other words, you must explain the innovation process by referring to relevant theory and use at least one innovation model to explain the innovation process at this company. You may also include some of the issues mentioned in 18D.2. If possible choose a relevant innovation (eg minerals industry related innovation if you are are enrolled for a programme in mining engineering).

If you selected an innovation that has not yet been commercialised (taken to the market), then determine the following:
- Technical/technology feasibility: How soon will the technology be ready for the market?
- Economic viability: Will the investment in R&D be recouped?

Project 18D.4 [Technology audit]
Do a technology audit on an organisation that you have access to. Identify the core competencies/technologies of this organisation.

Project 18D.5 [Technology forecasting]
Briefly describe one or more of the following technology forecasting techniques and then apply it to one or more technologies/technological innovations. The emphasis should be on application.

- Expert judgement
- Delphi technique
- Trend extrapolation
- Normative forecasting
- Forecasting by monitoring
- Dynamic modelling
- Scenarios
- Learning curve/experience curve

Project 18D.6 [Patenting and the management of intellectual property]

Produce a report that will tell an inventor exactly what procedure to follow when registering a patent in South Africa (or any other country of your choice). You must also explain the potential advantages and disadvantages of patents from both the perspective of patent holders and society in general. You must explain the following in your report:

- What can be patented?
- What are the advantages and possible disadvantages of patenting? What is patent trolling?
- What protection will patenting in a specific country provide to the inventor?

The document must include details such as where patents must be registered (address), costs and requirements of the patent office. You should earn higher marks if you interviewed at least one person or representative of a company who is benefitting from a patent and another individual or representative from a company who is disadvantaged by existing patents.

Project 18D.7 [Innovation trajectory – technology S-curve]

Draw an S-curve (or curves) for a product or technology for which you can obtain the data. You must attach the data to your assignment and analyse the S-curve that you obtained. For example, give reasons for the shape of the S-curve. You should preferably provide your data in spread sheet format (eg Microsoft Excel) and use the graphics facilities of the software application to draw the S-curve. Attach as much information as possible to your assignment (preferably in electronic format). Possible examples of S-curves follow (this is just to give you a better idea of what is required):

- Drilling rate (eg metres per minute) of underground hard rock drilling machines on the vertical axis versus time and/or engineering effort on the horizontal axis. What will the S-curves for two different technologies (air-driven machines and hydro-powered machines) tell us in this case?

- Power produced by a 1500cc internal combustion (car) engine on the vertical axis versus time and/or engineering effort on the horizontal axis.

- The number of transistors that can be placed per cm^2 of silicon wafer on the vertical axis versus time and/or engineering effort on the horizontal axis.

- Laser or ink-jet printer speed (measured in characters or pixels per second) on the vertical axis versus time and/or engineering effort on the horizontal axis. What will the S-curves for two different technologies (laser and ink-jet) tell us in this case?

You can obtain more information on S-curves from a number of books, including the following readings in Burgelman, RA, Maidique, MA & Wheelwright, SC. 2000. *Strategic management of technology and innovation*. 3rd edition. Boston: McGraw-Hill/Irwin:

- Reading II-4A (pp 124–142): Christensen, CM. 1992. Exploring the technology S-curve. Part I: component technologies.

- Reading II-4B (pp 142–149): Christensen, CM. 1992. Exploring the technology S-curve. Part II: architectural technologies.

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Section 18E – Case studies

Case 18E.1 (Advent Corporation)

The following questions are based on the Advent Corporation case study written by R.S. Rosenbloom (Harvard Business School Case 9-674-027)).

You will find this case in the following book:
Burgelman, R.A., Christensen, C.M. & Wheelwright, S.C. 2009, 5th ed. Strategic Management of Technology and Innovation, McGraw-Hill, Case I-2, pp. 49-62

Note: This case study is about a small company called Advent Corporation and its owner, Mr Kloss, in the 1970s.

1. Describe Advent's strengths and weaknesses. Describe its initial business and technology strategy. Explain whether Advent has a "first-to-market" or "fast follower" marketing strategy and how that impacts on its technology strategy. (12)

2. Discuss the value chain of Advent and indicate which skills, capabilities and technologies are used in it. (6)

3. The following organisational factors support the creation and maintenance of an innovative organisational environment:

- Vision, leadership and will to innovate
- Appropriate structure
- Key individuals
- Effective teamwork
- Innovative climate
- Learning organisation
- Customer focus

Describe Kloss' general management task of exploiting Advent's capacity for innovation. Use the above factors to evaluate Kloss' role as a general manager. (10)

4. The process of innovation can be described by various models. According to the linear model, the innovation process consists of the following steps:

- Basic research
- Applied research
- Product idea generation
- Product and/or process development
- Market entry

Use the above model to describe the innovation process at Advent and the role of Kloss. (6)

5. The paper by Madique and Hayes, "The Art of High-Technology Management", refers to factors that make high-tech companies successful. Use this reading and other frameworks to explain what Kloss could still do to improve innovation at Advent. (4)

6. What resources are required to develop the full screen television? (4)

7. What options are available to Kloss? Describe the pros and cons of each option and make a recommendation on what Advent should do. You must incorporate the technology portfolio model in your answer. (8)

Additional sources of information:

Madique, M.A. & Hayes, R.H., 1984 The Art of High Technology Management, Sloan
   Management Review 25 (Winter 1984), pp. 18-31

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Case 18E.2 (Eli Lilly and Company: Drug Development Strategy)

The following questions are based on the Eli Lilly case study written by S. Thomke, A.
Nimgade & P. Pospisil (Copyright: Harvard College).

You will find this case in the following book:

Burgelman, R.A., Christensen, C.M. & Wheelwright, S.C. 2009, 5th ed. Strategic
Management of Technology and Innovation, McGraw-Hill, Case II-8, pp. 470-485

1.   Discuss Eli Lilly's technology strategy. You may want to refer to the following:

- timing of market entry;
- technology portfolio;
- level of expertise in each technology;
- sourcing of technology;
- level of investment in Research and Development; and
- organisational policies and practices.   (15)

2.   Describe some of the competitive challenges that pharmaceutical companies face in the
1990s (and beyond). What are the resulting implications for the new drug development
process?   (6)

3.   Technology strategy involves choices between alternative technologies. Briefly describe
how combinatorial chemistry is changing the drug discovery process. How does it affect
the roles of experience and experimentation? What are its risks? How does
combinatorial chemistry affect the different stakeholders in the development process
(e.g. traditional chemists, research scientists, middle and senior management)?   (8)

[29]

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Case 18E.3 (Intel Corporation (D): Microprocessors at the Crossroads)

The following questions are based on the Intel Corporation case study written by D. Steer & R.A. Burgelmann.

You will find this case in the following book:

Burgelman, R.A., Madique, M.A. & Wheelwright, S.C. 1996, 2nd ed. Strategic Management of Technology and Innovation, McGraw-Hill, Case II-15, pp. 455-478

Case II-15 (pp.455-478), Intel Corporation: Microprocessors at the crossroads

1. In what phase of the industry life cycle (ILC) is the CISC technology? What would you say is the reason why the financial characteristics in that specific ILC phase are different from the usual reasons? Why should or shouldn't Intel proactively propose RISC technology as the new architecture to power Personal Computers? Use the industry life cycle model to explain your answer. (10)

2. Intel faces a challenge from RISC and from within the x86 architecture. Discuss both challenges critically to determine where the greatest threat to Intel lies. What other threats is Intel also facing? (8)

3. Discuss Intel's strategy with the original equipment manufacturers (OEMs) and their relationships with end-users. Which of these two groups does Intel seem to view as its key customers? How should Intel react towards these interest groups? What is the role of the corporate marketing group? What is Intel's marketing strategy? How well is it integrated with the technology strategy? How well is it integrated with the micro-processor business strategy? (9)

4. How important is Microsoft for Intel's microprocessor business strategy? Why? What is the role of software in Intel's microprocessor business strategy? (6)

5. How important is manufacturing capability and know-how in Intel's technology strategy for microprocessors? Explain your answer. (4)

6. Suppose you were AMD. How would you feel about Intel? Why? What would you try to do? How would you do it? (5)

7. What should Intel's competitive strategy for its older microprocessor generations be? Why? (4)

8. How dependent is Intel's corporate strategy on microprocessors? What should it do about that? (4)

[50]

Section 18F – Sources on the world wide web

<u>18F.1</u> Do a google search to obtain information on "What can be patented".

<u>18F.2</u> How did Robert William Kearns get the idea of an intermittent windshield wiper system? How did his patent of this system protect his intellectual property? What was his patent infringement case against Ford Motor Company all about? Do you think Kearns' innovation is novel / original / new?

<u>18F.3</u> Read: "Why patents are still central to innovation, whatever Tesla does". Available online at http://www.polity.org.za/article/why-patents-are-still-central-to-innovation-whatever-tesla-does-2014-06-23

<u>18F.4</u> Listen to this audio clip about "Patent trolling" at http://www.thisamericanlife.org/play_full.php?play=441

<u>18F.5</u> Find some information about the "New Product Development Process".

- - - - End (Questions on Chapter 18) - - - -

Chapter 19, An Overview of Environmental Management and Sustainable Development Concepts for Management Practices

Section 19 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down 'true' or 'false' and provide a brief explanation for your answer.

Examples (questions and answers)

-

Other True/False questions (without answers)

-

_ _ _ _ _ _

Section 19 B – Multiple choice questions

This section consists of multiple-choice questions. Write down the number of the question, and next to it the number representing the correct option, for example '19.9 [4]'.

Examples (questions and answers)

19.1 Read the following three statements:
   a) Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
   b) Past directors of companies may be held liable if their companies polluted or degraded the environment.
   c) Companies tend to place an increasing emphasis on corporate social responsibility.
   Which of the above statements is/are **correct**?   (1)
   [1]   a
   [2]   a and b
   [3]   a, b and c
   [4]   a and c
   [5]   None of the options (1, 2, 3, or 4) is correct.

19.1 Answer: [3]
   a - True, METS-2, p. 403; b - True, METS-2, p. 404; c - True, METS-2, p. 407

19.2 Read the following three statements:

    a)   The environmental and social implications of the life cycles of physical assets and related products often extend beyond the life cycles of the relevant projects.

    b)   The life cycle engineering (LCE) approach tends to be reactive in nature.

    c)   LCE evaluates technology from both an economic and an environmental perspective.

Which of the above statements is/are **correct**?   (2)

    [1]   a

    [2]   a and b

    [3]   a, b and c

    [4]   a and c

    [5]   None of the options (1, 2, 3, or 4) is correct.

19.3 Read the following three statements:

    a)   Environmental legislation and regulations have increased in South Africa over the years.

    b)   Cradle-to-grave means that all aspects in the life cycle of a product, process or service have to be considered, investigated and analysed.

    c)   The polluter pays principle means that anyone whose activities cause (or are likely to) cause damage to the environment shall bear the cost of full preventative and restorative measures.

Which of the above statements is/are **correct**?   (2)

    [1]   a

    [2]   a and b

    [3]   a, b and c

    [4]   a and c

    [5]   None of the options (1, 2, 3, or 4) is correct.
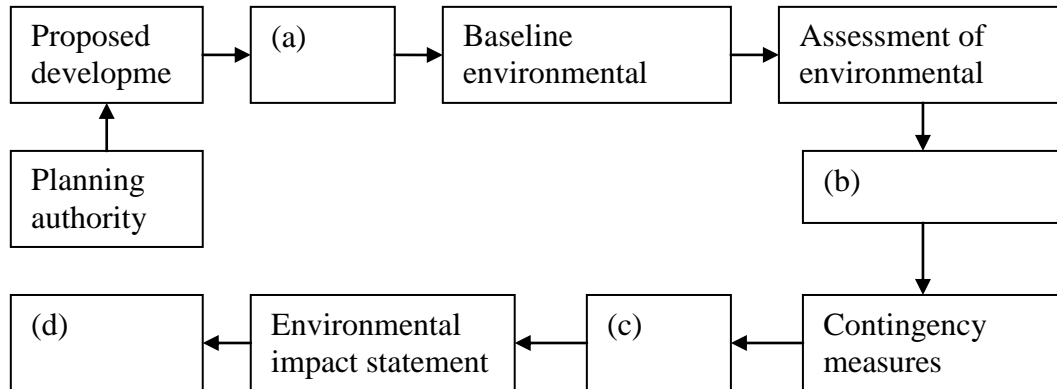

Section 19 C – short and long questions

Examples (questions and answers)

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Question 19c.1

Fill in the missing words in the environmental impact assessment structure below. In your answer book, write down the letters (a) to (d), and next to each write the correct word. (4)

```
┌──────────┐     ┌──────┐     ┌──────────────┐     ┌──────────────┐
│ Proposed │ ──▶ │ (a)  │ ──▶ │ Baseline     │ ──▶ │ Assessment of│
│ developme│     │      │     │ environmental│     │ environmental│
└──────────┘     └──────┘     └──────────────┘     └──────────────┘
     ▲                                                     │
     │                                                     ▼
┌──────────┐                                       ┌──────────────┐
│ Planning │                                       │ (b)          │
│ authority│                                       │              │
└──────────┘                                       └──────────────┘
                                                          │
                                                          ▼
┌──────┐     ┌──────────────┐     ┌──────┐     ┌──────────────┐
│ (d)  │ ◀── │ Environmental│ ◀── │ (c)  │ ◀── │ Contingency  │
│      │     │ impact       │     │      │     │ measures     │
│      │     │ statement    │     │      │     │              │
└──────┘     └──────────────┘     └──────┘     └──────────────┘
```

Question 19c.2

Choose a product such as a car or personal computer. List and briefly discuss the general life cycle steps and phases that should be considered to evaluate its impact on the environment during a 'cradle-to-grave' analysis. (8)

Question 19c.3

Define the following concepts:

a)	Polluter pays	{2}
b)	Environmental labelling	{2}
c)	Life cycle costing	{2}
d)	Social impact assessment	{2}
e)	Cradle-to-grave	{1}
f)	Life cycle engineering	{2}
g)	Environmental risk assessment	{2}
h)	Environmental impact assessment	{2}

(15)

Question 19c.4

Link the correct sustainability tool (labelled alphabetically) below with the correct phase(s) (numbered) of a typical project life cycle as illustrated below. In your answer book, write down the letters a) to g), and next to each write down the appropriate number. (7)
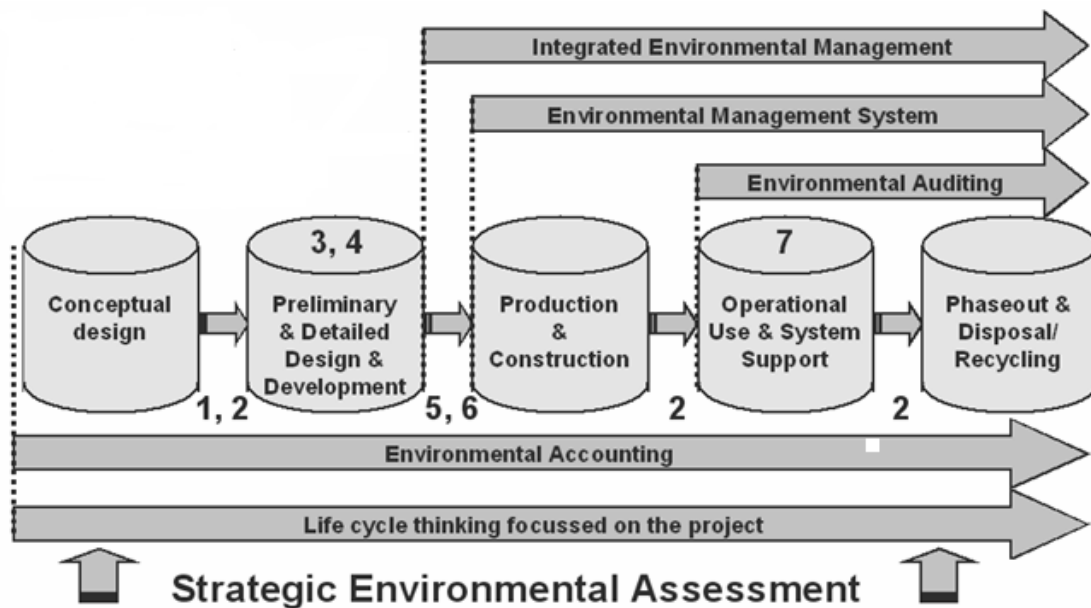
Strategic Environmental Assessment

Table - answers

	Number
a) Environmental labelling	
b) Life cycle costing	
c) Social impact assessment	
d) Life cycle engineering	
e) Environmental impact assessment	
f) Environmental risk assessment	
g) Life cycle assessment	

Question 19c.5

Briefly explain what companies try to achieve when they conduct life cycle assessments (LCAs). (4)

Question 19c.6

Describe the environmental impact assessment process in South Africa. (15)

Question 19c.7

Assess the challenges for South Africa's minerals industry of achieving sustainable development. (8)

Question 19c.8

List the names of at least 4 pieces of legislation where reference is made to environmental issues.   (4)

Question 19c.9

Match each of the following NEMA principles on the left of the table with its definition, example or closest related issue on the right of the table below. In your answer book, write down the number of each term, and next to it the letter representing the correct option, e.g. 1. j.   (5)

1. Cradle to grave	a. It is not fair that the innocent should pay for the pollution caused by others.
2. Polluter pays	b. The environmental impact of the production, use and disposal of a product should be considered.
3. Precautionary principles	c. Cleaner production.
4. Environmental justice	d. Where there are threats of serious or irreversible damage (e.g. global warming) then the fact that some scientists may disagree on the exact consequences of it should not be used as a reason to postpone cost-effective measures to prevent such degradation.
5. Waste prevention and minimisation	e. Is it fair that the poorest often stay closest to waste disposal dumps, heavy industrialised areas and other sources (or potential sources) of pollution and environmental degradation?

Question 19c.10

Briefly list and describe the four phases that a complete life cycle assessment (LCA) consists of.   (8)

Question 19c.11

List the two phases that an environmental impact assessment (EIA) consists of.   (2)

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Section 19D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 19D.1 ()

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Section 19E – Case studies

Case 19E.1 ()

Section 19F – Sources on the world wide web

- - - - End (Questions on Chapter 19) - - - -

Chapter 20, Entrepreneurship

_ _ _ _ _ _

Note regarding the new Companies Act (for South African students)

The new Companies Act (71 of 2008) came into effect from 1 May 2011 and replaces the Companies Act No 61 of 1973. It has some implications for the section on "forms of business ownership" in METS-3. More information on the new legislation is available from http://www.cipc.co.za/ (http://www.cipc.co.za/Publications_files/Companies_Act_Guide.pdf). Very briefly some of the implications are that:

- It will no longer be possible to register close corporations (CCs) or to convert companies to close corporations (as from 1 May 2011).
- Existing close corporations may continue to exist or can be converted to private companies.

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Section 20 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down "true" or "false" and provide a brief explanation for your answer where appropriate.

Examples (questions and answers)

20a.1 Small companies are more likely to introduce radical innovations than big companies with vested interests.

True. METS-2: 442

20a.2 An entrepreneur is a person who spots a gap in the market and conceptualises and evaluates a business idea to fill that gap.

True. A definition of an entrepreneur. METS-2: 442.

20a.2 The need for achievement often drives entrepreneurs.

True. METS-2: 443.

20a.3 Entrepreneurs usually take personal responsibility for accomplishments and results.

True. METS-2: 443.

20a.4 Entrepreneurs often have good skills in organizing and mobilizing scarce resources.

True. METS-2: 443.

20a.5 An intrapreneur is basically an entrepreneur that works for a corporation.

　　　True. METS-2: 444

20a.6 Corporate intrapreneurs usually challenge convention and exploit new technology and opportunities.

　　　True. METS-2: 444

20a.7 Innovation and creativity are key drivers for the entrepreneur.

　　　True. METS-2: 446

20a.8 The complaints of family, friends and colleagues regarding products and poor service can be a source of business ideas.

　　　True. METS-2: 448

20a.9 Trade fairs and exhibitions is a potential source for business ideas.

　　　True. METS-2: 448

20a.10 One of the advantages of a sole ownership is that members have limited liability.

　　　False. This is an advantage of the close corporation. METS-2: 453.

20a.11 Close corporations are subject to more legislation than companies.

　　　False. METS-2: 453.

20a.12 A close corporation may have 12 members.

　　　False – max 10. METS-2: 454.

_ _ _ _ _ _

Other True/False questions (without answers)

20a.13 A joint venture is a partnership (from a legal perspective).

20a.14 A public company may not have more than 50 members.

20a.15 KFC is an example of a franchise.

20a.16 Private equity and venture capital funds are possible sources of finance for new businesses.

20a.17 The Alt^X market of JSE Ltd. is for small companies and start-up companies.

20a.18 The purpose of a business plan is to define how the entrepreneur/management intends to capitalise on a business opportunity.

_ _ _ _ _ _

Section 20 B – Multiple choice questions

This section consists of multiple-choice questions. Write down the number of the question, and next to it the number representing the correct option, for example "20.1[4]".

Examples (questions and answers)

20.1 Read the following three statements:

a) Small companies are more likely to introduce radical innovations than big companies with vested interests.

b) Corporate intrapreneurs usually challenge convention and exploit new technology and opportunities.

c) Innovation and creativity are key drivers for the entrepreneur.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

Answer 20.1: [4]; a) True; b) True; c) True

– – – – – –

Other MCQs (without answers)

20.2 Read the following three statements:

a) The complaints of family, friends and colleagues regarding products and poor service can be a source of business ideas.

b) The joint venture is a partnership from a legal perspective.

c) The Alt^X market of JSE Ltd. is for small companies and start-up companies.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

20.3 Read the following three statements:

a) Entrepreneurs usually have a need for achievement and want to accomplish things.

b) Entrepreneurs usually take personal responsibility for accomplishments and results.

c) Entrepreneurs often have good skills in organizing and mobilizing scarce resources.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   b and c

[3]   a and c

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

20.4 Read the following three statements:

a)   KFC is an example of a franchise.

b)   A public company may not have more than 50 members.

c)   A close corporation may have 12 members.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   b and c

[3]   a and c

[4]   a, b and c

[5]   none (not a, b or c)

20.5 Read the following three statements:

a)   The shares of a private company are available to the general public.

b)   Close corporations are subject to more legislation than companies.

c)   Close corporations do not issue shares because the ownership of members are expressed as percentages.

Which of the above statements is/are **correct**? (2)

[1]   a

[2]   b and c

[3]   c

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

20.6 Read the following three statements:

a)   Trade fairs and exhibitions is a potential source for business ideas.

b) Friends and family complaining about bad service is a potential source for business ideas.

c) The public company is usually chosen as the form of business enterprise when huge sums of money need to be raised.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

20.7 Read the following three statements:

a) A business idea should only be implemented if an entrepreneur will be able to generate profits.

b) One of the advantages of a sole trader as a type of business is that business losses can be deducted from owners' personal income.

c) The purpose of a business plan is to define how the entrepreneur/management intends to capitalise on a business opportunity.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

20.8 Read the following three statements:

a) CC stands for Close Corporation.

b) One disadvantage of a CC, from a member's perspective, is that it has limited liability.

c) In terms of the new Companies Act (71 of 2008) that came into effect from 1 May 2011 it will no longer be possible to register CCs.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

20.9 Read the following three statements:

a) A partnership may have 30 members.

b) One disadvantage of a partnership is that it is easy to set up and manage.

c) The partnership is ideally suited to knowledge-based, professional organisations.

Which of the above statements is/are **correct**? (2)

[1] a

[2] b and c

[3] a and c

[4] a, b and c

[5] None of the options (1, 2, 3, or 4) is correct.

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Section 20 C – Long and short questions

Examples (questions and answers)

Question 20c.1

Many different forms of business enterprise exist for example sole ownership, close corporation, partnership, private company and public company. An important decision that has to be taken when starting up a new business is to choose the most applicable legal structure for the business. List five criteria that should be considered when choosing the form of business enterprise. (5)

Answer 20c.1

Any five of the following:

- Number of participants. A CC can only accommodate up to 10 members for example.

- Costs of formation and the ongoing running of the business. More formalities and higher costs are involved for a public company. A partnership requires limited up-front capital.

- Formalities such as the registration of the business.

- Whether an independent legal personality is required.

- Whether auditing is required or not.

- Applicable legislation. Some forms of entity are regulated by statue. Attorneys and engineers may not organise themselves as limited liability companies.

- Tax implications for the business and its members.

- Liability of participants – members of a close corporation or shareholders of a company cannot be personally held liable for corporate debts.

- Financing required. Deep level mines require hundreds of millions of rand to develop. Many shareholders are therefore required to raise the money. A public company would therefore be appropriate.

- Etc. (5)

_ _ _ _ _ _

Other questions (without answers)

Question 20c.2

Discuss the possible sources of finance for a business. (6)

Question 20c.3

There is no guarantee that every person that starts a new business will be successful. We often hear about the success stories in the media (Patrice Motsepe, Raymond Ackerman, Oprah Winfrey, Jannie Mouton, Richard Maponya and so on) and less about the thousands of people who tried but failed. Some entrepreneurs are just generating enough income to fulfil their basic needs. A friend of you cannot find employment and is considering starting her own business. She wonders whether she has the right personality to take on the responsibility of earning her own income. She is not sure whether she will succeed. Tell her about the characteristics that most entrepreneurs share. List and describe six characteristics of entrepreneurs. (12)

Question 20c.4

List at least 8 skills that are considered essential for the successful entrepreneur. (8)

Question 20c.5

There is an opportunity to start a Kentucky Fried Chicken (KFC) in a shopping centre in the town where you stay. Describe this type of business and list some of the advantages and disadvantages of this type of business. (6)

Question 20c.6

You want to start your own business. List and briefly assess the different forms of business ownership that you should consider. (12)

Question 20c.7

List four possible sources of business ideas. (4)

Question 20c.8

a) Explain why huge organisations that require huge capital outlays (for example deep level mining companies), usually choose the public company as the form of business enterprise. (2)

or

b) It is not possible for a rich person that is worth, say R25m, to owe more than just a very small percentage of the shares of a large public company (such as BHP Billiton) that has a market capitalisation worth billions of rands. Use this example to explain the advantage of the public company as form of business enterprise. Refer to the capacity of such corporations to initiate new projects that may cost hundreds of millions of rands. Who are the owners of such large corporations? (4)

Question 20c.9

Briefly describe how a business idea should be evaluated. (6)

Question 20c.10

Briefly explain what a new business venture can do to reduce risk during the entry phase. (6)

Question 20c.11

Briefly discuss at least two advantages and two disadvantages of the following types of business enterprises as well as at least one application of each:

a) sole trader
b) partnership
c) joint venture
d) close corporation

(20)

Question 20c.12

Briefly list six sections that a business plan may consist of. (6)

Question 20c.13

Briefly differentiate between a public company, a private company and a close corporation as forms of enterprises. As part of your answer, describe the advantages and disadvantages of each of these. (10)

Provide your answer in table format as shown below:

Public Company	Private Company	Close Corporation

Question 20c.14

a) State what the letters "CC" stands for. {1}
b) List two advantages associated with a CC. {2}
c) List two disadvantages associated with a CC. {2}
(5)

Question 20c.15

Briefly differentiate between franchise, franchisor and franchisee. You may use an example to explain the difference between these terms. (3)

Question 20c.16

Match each of the following forms of business ownership and other concepts on the left of the table with its definition, example or closest related issue on the right of the table below. In your answer book, write down the number of each term, and next to it the letter representing the correct option, e.g. 1. j. (9)

1. Sole trader	a. An entrepreneur that works for a corporation.
2. Close Corporation	b. Business losses can be deducted from owners' personal income.
3. Entrepreneur	c. KFC
4. Intrapreneur	d. Defines how the entrepreneur/management intends to capitalise on a business opportunity.

5. Source of a business idea	e. Maximum 10 members
5. Example of a franchise	f. A person who spots a gap in the market and conceptualises and evaluates a business idea to fill that gap.
6. Business plan	g. The complaints of family, friends and colleagues regarding products and poor service.
7. Partnership	h. Possible sources of finance for a business
8. Johannesburg Securities Exchange	i. Suited to knowledge-based, professional organisations

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Section 20D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 20D.1 [Business plan]

Compile a business plan for a business idea that you have. The business idea should be related to engineering – it should be a type of business where you would be able to use your technical knowledge and skills. A business plan for a bakery, hair dressing saloon and café would be unacceptable. Mining Engineering students may compile a business plan for a company that wants to start:

  a) a sand pit for the mining of building sand
  b) a quarry for the mining of aggregate and production of (crusher) sand
  c) any other type of mine

Remember to still write your business plan in the form of a report.

Project 20D.2 [{project} Financing]

A company has completed the evaluation of a new project. Capital in the order of R800m is required for this project. Write a report that will explain to top management the different options that can be used to finance the project. Include the following in your report:

• Describe the different financing options as well as their advantages and disadvantages.

- What are the requirements that the project will have to meet when it opts for a specific form of finance?
- Describe the money and capital markets.
- What is the risk associated with each type of financing?
- What recommendation can be given to management on the source(s) of finance that should be considered?

Project 20D.3 [Interview with a techno-entrepreneur]

Interview a techno-entrepreneur (Definition – METS-3:493) and describe in detail how his/her business developed from idea to implementation (innovation cycle). All the lessons that you learned from this person must be recorded in your report.

The first step would be to identify a person that not only invented something but also commercialised it. Briefly describe the invention and pay attention to issues related to the "Management of technology and innovation" as well as "Entrepreneurship". Make sure that you understand both bodies of knowledge so that you can formulate appropriate questions (questionnaire) for your interview with the techno-entrepreneur. You should therefore deal with the following issues:

- How did the entrepreneur invent this invention?
- How did the entrepreneur mamage to take the invention from an idea to a patent and/or business? How did he/she finance it?
- How is the intellectual property protected?
- Describe the business model – how is he/she making money from this invention? What is the technology strategy?
- What are the normal aspects that will be covered in a business plan, eg marketing, operations, economics and staffing of the business.?

Remember to attach your questionnaire as an Annexure to the report.

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Section 20E – Case studies

Case 20E.1 ()

Section 20F – Sources on the world wide web

- How to write a business plan – Entrepreneur SA - http://www.entrepreneurmag.co.za/advice/business-plans/how-to-guides-business-plans/step-by-step-guide-how-to-write-a-business-plan/

- - - - End (Questions on Chapter 20) - - - -

Chapter 21, Ethics for Engineering Professionals (METS-3)

Section 21 A – True/false questions

This section consists of true/false questions. State whether the following statements are true or false. In your answer book, write down "true" or "false" and provide a brief explanation for your answer where appropriate.

Examples (questions and answers)

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21a.1   The things we value, and the degree to which we value them, can sometimes result in unethical (wrong) behaviour.
True. Peter values money so highly that he cheats others.

Other True/False questions (without answers)

21a.2 Ethical practice only applies to individual decision makers.

21a.3 In spite of differences between cultures some values are shared across cultures.

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Section 21 B – Multiple choice questions

This section consists of multiple-choice questions. Write down the number of the question, and next to it the number representing the correct option, for example "21.1[4]".

Examples (questions and answers)

21.1 Read the following three statements:
   a) Ethical behaviour guarantees success in the short term.
   b) Leaders can either run their organisations with fear or real concern for others.
   c) Environmental ethics apply to engineers involved: i) in the mining of minerals; ii) with decision making regarding materials used in products; and iii) with making choices regarding energy use.

Which of the above statements is/are **correct**?   (2)

[1]   a

[2]   b and c

[3]   a and c

[4]   a, b and c

[5]   None of the options (1, 2, 3, or 4) is correct.

Answer 20.1: [2]; a) False, ethical behaviour cannot guarantee success in the short term (p. 12); b) True, leaders have this choice (p. 13); c) True (p. 16).

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Section 21 C – short and long questions

Examples (questions and answers)

Question 21c.1

Provide two examples where two cultures have different views regarding what is right or wrong.   (4)

Answer 21c.1

METS-3: 465, 466 – five examples from the textbook follows.

(Sub)cultures A, B, C, …	(Sub)cultures X, Y, Z, …
Want to criminalise gay sexual practice	Calls for acceptance
Regard "bribes" as honourable gifts to illustrate respect and seriousness of purpose.	Disapproves of bribes. Regards bribes as corrupt.
Permits polygamy	Polygamy is taboo
Meat eating is normal	Meat eating is wrong or not desirable
Charging of interest is forbidden in Islam	Charging of interest is fine

(Student must provide 2 examples only}   (4)

– – – – – –

Other questions (without answers)

Question 21c.2

State three values as well as the Golden rule that are basically shared by most cultures.   (5)

Question 21c.3

Define the following:

Goodness; values; principles; conscience; ethical fitness; unity; ethics audit; and ethical dilemma.   (8)

Question 21c.4

"… ethics includes both character and context." (METS-3: 469). Briefly describe the context in which typical engineering work takes place.   (3)

Question 21c.5

List the eight core values shared across cultures that was identified by Kidder.   (8)

Question 21c.6

Explain why religious issues are usually kept out of the workplace in South Africa where people from different cultures and religions have to work together.   (2)

Question 21c.7

Lord Acton said that all power corrupts. Explain the source of power that the engineering profession has.   (3)

Question 21c.8

List the four kinds of ethical dilemmas that were identified by Kidder.   (4)

Question 21c.9A

Rossouw developed a four-way test that decision makers in an organisation can apply to ensure that their conduct is ethically correct and professional. Reconstruct Rossouw's four-way test in the form of a flow-chart.   (

Question 21c.9B

Deon Rossouw developed a four-way test that decision makers in an organisation can apply to ensure that their conduct is ethically correct and professional. Please list the four steps.   (4)

Question 21c.10

Match each of the following concepts on the left of the table with its definition, example or closest description on the right of the table below. In your answer book, write down the number of each term, and next to it the letter representing the correct option, e.g. 1. j.   (7)

1. Golden rule	a. Bringing benefit to others.
2. Goodness	b. Anything that is important to a person.
3. Values	c. Fundamental truths
4. Principles	d. Never do to others that you do not want done to you.
5. Conscience	e. The inner voice of ethics that guides a person towards making ethical choices.
6. Unity	f. Active, committed conscience
7. Ethical conscience	g. Inclusiveness

Question 21c.11

Which of the following projects would you regard as unethical for engineers, technologists and scientists to become involved in. Explain your answer.

- A mine that is designed according to the health, safety and environmental legislation and standards of the country.
- Designing and building the gas chambers of Auschwitz in which hundreds of thousands of Jews were killed.
- Designing modern weapon systems for the military.

Question 21c.12

State the Golden rule and briefly use an example from the workplace to illustrate how you will apply this rule. (3)

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Section 21D – Project work

Note: You will find general guidelines for the answering of projects and the writing of reports in Annexure C, at the end of this document.

Project 21D.1 [Professionalism and ethics]

Write a report to provide guidelines to young professionals on how to conduct themselves professionally i) in general (if you are unemployed) or ii) within the context of your organisation's (corporate) culture (if you are employed). There are a number of grey areas related to professionalism where it is not always possible to say who is right and who is wrong. Your first task is to identify a number of issues related to professionalism that young professionals grapple with. The idea is to inform them of all the unwritten rules that may not

always be spelt out in the form of official policies. (If you are employed, then you should attempt to capture all the unwritten rules that may exist in the organisation and that you wish somebody informed you about when you just started your career.) You may address the following issues in your report:

Corporate culture. If employed, provide some background information on the organisational climate/culture – is it relaxed, informal or very formal? Why do you think it is like that? Do you think the older people at work are generally too conservative?

Dress code. How does this impact on professionalism? How are young professionals expected to dress i) in general or ii) at your organisation? Mark Zuckerberg from Facebook {http://edition.cnn.com/2012/05/09/tech/social-media/zuckerberg-hoodie-wall-street/} went dressed in a hoodie to Wall Street to ask for a few billion dollars. He got it. Was there anything wrong with his professional image? What if a conservative banker did not invest in Facebook based on his appearance?

Communication with seniors and clients. Are you expected to address seniors in a formal manner? May you call them by their first names? Is that OK? Is swearing allowed? Are you practising your profession predominantly in a language other than your mother tongue? What are you doing to improve your language skills? Do you keep your colleagues and clients informed about work in progress?

Written communication. Do you think spelling and grammar will be important in official documents when members of today's SMS and WhatsApp generation become the bosses of tomorrow? Do you use the word processor's grammar and spellchecker when typing reports and other official documents? How important is good language in technical reports? Can bad language result in poor implementation of designs and even in loss of life?

Ethical use of organisational resources. How are you supposed to use the organisation's telephone, e-mail and internet facilities? May you make personal phone calls, for example?

Empowered by your organisation to act professionally and ethically? Does your organisation allow or empower you to act ethically and professionally? Are you, for example, equipped with a telephone answering service or voicemail so that clients can leave messages when you are in meetings or out of the office?

Time management. Is it important to be punctual when attending meetings and adhering to appointments? Is it OK to hand in an assignment late?

Continued professional development (CPD). Are you taking responsibility for your personal development? Are you obtaining the minimum prescribed CPD credits per year as required by the Engineering Council of South Africa (ECSA) or any other relevant professional body?

Context. How do you think professionalism in an African context differs from that of the European, Asian or American contexts? Is a (European) suit and tie appropriate in Africa's

warmer climate? Do you think it is important to have a strict dress code in certain organisations, for example the military? Is it OK for a professor to go to varsity in jeans and a T-shirt? Is it OK for South Africans to be more relaxed, flexible and accommodating given their authoritarian past?

Miscellaneous (other issues). Are you allowed to eat and have coffee or tea in the office? What are you expected to do before going on leave? Do technicians, technologists and engineers have to adhere to specific standards? Do you think additional rules should apply in an open-plan office environment?

Section 21E – Case studies

Section 21F – Sources on the world wide web (Engineering ethics and professionalism)

21F.1 Go to the website of the Engineering Council of South Africa (ECSA). What is required to register with the ECSA as a candidate Professional Engineering Technician, Technologist and Engineer?

- - - - End (Questions on Chapter 21) - - - -

"Chapter 22" - Miscellaneous questions, case studies and mini-projects

Some of these questions are based on more than one chapter of METS-2 and others go beyond the content in METS-2.

Question 22.1 ("Multi-disciplinary" question)

{Note: the purpose of this question is to challenge the learner to combine information from two or more chapters of METS-2 and to apply it}

You recently graduated with a B Tech in Electrical Engineering from Unisa and decided to start your own business. **Design** or formulate the following for this business:

a) A business concept. How are you planning to make money? What are you planning to design, manufacture and sell? (2)

b) Two business objectives. (2)

c) A basic control process to ensure that objectives are being met. (6)

d) A basic organogram (organisational structure) for your business showing reporting lines. (6)

e) A basic job advertisement (containing the main elements) for recruiting somebody to fill one of the positions that form part of the organogram. (6)

f) A list of 8 questions that you will ask when interviewing candidates that may apply for the position referred to in (e). (8)

g) A structure of a very simple contract for the renting or hiring of a office, factory or workshop. (5)

h) A diagram that illustrates the basic structure of the (operational) transformation process at this company. (6)

i) The basic structure of a quality management system for this business. (6)

j) A basic maintenance plan for one of the big assets (eg delivery truck) of this business. (6)

k) A diagram illustrating the value chain that your business forms a part of. (4)

l) The structure of the market analysis section of the business plan (just provide the basic structure showing the main features that will be addressed) (6)

m) A basic information system for this (small) business. Just indicate the main components of this information system. (5)

n) A framework for the technology strategy. (6)

[74]

Question 22.2

Mini-case study: Provision of underground communication technology/product to the South African minerals industry.

You are a management consultant. You have been approached by a company, XYZ-ICT Ltd., which designs, manufactures and sells a number of information and communication technology (ICT) products to various industries. To date the company has not focussed on the needs of the mining and minerals industry. The management of XYZ-ICT think that opportunities may exist for the company to develop or source technologies and products that will satisfy the needs of underground mines better than existing products. An improvement in communication underground seems to offer the best opportunity for XYZ-ICT. Currently, only a small percentage of workers are within immediate reach of supervisors and management via existing communication and information technology devices. Safety and productivity can be improved if a cost-effective and robust product or products can be developed to place every worker within immediate reach of his/her supervisor and team members. This will speed up the flow of information so that supervisors and management have timely and accurate information on which to base decisions.
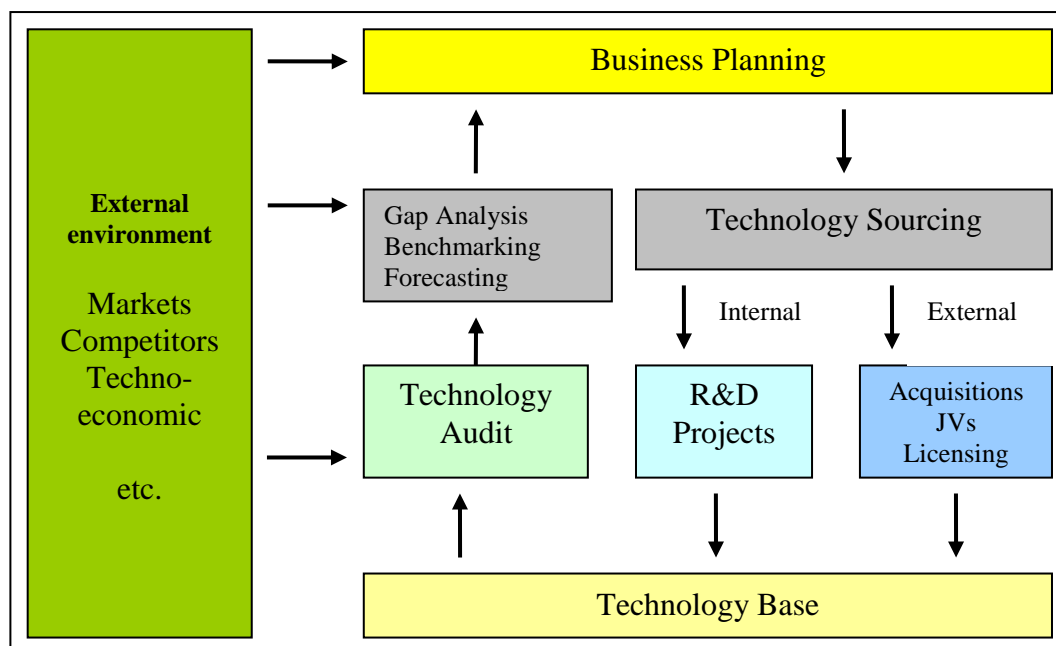
Use the above technology strategy model (METS-2: 380) in your analysis to develop a technology strategy for XYZ-ICT. You should investigate all options as illustrated in this model and use this model to structure your report for XYZ-ICT. In your answer, do not fabricate information, but rather describe the information that you will have to obtain and analyse to produce a comprehensive report for XYZ-ICT.

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Question 22.3

Case study - The Hilti Electric Rock Drill for hard rock applications in 2006

Read the following:

Creamer M. 2006. **After century of air power, new electric rockdrilling era dawns.** *Mining Weekly* 10 February [online]. Available on the Internet at

http://www.miningweekly.co.za/?show=80200

a. Marketing of the electric rock drill

    The Hilti electric rock drill was developed at the request of AngloGold. Assume that it is early 2006, and Hilti has not yet started to market the electric rock drill to other mining companies. Advise Hilti on how to "cross the chasm" and market this new drill to AngloGold as well as other deep-level mining companies such as Gold Fields and Harmony. Also discuss other marketing segments that Hilti should target and the timing of doing so. Briefly comment on Hilti's product offering as well as the distribution channel(s) and sales channel(s) that Hilti should use.   (16)

b. Diffusion of the electric rock drill

    Briefly discuss what Hilti probably did during the design phase and is still doing in terms of speeding up the diffusion of the electric rock drill. Advise Hilti on what it can still do to achieve the goal of speeding up the diffusion of the drill even further. Briefly comment on the future diffusion patterns and technology performance patterns that you would expect for both the Hilti electric rock drills and the current incumbent pneumatic rock drills.   (10)

c. The Hilti rock drills have opened up a number of other opportunities for the suppliers of other electrical mining equipment. Briefly discuss this in the light of a potential new de facto (electrical) standard for underground mining equipment as compared with a compressed-air standard for mining equipment.   (4)

                    [30]

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Question 22.4

Mini-project: Managing crime (in the South African context).

Describe the impact of crime on your company. How does your company manage it?

Minerals industry specific

From January 2005 to March 2007:

• 997 criminal miners were arrested on mines in the Free State Gold Fields

- 11 827 kg of gold bearing material were recovered during arrests (Source: Presentation by Gold Fields Protection Services at the MVS 2007 conference)

How does your (mining) company manage illegal miners and criminal miners (zama-zamas)?

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Question 22.5 – Case study (Braun AG)

The following questions are based on the "Braun AG: The KF 40 Coffee Machine" case study written by K. Freeze (Copyright: Design Management Institute).

<u>You will find this case in the following book:</u>
Burgelman, R.A., Christensen, C.M. & Wheelwright, S.C. 2004, 4th ed. Strategic Management of Technology and Innovation, McGraw-Hill, Case IV-4, pp. 1035-1051

<u>Note</u>: This case study is about the design of a new coffee machine, the KF40 at Braun (company name).

1. Describe Braun's business strategy before and after the introduction of the KF40 coffee machine. You may use the following table to structure your answer. (12)

	Old Braun (before the Gillette takeover and Waxlax as chairman)	New Braun (after the Gillette takeover and Waxlax as chairman)
Customers/market segments		
Marketing channels		
Design philosophy		
Development process		
Manufacturing capability		
Product philosophy		

2. Describe the link between design, marketing and market segmentation. Explain how customer values could be reflected by or embedded in a product. Evaluate Braun's attempt to achieve a match between product design and the needs of its target market. Evaluate the design and manufacturability of the KF 40 against Braun's ten principles of good design. Explain how material selection enabled Braun to target different markets. (12)

3. Briefly discuss the impact of Gillette on Braun.   (4)

4. Identify and discuss some of the risks involved in Braun's strategy with the KF 40 in addressing the needs of a wider market segment. How successful was Braun in managing these risks?   (5)

[33]

Additional sources of information:

Geldenhuys, P.A. 2005 Technology Management Study Guide, North-West University, pp. 184-193

Question 22.6 – Chamber of Mines Workbook III for the Certificate in Mine Environmental Control (Minerals Industry)

The COM Workbook III contains three mine environmental control related worked examples where cost engineering and time value of money principles are applied. More information follow:

- Worked example no 1 (pp. 248-251) – choosing between two fans
- Worked example no 2 (pp. 251-254) – choosing between two types of streamlined buntons
- Worked example no 3 (pp. 254-260) – Determination of economic size of ducting, etc.

Other examples of topics for project work

Although detailed guidelines are not provided for these it is important that the topics be discussed as an Engineering Management assignment – management theory and models should therefore be applied to analyse the topics below. The general guidelines are applicable as well.

- The top three to five issues that your company's management grapple/struggle with

- Your (mining) company's social responsibility

- Corporate governance

- The management of BEE in your organisation

- Cutting costs at your company

- Globalisation and its impact on your company

- Management of diversity

- Strategic planning at your organisation

- Analysis of the industry in which your company competes

- The impact of the business cycle on your company's operations and planning
- The development of skills at your company
- Managing a mine (or other company) in a remote area (with little infrastructure)
- Your organisation's views regarding political and other risks
- The impact of loadshedding on your company's operations and what companies can do at times when Eskom does not provide them with enough electricity
- The impact of crime on your company. How does your company manage?
- Discuss one or a number of laws with a major impact on your company and how it is managed

Annexure A

List of formulae

Engineering and Technology Management

Cost estimation

$C_2 = C_1 \times (Q_2/Q_1)^Y$

Where:

C_2 = Cost of desired plant or piece of equipment

C_1 = Known cost of plant or piece of equipment

Q_2 = Capacity of desired plant or item

Q_1 = Capacity of known plant or item

Y = Constant (cost capacity factor)

Maintenance management

2-parameter Weibull distribution:

$R(t) = e^{-(\frac{t}{\theta})^m}$; where

m = shape parameter

θ = characteristic life

Time value of money and project selection

$FV = PV (1 + i)^n$ or $FV = PV \times FVIF (i \%, n)$

$PV = FV/(1 + i)^n$ or $PV = FV \times PVIF (i \%, n)$

$FVA = A \times FVIFA(i, n)$; where $FVIFA(i, n) = \left[\dfrac{(1+i)^n - 1}{i} \right]$

$PVA = A \times PVIFA(i, n)$; where $PVIFA(i, n) = \left[\dfrac{(1+i)^n - 1}{i(1+i)^n} \right]$

$NPV = \sum\limits_{t=1}^{n} \dfrac{CF_t}{(1+k)^t} - I$ for projects with a single cash outflow at the beginning of the project

Average annual profit = [(total gains) – (total outlay)] / number of years

ROI = Average annual profit / original investment x 100

Annexure B – Errata

Please correct the following in the 2nd edition of the textbook:

- The Children's Act 38 of 2005 came into operation on 1 July 2007. It states the age of majority to be eighteen years. Please replace 21 years with 18 years on p. 117 of METS-2 (2 times).

- Question 16.10, p. 356 of METS-2, contains two questions for self-evaluation. The second question starts with "Determine the replacement …". Rather attempt questions 16c.3 and 16c.12 in this workbook.

_____

Please correct the following in the 3rd edition of the textbook:

Chapter 10, page 209, Example 10.1

The formula for R(t) should be used.

An additional '3' was printed in the solution. It should be:

a. Reliability after 40 days: R(40) = $e^{-(40/60)^{3,5}}$ = 0,785

b. Reliability after 80 days: R(80) = $e^{-(80/60)^{3,5}}$ = 0,065

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Annexure C – General guidelines for doing a mini-project report (in engineering management)

Use the format of a report. Indicate clearly, on the cover page, the title of your report. The following criteria may be used to evaluate your project.

	Evaluation criteria	Max. mark	Your mark
1.	**Meeting the objectives of the assignment**		
1.1	The assignment has been understood and answered comprehensively. (The topic has been addressed; minimum of 8 pages / 2500 words for high marks in this section; zero marks for extensive plagiarism)	20	
1.2	Independent work/thought is reflected (student declared that it is his/her own work (4 marks); there are no signs of copying; student added value to existing sources of information; zero marks for extensive plagiarism)	10	
1.3	Insight into the topic is reflected. (Zero marks for extensive plagiarism)	10	
1.4	Logical, systematic thought and reasoning is demonstrated (logical flow, readability; zero marks for extensive plagiarism)	10	
1.5	Quality research (literature study or empirical work) has been done (References: 1 mark per reference up to a max of 5; max of 3 marks for WWW-references only; max of 3 marks for using references inside the 'body' of the report; max of 2 marks for listing references correctly and comprehensively)	10	
1.6	Conclusions (and recommendations, where applicable) are logical, meaningful and substantiated (zero marks for extensive plagiarism)	10	
	Subtotal	**70**	
2.	Presentation and technical aspects		
2.1	The content shows a logical and integrated development and forms a balanced, holistic whole. (zero marks for extensive plagiarism)	10	
2.2	Executive summary reflects the content comprehensively and meaningfully. (zero marks for extensive plagiarism)	5	
2.3	Style, language, layout and neatness are of an acceptable standard (Table of contents has been provided, page numbering; zero marks for extensive plagiarism)	5	

		Subtotal	20	
3.	**General quality rating**			
	Evaluator's general evaluation mark of the assignment's quality – taking into consideration the above and other factors. Does the presentation of the report reflect professionalism?	10	
	Total		100	

Study the above structure. Have you noticed that your report should include an executive summary, conclusion, "declaration of own work" and list of references? Use the above evaluation sheet as a checklist to ensure that you meet all the requirements. All sources that you consulted must be listed under "References". Do not copy. You must illustrate to the marker that you produced original work.

You may include technical information in your report but this must be kept to the minimum. The focus should be on economic/financial, project management and other engineering management content. Your report should be balanced in terms of theory and the application thereof. You will earn higher marks if you can illustrate that you have mastered the theory and know how to apply it in practice.

- Length: approximately 10 to 15 pages (2 500 words)
- Search and identify relevant information.
- Provide background information in the introduction-section of the report but be careful not to include irrelevant information. Be focussed.
- If possible, use a word-processor package to type the report. Use the spell-checking and other useful functions to produce a good quality report.
- Ensure that your report is well structured. Include an executive summary, introduction and other sections. List your references at the end of the project.
- Have a look at the marking criteria.
- Students are allowed to share sources of information but should write their own reports. Do not copy word-for-word from information sources, especially the Internet. This is called plagiarism and not allowed. Consult a number of sources of information (e.g. books and knowledgeable persons) and then write and structure the information yourself. There are good examples of business plans on the Internet. Learn from them but do not copy.

Using and referring to sources of information

You have to consult additional sources of information (in addition to METS-3) for the purposes of a mini-project. It is not good enough to consult one source of information only. Do not only consult books and academic papers but also talk to people in industry with relevant experience.

You should refer to sources inside your report as follows: According to Nel (2012: 2) technology is needs driven. Only list the sources that you referred to in your report in the bibliography at the end of your report.

No specific referencing system is prescribed. It is important however that the full reference should be provided at the end of your report under the list of references or bibliography. An example follows:

Bibliography

- Nel, W.P. (ed.), 3rd ed., 2012. *Management for engineers, technologists and scientists.* Cape Town: Juta. (ISBN: 0702171611)

By referring to such sources of information you illustrate that you actually did consult the various references and you also give recognition to such sources.

It is important that you first do some background reading on the topic that you selected. You should for example be familiar with the various issues that should be addressed in a business plan before you can actually develop your own. It is impossible to write a good report if you do not understand the issues and theory related to the specific topic that you selected.

Declaration of own work

Universities expect you to work independently and not to plagiarise. Credit must be given to all sources used. It is therefore important that you declare in your report the true situation. The following is a guideline of what such a declaration may look like:

I, Mr/Ms AA Maseko, declare that the content of this report is my own, unaided work and that I have referenced all information used from other sources. I confirm that no plagiarism and copyright infringement exists in this report. I willingly submit to any investigation in this regard by {Name of University} and will abide by the decision of any such investigation.

Useful source on technical report writing

- Dr Glynis Perkin, (2009): Technical Report Writing Workshop, Loughborough University, Online available at: http://www.slideshare.net/engCETL/report-writing-3978063 (Date accessed: 30 October 2012)

Typical layout of the report

{Pages 1 to 2}

Title of your report

Your details – Name, surname and student number

Course details - Module name and code

Declaration of own work

Executive summary

{Page 2 or 3}

Table of contents

{Pages that follow}

Various headings (and subheadings) of your report, starting with an 'Introduction' and ending with 'Conclusion(s) and recommendation(s)'

{Last page}

Bibliography

Annexure D - Action words and what students must do when they see them

Apply	Put to practical use or make use of a relevant equation or law.
Calculate	Determine the value, using formulae or specific calculation methods.
Classify	Group concepts or subjects together based on certain characteristics or commonalities.
Compare	Point out the similarities and differences between objects or points of view. The word *contrast* can also be used.
Convert	Transform a quantity expressed in one unit to a quantity expressed in another unit.
Define	Give a short and clear description of a term or concept.
Demonstrate	Show clearly/prove/make clear by reasoning or evidence/illustrate and explain, especially with many examples.
Derive	Deduce or infer something from the given information.
Describe	Tell in detail how a process works or how a subject appears. You need not comment on the process or the subject or give your own point of view.
Differentiate	Find differences between objects or statements.
Discuss	Explain terms or concepts in your own words. Give comments or give your own point of view.
Distinguish	Write down the differences between subjects or concepts.
Draw	Create a drawing, diagram or representation of a subject or concept.
Explain	Write about the subject in your own words. Clarify or give reasons – it may be useful to use examples or illustrations. You must prove that you understand the content.
Formulate	Express in a concise, systematic way.
Identify	Establish the identity or recognise a process.
Illustrate	Explain by means of detailed descriptions and drawings.
Interpret	Explain or clarify the meaning of a concept/value.
List/Name	Briefly write down the facts or main points.
Motivate	Give reason(s) for your answer.
Name	Nominate or specify a site or process.
Organise	Arrange data according to certain criteria.
Predict	Use the facts available to derive an outcome.
Relate	Show the relation/connection of entities, how the concepts can be linked.
Solve	Find an answer by using critical thinking and/or calculations.
Summarise	Briefly state/list/write down only the most important detail/facts.
Understand	Show insight into or know the meaning/nature of a concept or term; to comprehend.

(Source: unknown)