Tutorial letter 102/2/2016

Chemistry First Year (Practical)

CHE1503

Semester 2

Department of Chemistry

IMPORTANT INFORMATION:

PRACTICAL DATES:

SLOT 1: 15 to 26 August 2016

Slot 2: 19 to 30 September 2016

BAR CODE

Prof S Dube

(011) 670 9308

Dear Student,

This is a friendly reminder about the first year practical module CHE1503

- **Who is eligible to attend the practical course(s)?**

Students who are registered for CHE1503 module and have **submitted** assignment 1 will be considered for admission to the practical. This mean by now you should have already completed and submitted your assignment to confirm your space. Also only students who have booked their spaces via the Sign Up Tool on myUnisa will be considered. Note that it is assumed that students who are registered for CHE1503 have already passed CHE1501 and are taking CHE1502 (if not already passed) concurrently with the practical module.

NB: You are not eligible to attend the practical course if you have not passed CHE1503 and are not registered for CHE1502.

Students are required to attend a compulsory practical course which runs for a period of two weeks in the Chemistry laboratories at the Florida Science Campus. This practical covers titrations, organic, inorganic and physical chemistry related experiments.
Please contact your lecturer Prof S Dube (dubes@unisa.ac.za or 011 670 9308) if you are not sure about your admission.

- **When and where will the practical work be carried out?**

Students are required to attend the practical module for two weeks on the following dates:

Slot 1: 18-29 August 2016
Slot 2: 15-26 September 2016
The practical sessions start at **08:00** and end at **16:00** daily.

Practical venues: Eureka Building, Florida Science Campus, Florida.
Maps and directions to UNISA Florida Science Campus can be found in Tutorial Letter CHEALL1 301 as well as at the end of this tutorial letter.

- **Is there any transport arrangements?**

There is no transport arrangement that has been made for students. You should therefore make your own arrangements of getting to and from the Florida Science Campus.

- **Do I have to make any arrangements for my accommodation?**

  Yes. You are responsible for making your own arrangements regarding accommodation during the practical. Some names and telephone numbers of guest houses are given in the Table below for your information. However do note that we do not take responsibility of the quality of the service provided by these facilities.

Table 1: List of Possible Accommodation around Florida Science Campus

Accommodation	Prices	Distance	Contact details
Silver Birch	R390.00-700.00	1.5 km from Unisa****	011- 763 8619/083 431 0501
Gold Crest Guesthouse	3 rooms Single=R520.00 + breakfast R480 excluding	2.4km from Unisa ****	011-6744367/ 082-8583493
	2 rooms Sharing=R720 + breakfast R680 excluding		
The Old'e Charm	3 room single= R370 + breakfast R330 excluding	2.7km from Unisa ****	011-6744589/ 072-1587211
	Cottage (for sharing) = R600 + breakfast		
Didiloni Lodge	R350.00	2.9km from Unisa ****	011- 477 9468/ 082 490 0889/ 073 789 2180
The Kings Lodge	R600.00	4.3km from Unisa ****	011- 476 9654/0 83 414 0013
Loeries Next B&B Guesthouse Berna.dutoit@clover.co.za	R550.00	4.9km from Unisa ****	011 471 1405/ 0832591342

What do I have to bring along for practical course?

Please bring the following for the practical:

- Your own **laboratory coat**
- **Closed shoes. High heels, sandals or any type of open shoes will not be allowed in the laboratory.**
- Stationery (notebook, scientific calculator, writing instruments)
- Prescribed textbook(s)
- Tutorials 101 and 102 for CHE1503

Preparation for Laboratory Experiments

Your laboratory time is very limited hence it is important to prepare for every experiment in advance. Thus each experiment should have been read and understood prior to the laboratory session. Such an approach minimizes unnecessary errors and will allow you to carry out the experiments with understanding and hence perform better. Each laboratory experiment is preceded by a brief lecture which further assists you in your planning for the experiment. You are therefore encouraged to attend all the scheduled pre-lab talks which will be offered during the practical. The Virtual ChemLab CD is another vital resource that will assist you in preparing for the practical while at home. Some experiments covered in the CD will also be covered during the laboratory sessions. Please go through as many experiment activities in the CD as possible. The laboratory manual (TUT Letter 103) will guide you to the experiments that will be covered during the practical. The copy of the manual has been uploaded on myUnisa under the Additional Resources. **NOTE: You will be provided with a printed manual when you arrive hence there is no need to print the document**. Examples of experiments that you need to pay attention to on Virtual ChemLab are the following:

- Writing Balance Precipitation Reactions (2-2 ;pg 41 Virtual ChemLab)
- Precipitation Reactions (2-4; pg 45, Virtual ChemLab)
- Heat of Fusion of Water (4-1; pg 95 Virtual ChemLab)
- Concepts in Acid-Base Titrations (6-3; pg 129; Virtual ChemLab)
- Predicting the Equivalence Point (6-4 to 6-6; pg 131-135; Virtual ChemLab)

- Acid Base Titrations (6-8, 6-9, 6-11, 6-15, 6-16, pgs 139-142; 145,153, 155; Virtual ChemLab)
- Standardization of Permanganate Solution (7-2, pg 159; Virtual ChemLab)
- Analysis of a Ferrous Chloride Sample (7-3, pg 161; Virtual ChemLab)

Laboratory safety rules

The laboratory is supposed to be a safe working place. To maintain this, safety rules are listed below.

1. The students have to be familiar with the locations of safety equipment (i.e. fire extinguishers, first aid kits, eye wash bottles and waste containers).

2. Students must never work alone in a laboratory.

3. Students may not work in a laboratory outside scheduled hours without permission of the lecturer in charge.

4. Safety glasses should be worn when working in the laboratory.

5. Long and falling hair must be tied at the back of the head.

6. All accidents, however small, must be reported immediately to a lecturer in charge.

7. Materials accidentally spilled on the bench or floor must be wiped immediately and the area washed thoroughly.

8. Students **must** wear **only** closed shoes in the laboratory.

9. Students **must** wear clothes that cover torso and legs to the knee.

10. Smoking, eating and drinking are not allowed in the laboratory.

11. Never taste chemicals or allow them to come into contact with your body.

12. Do not smell a chemical by holding it directly near your nose.

13. Unauthorized experiments are strictly forbidden. If you wish to try something new, obtain permission from the lecturer.

14. When heating liquids in a test tube do not point it at your-self or at anybody else.

15. When diluting acids, pour the strong acid into water slowly and stir constantly. NEVER POUR WATER INTO A STRONG ACID.

16. Do not pipette solutions by mouth.

17. Strong concentrated acids and bases must be carefully diluted before emptying into the sink (dispose organic wastes into appropriate organic solvent containers).

18. Do not engage in games or horseplay in the laboratory.

19. Use a fume hood for experiments involving noxious fumes.

20. Faulty equipment of any kind must not be used and must be returned to the staff member in charge.

21. Broken glassware and paper must be removed from all sinks.

22. Consult a demonstrator before using any electrical equipment or instrument for the first time.

23. Wash your hands and dirty apparatus before leaving the laboratory.

Significant figures

Any experimental data is meaningless to users if its accuracy is unknown. To achieve a reliable data with 90-95 % confidence level a significant figure conversion must be employed.

(i) Counting Significant Figures

Digits other than zero are always significant. Depending on their position in the number, zeros may or may not be significant.

There are several possible situations:

1. All zeros between other digits in a number are significant; for example 3.079, 4002, 790.2. Each of these numbers has **four significant figures**.
2. Zeros to the left of the none zero digit are used to locate the decimal point and are not significant. Thus 0.013 has **only two significant figures** (1 and 3).
3. Zeros to the right of the last non-zero digit, and to the right of the decimal point, are significant, for they would not have been included except to express precision. For example, 3.070 has **four significant figures**; 0.070 has **two significant figures**.
4. Zeros to the right of the last non-zero digit, but to the left of the decimal, as in the numbers 100, 590, 38000, etc., may not be significant. For example, in 38000 the measurement might be good to the nearest 1000, 100, 10 or 1. There are two conventions which may be used to show the intended precision. If all the zeros are significant, then an expressed decimal may be added, as 580, or 38000. But a better system, and one which is applicable to the case when some but not all of the zeros are significant, is to express the number in exponential notation, including only the significant zeros. Thus for 300, if the zero following 3 is significant, we would write 3.0×10^2. For 17000, if two zeros are significant, we would write 1.700×10^2. The number we correctly expressed as 580 can also be expressed as 5.80×10^2. With exponential notation, there is no doubt as to the number of significant figures.

Addition and Subtraction

The result of an addition or subtraction should contain no more digits to the right of the decimal point than are in the quantity which has the least number of digits to the right of the decimal point. Perform the operation indicated and then round off the number to the proper number of significant figures.

Example:

    24.327
    72.21
    +6.1488
    102.6858 (102.69)

Example:

    242.112
    -84.9
    157.212 (157.2)

Since the digit 1 in 72.21 is uncertain, the sum can have no digits beyond this point, so the sum should be rounded off to 102.69. In the subtraction, the answer should contain four significant figures.

Multiplication or Division

In multiplication or division, the answer can have no more significant figures than the factor with the least number of significant figures. In multiplication or division, the position of the decimal point has nothing to do with the number of significant figures in the answer.

Example: 3.1416 x 7.5 x 252 = 5937.624 (5.9 x 10^3)

The operations of arithmetic supply all the digits shown, but this does not make the answer precise to seven significant figures. Most of these digits are not realistic because of the limited precision of the number 7.5. So the number must be rounded to **two significant figures, 5900 or 5.9 x 10^3**. It should be emphasized that in rounding-off the number you are not sacrificing precision, since the digits discarded are not really meaningful.

Example:

$$\frac{189}{24} = 7.875(7.9)$$

The answer contains two significant figures.

(ii) Precision and Significant Figures

When the measured value is determined to the highest precision on the measuring instrument, the digits in the measurement are called significant digits or significant figures.

Suppose we are measuring two pieces of wire, using the metric scale on a ruler that is calibrated in tenths of centimeters as shown in figure 1.1a and b. One end of the wire is placed at exactly 0.0 cm and the other end falls somewhere between 6.3 cm and 6.4 cm. Since the distance between 6.3 and 6.4 is very small, it is difficult to determine the next digit exactly.

One person might estimate the length of the wire as 6.34 cm and another as 6.33 cm. The estimated digit is never ignored because it tells us that the ruler can be read to the 0.01 place. This measurement therefore has three significant digits (two certain and one uncertain figure).

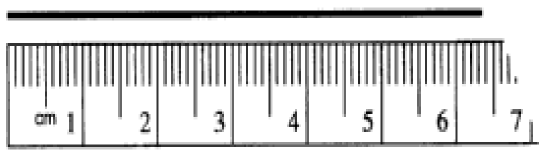


Figure 1.1a

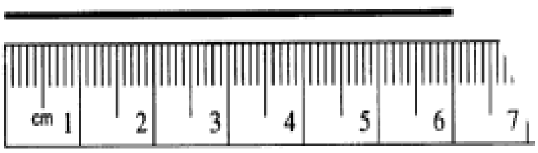


Figure 1.1b

The second wire has a length that measures exactly 6 cm on the ruler as shown in figure 1.1b. Reporting this value as 6 cm would be a mistake for it would imply that the 6 is an uncertain digit and others might record 5 or 7 as the measurement.

Recording the measurement as 6.0 cm would also be incorrect because it implies that the 0 is uncertain and that someone else might estimate the length as 6.1 or 5.9. What we really mean is that, as closely as we can read it, the length is exactly 6 cm. So, we must write the number in such a way that it tells how precisely we can read it. In this example we can estimate to 0.01 cm so the length should be reported as 6.00 cm.

(iii) Precise Quantities versus Approximate Quantities

In conducting an experiment it is often unnecessary to measure an exact quantity of material. For instance, the directions might state, “weigh about 2g of sodium sulfite.”
This instruction indicates that the measured quantity of salt should be 2g plus or minus a small quantity. In this example 1.8 and 2.2g will satisfy these requirements. To weigh exactly 2.00g or 2.000g wastes time since the directions call for approximately 2g.

Sometimes it is necessary to measure an amount of material precisely within a stated quantity range. Suppose the directions read, “Weigh about 2g of sodium sulfite to the nearest 0.001g.” This instruction does not imply that the amount is 2.000g but that it should be between 1.8 and 2.2g and measured and recorded to three decimal places.

Therefore, four different students might weigh their samples and obtain 2.141g, 2.034g, 1.812g and 1.936g, respectively, and each would have satisfactorily followed the directions.

Volume

Beakers and flasks are marked to indicate only approximate volumes. Volume measurements are therefore made in a graduated cylinder by reading the point on the graduated scale that coincides with the bottom of the curved surface called the meniscus of the liquid. Volumes measured in your graduated cylinder should be estimated and recorded to the nearest 0.1ml.

Read more about the rules of significant figures and other measurements in the textbook prescribed in theory.
Chemistry “The Central Science: A Broad Perspective”, Brown, LeMay, Bursten, Murphy, Langford, Sagatys, 2nd Edn pg 14-19

Pre-Prac Questions and Definitions (Not to be handed in)

Note: The questions included in this section are very important and you should attempt all of them as they will assist you to prepare for the practical and will be valuable during the practical.

- Define the following terms
  - a. Standard solution
  - b. Primary standard
  - c. Titration
  - d. End point
  - e. Standardization

- Describe the preparation of 500 mL of 0.0750 M $AgNO_3$ from the solid reagent.

- Given: potassium hydrogen phthalate (KHP) and molecular weight of 204.23 g/mol
  - a. Calculate the mass of KHP needed to prepare 0.1M solution in a 250 mL volumetric flask.
  - b. A 25.00 mL aliquot of KHP (prepared in (a)) required 23.85 mL of NaOH solution to reach the end point during titration.

$$KH(C_8H_4O_4) + NaOH \longrightarrow NaK(C_8H_4O_4) + H_2O$$

(i) What is the exact concentration in moles/Liter of your NaOH solution?

(ii) Which one between KHP and NaOH is the primary standard and why?

(iii) Which indicator is suitable for a weak-acid/strong-base titration and why?

- - If Apple cider is allowed to spoil, the result is vinegar, the distinctive ingredient of which is acetic acid, CH_3COOH. The acid reacts with NaOH according to the balanced equation:

$$CH_3COOH(aq) + NaOH(aq) \longrightarrow NaCH_3COO(aq) + H_2O(l)$$

If 25.67 mL of 0.09674 M NaOH are required to react with a 50.0 mL sample of vinegar, how many grams of acetic acid are in the vinegar sample?

- Oxalic acid is found in many plants and vegetables. Like vitamin C, oxalic acid is both an acid and a reducing agent. It can react with an oxidizing agent such as $KMnO_4$ according to the balanced equation:

$$2MnO_4^-(aq) + 5H_2C_2O_4(aq) + 6H_3O^+ \longrightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 14H_2O(l)$$

How many millilitres of 0.0200 M $KMnO_4$ would be required to react completely with 0.892g of oxalic acid?

- Define Le Chatelier's principle.
- Aqueous chromate ion, CrO_4^{2-}, exists in equilibrium with aqueous dichromate ion, $Cr_2O_7^{2-}$ in an acidic solution. What effect will (a) increasing the dichromate ion, and (b) adding HCl have on the equilibrium?
- Write down the equilibrium reaction of Fe^{3+} and SCN^-.
- Write down the equilibrium reaction of Ni^{2+} and NH_3.
- Write down the equilibrium reaction of Co^{2+} and Cl^-.

Familiarize yourself with the following:

1. Nucleophile and electrophile
2. Leaving group
3. Aqueous and organic phase
4. Density (plays a major role during separations of liquids)
5. Identification of functional groups
6. Different kinds of Isomers

Answer the following questions:

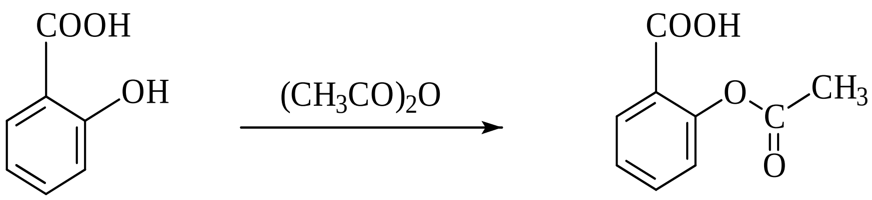
a. Could dilute H_2SO_4 be used as a catalyst? Explain.

b. Why should bumping granules be used when boiling liquids?

c. What is recrystallization?

d. Sometimes after obtaining a crude product we recrystallise it. What is the purpose of recrystallization of the crude product?

e. Aspirin is synthesised on an industrial scale by combining the following reactants:



Show the organic products from this reaction and name both reactants and products.

Give a detailed mechanism for the acid catalysed reaction given above

MAP and DIRECTIONS

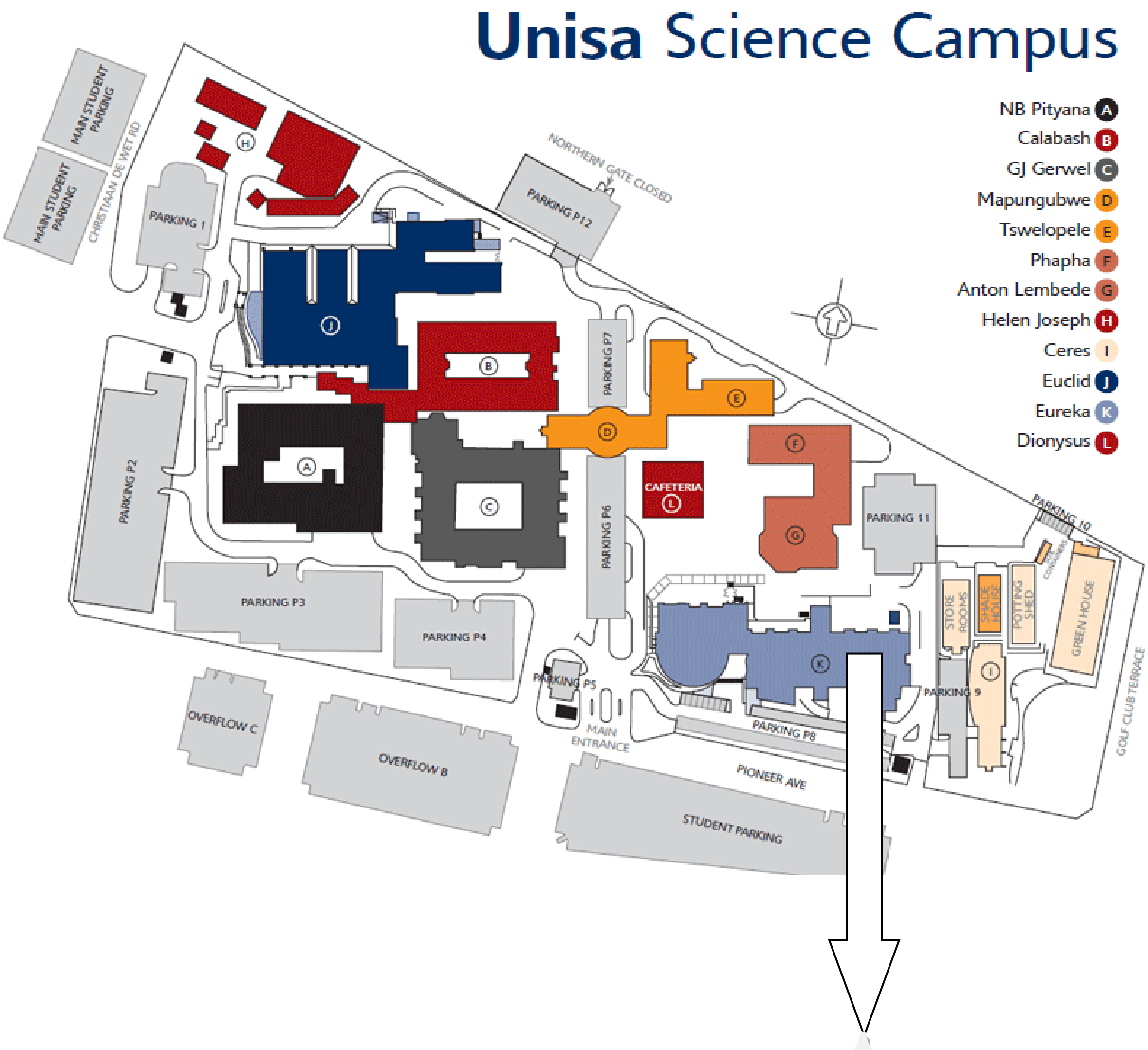
UNIVERSITY OF SOUTH AFRICA FLORIDA SCIENCE CAMPUS

Chemistry Laboratories are found in **Eureka Building (indicated as the red building in the picture below).** The laboratories will be found on the first and second floor of this building. You will be provided with the actual laboratory room numbers on arrival. The details .of the rooms will be pasted at the entrance door to this building.

Directions

Please visit the Unisa website www.unisa.ac.za for detailed directions to the Unisa Florida Science Campus. Alternatively use Google Maps to get the directions from wherever you will be starting your trip from.

GPS Co-ordinates: -26.158842, 27.904002



All CHEMISTRY PRACTICAL SESSIONS WILL TAKE PLACE IN THE EUREKA BUILDING, K