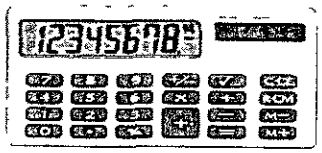
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

CHE1502 (469021) October/November 2013

GENERAL CHEMISTRY IB

Duration 2 Hours

100 Marks

EXAMINERS
FIRST PROF CA SUMMERS
SECOND MR LG LESENYEHO

Use of a non-programmable pocket calculator is permissible

Closed book examination

This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue

EXAMINATION PAPER UNIQUE NUMBER: 469021

The examination paper consists of 23 pages (a periodic table is on page 23) plus 5 pages for rough work plus instructions for completion of the mark reading sheet

The examination paper consists of two parts:

SECTION A: consists of 40 multiple choice questions –answer on marking reading sheet

SECTION B: Written questions – answer in green book.

SECTION A. Each question is allocated TWO marks- 80 marks
SECTION B: 20 marks

The multiple choice questions have four possible answers. In each case, provide only ONE answer to each question

The use of molecular models is permissible

ANSWER ALL QUESTIONS IN SECTION A AND SECTION B

SECTION A

This section consists of **40 MULTIPLE CHOICE QUESTIONS**

Answer ALL **the questions in this section on the MARK READING SHEET**

Unique Number **469021**

1 What type of bonding is found in the carbon dioxide molecule, CO_2?

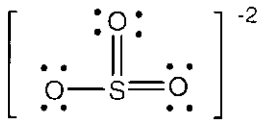
(1) nonpolar covalent
(2) ionic
(3) a mixture of covalent and ionic
(4) polar covalent

2 The ground state electron configuration of Cu^{2+} is

(1) [Ar] $3d^9$
(2) [Ar] $3d^{10}\ 4s^1$
(3) [Ar] $3d^{10}$
(4) [Ar] $3d^8\ 4s^1$

3 Which of the following is NOT a valid Lewis structure of the SO_3^{-2} ion?

(1)



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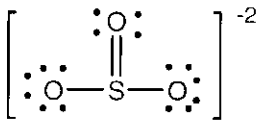

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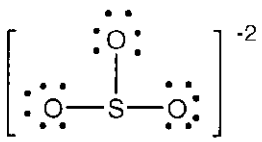

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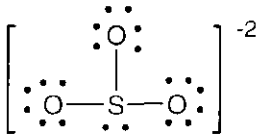
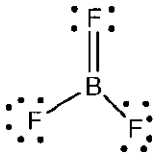
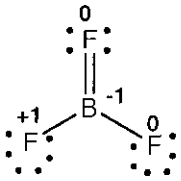


4 Consider the representation of BF_3 below



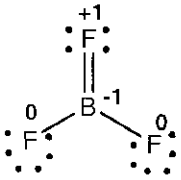
The formal charges on each atom are shown in bold The CORRECT formal charges on the atoms are

(1)



(2) All zero

(3)



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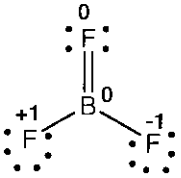
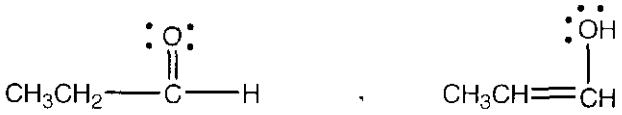


5 Which of the following choices represent a pair of resonance forms?

(1)

(2)

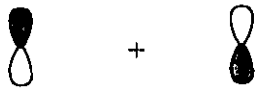
(3)



(4)

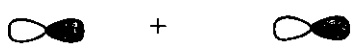
6 Which atomic orbital combination would result in a molecular PI (π) bond?

(1)



(2)

(3)

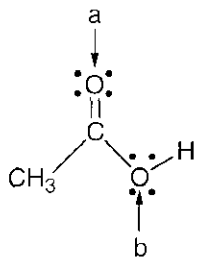


(4)

7 Use the VSEPR method and predict the shape of the SO_2 molecule

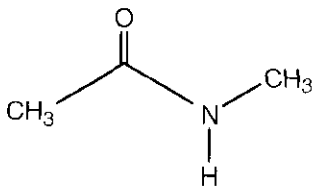
(1) tetrahedral
(2) Square planar
(3) bent
(4) trigonal pyramidal

8 The hybridization states of the oxygen atoms in the molecule shown below are



(1) a = sp^3, b = sp^3
(2) a = sp^3, b = sp^2
(3) a = sp^2, b = sp^2
(4) a = sp^2, b = sp^3

9 Based on the structure of the following compound, which statement is INCORRECT?



(1) the carbon –oxygen bond is non-polar
(2) the sigma bond of the carbonyl is formed from the overlap of a sp^2 hybrid atomic orbital of carbon and a sp^2 hybrid atomic orbital of oxygen
(3) the value for the H-N-CH_3 bond angle is 120 degrees
(4) there is a non-bonding electron pair on nitrogen

10 Which intermolecular forces are present in ethanol, CH_3CH_2OH (s)?

(1) Dipole-dipole only

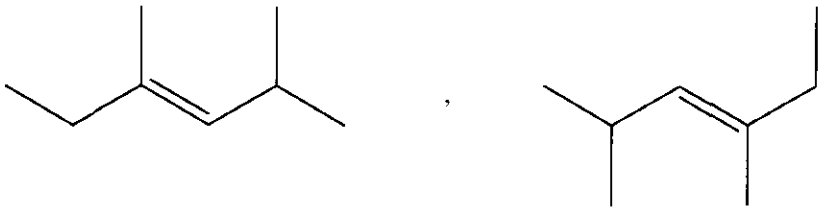
(2) Hydrogen-bonding only

(3) London dispersion and dipole-dipole

(4) London dispersion, dipole-dipole and hydrogen bonding

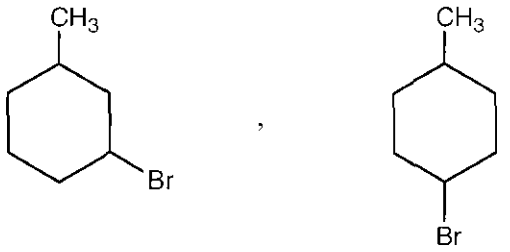
11 Which of the following pairs of compounds are constitutional isomers?

(1)



(2) $CH_3CH_2OCH_2CH_3$ and $CH_3CH_2CH_2OH$

(3)



(4)

12 The hydroxide ion, HO^-, DOES function as

(1) an electron-pair acceptor

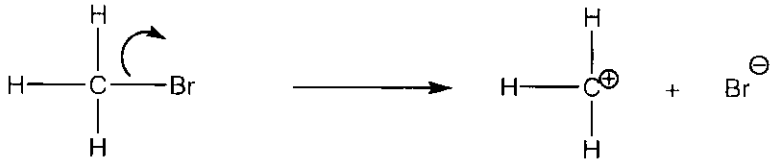
(2) an electrophile

(3) a Lewis acid

(4) a nucleophile

13 Identify the CORRECT process of homolytic bond breaking below

(1)



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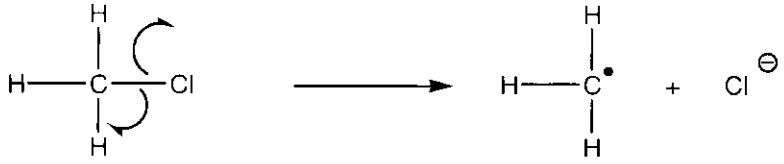

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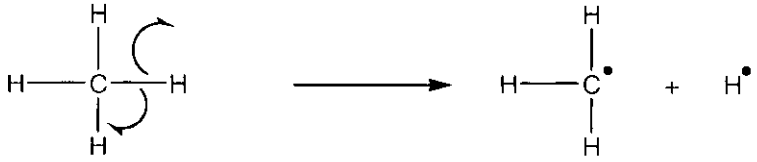

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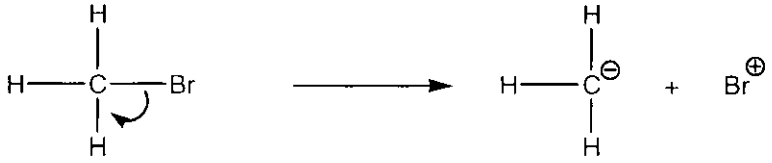
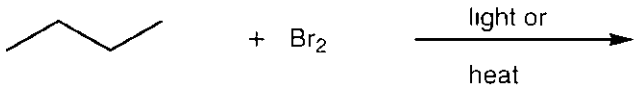
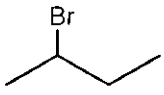


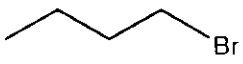
14 What is the MAJOR monobrominated product formed in the following reaction?



(1)



(2)



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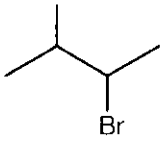

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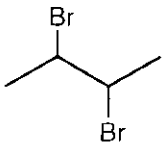
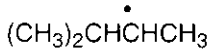
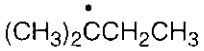


15 Rank the following radicals in order of INCREASING stability (from least stable to most stable)


A


B


C

(1) A<B<C

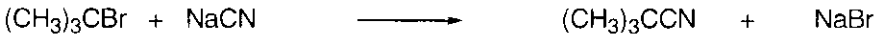
(2) B<A<C

(3) B<C<A

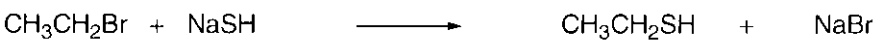
(4) C<A<B

16 Which of the following reactions proceeds via an S_N1 reaction mechanism?

(1)



(2)



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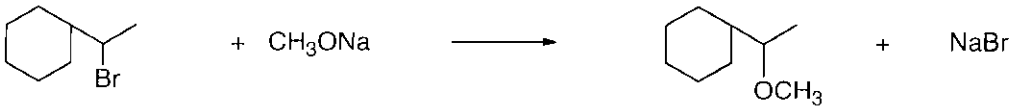
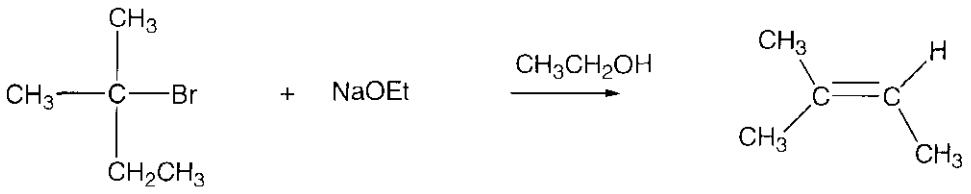


(4)

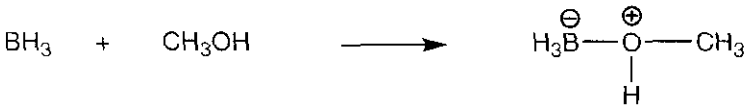
17 Which of the following reactions is an example of a substitution reaction?

(1)



(2)

(3)



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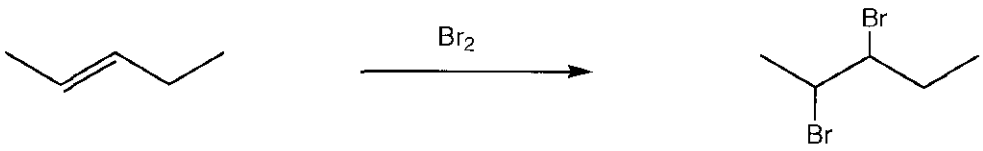


18 Which of the following species will react the FASTEST in a S_N2 nucleophilic substitution reaction?

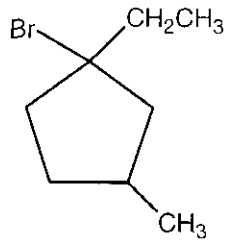
(1) $(CH_3)_2CH\text{-}I$

(2) $CH_3CH_2CH_2\text{-}I$

(3) $CH_3\text{-}I$

(4) $(CH_3)_3C\text{-}I$

19 What is the IUPAC name of the molecule shown below?



(1) 3-ethyl-3-bromo -1-methylcyclopentane

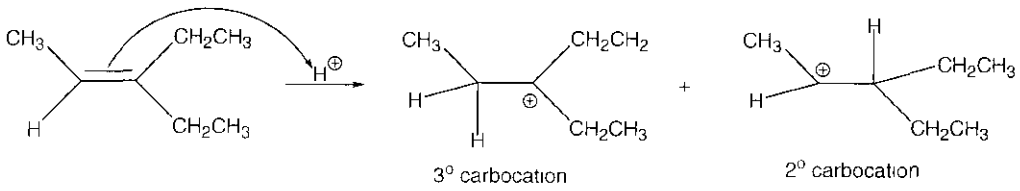
(2) 1-bromo-1-ethyl-3-methylcyclopentane

(3) 1-bromo-(3-methylcyclopentyl)propane

(4) 3-bromo-3-ethyl-1-methylcyclopentane

20 Which of the following mechanisms is a CORRECT representation of an E2 reaction?

(1)



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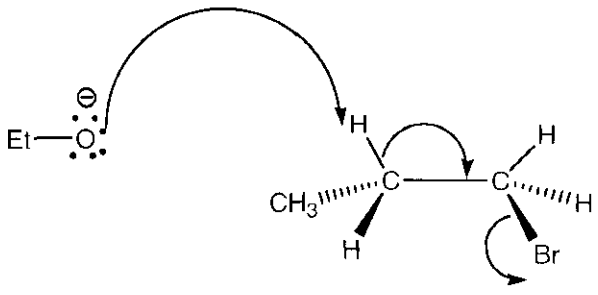

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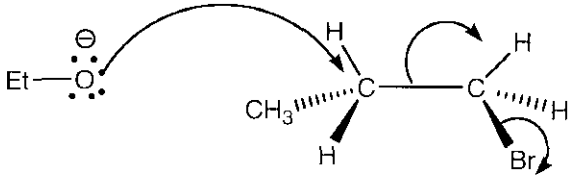

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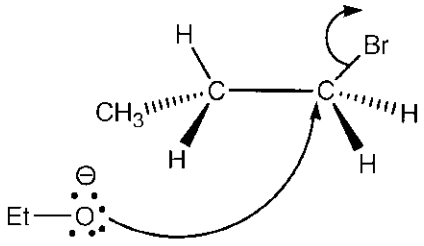
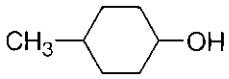


21 Alcohols undergo dehydration in the presence of a strong acid Which of the following alcohols undergoes dehydration at the FASTEST rate?

(1)



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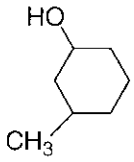

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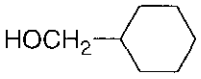

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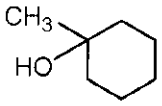
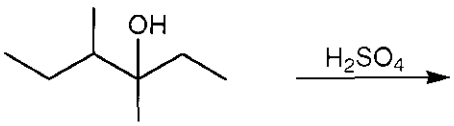
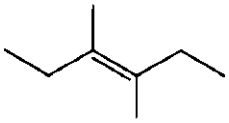


22 Dehydration of alcohols leads to alkenes What is the MAJOR product of following reaction?



(1)



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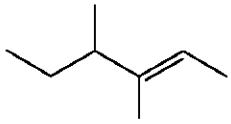
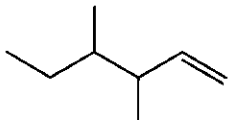


(3)



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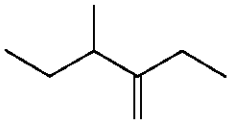
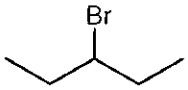


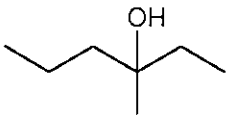
23 Which of the following molecules has a chiral (asymmetric) carbon atom?

(1)



(2)

(3)



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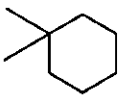
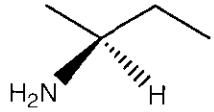


24 The absolute configuration of a chiral carbon is defined as R- or S- according to the Cahn-Ingold-Prelog rules What is the name for the following compound?



(1) R-3-aminobutane

(2) S-2-aminobutane

(3) S-2-nitrobutane

(4) R-2-aminobutane

25 The compound shown in 22 above is

(1) a secondary amine

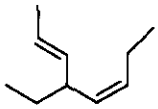
(2) a primary amine

(3) a tertiary amine

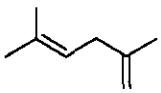
(4) a diamine

26 Which of the following structures contains ONLY *CIS* double bonds?

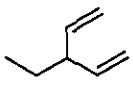
(1)



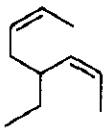
(2)



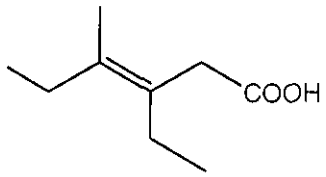
(3)



(4)



27 Name the following compound according to the IUPAC rules



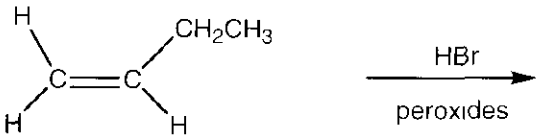
(1) (E)-3- ethyl-4-methyl-3-hexenoic acid

(2) (Z)-3- ethyl-4-methyl-3-hexenoic acid

(3) (E)-1,2-diethyl-1-methyl-1-butenoic acid

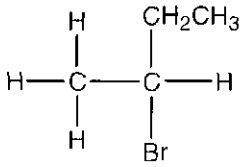
(4) (Z)-1,2-diethyl-1-methyl-1-butenoic acid

28 Consider the following reaction

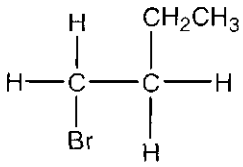


The product formed in the reaction is

(1)



(2)



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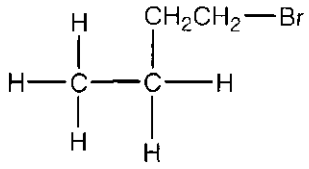
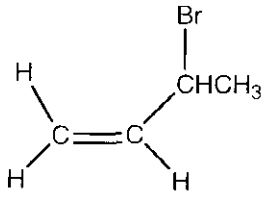
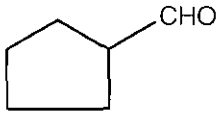


(4)



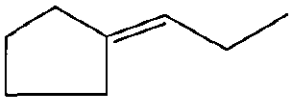
29 An unknown alkene was treated with ozone and then with Zn/H_2O The reaction products isolated were



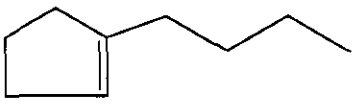
+ CH_3CH_2CHO

What is the structure of the unknown alkene?

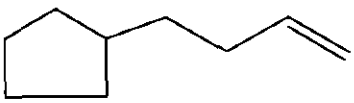
(1)



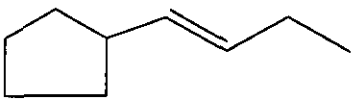
(2)



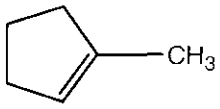
(3)



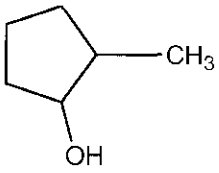
(4)



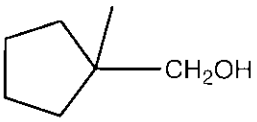
30 Which of the following alcohols is produced by the acid catalyzed hydration of the following compound?



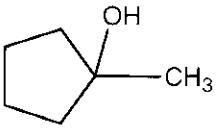
(1)



(2)



(3)



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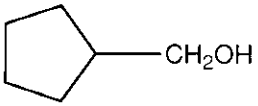
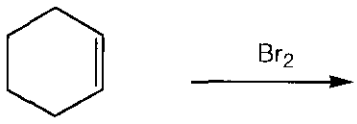
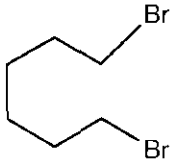


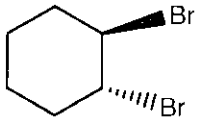
31 What is the major organic product formed in the following reaction?



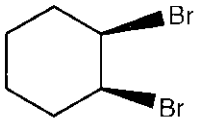
(1)



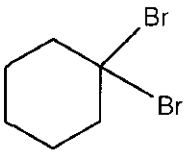
(2)



(3)

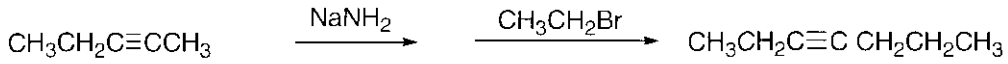


(4)

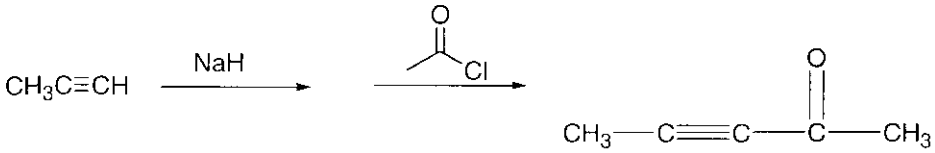


32 Terminal alkynes are very weak acids and only react with very strong bases Which of the following reactions will **NOT** take place?

(1)



(2)



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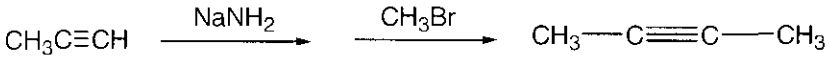
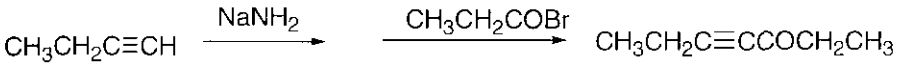
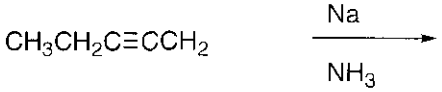


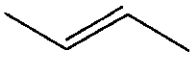
(4)



33 What is the structure of the major organic product(s) in the reaction sequence below?

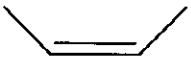


(1)

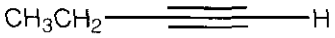


(2)

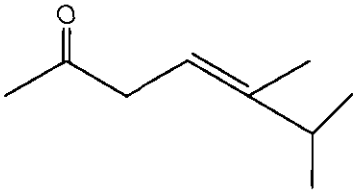
(3)



(4)



34 What is the IUPAC name for the following compound?



(1) 5,6-dimethyl-4-hepten-2-one

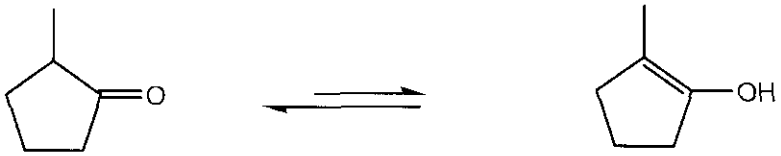
(2) 5-(2-propyl)-4-hexen-2-one

(3) 2-(2-propyl)-2-hexen-5-one

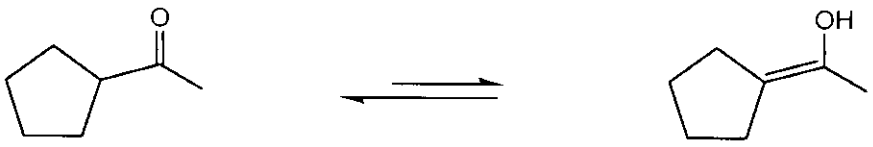
(4) 1-carboxy-3,4-dimethyl-2-pentene

35 Which of the following DOES NOT represent keto-enol tautomerism?

(1)



(2)



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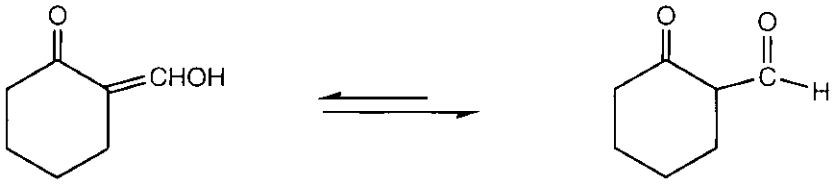
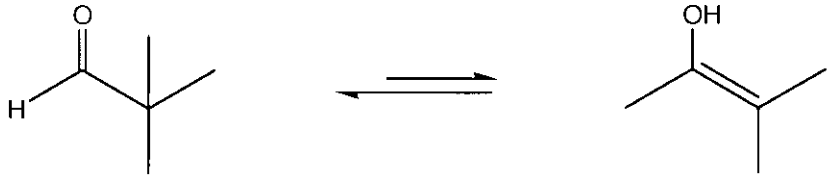
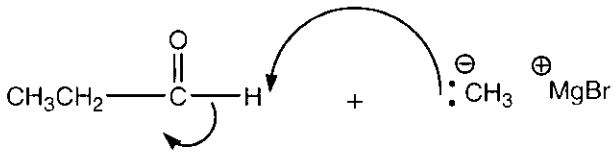


(4)

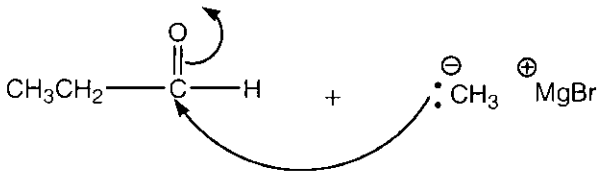


36 Ketones and aldehydes undergo nucleophilic addition reactions Which of the following steps is the CORRECT mechanism of the reaction of an aldehyde, propanal with the nucleophile, methylmagnesium bromide?

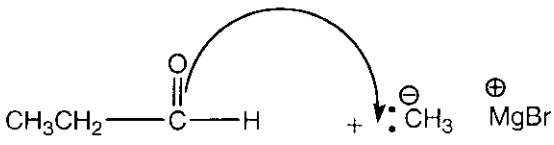
(1)



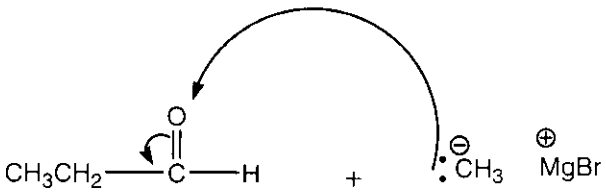
(2)



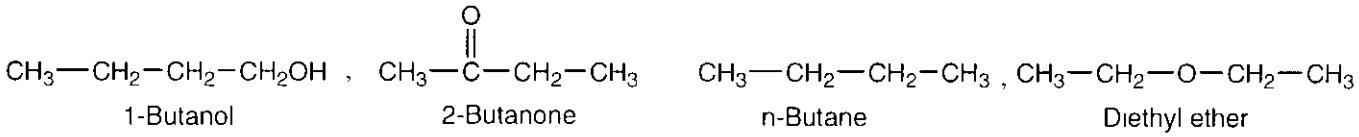
(3)



(4)



37 Consider the compounds below



Which of the following represents the correct ranking in terms of increasing boiling point (from lowest to highest)?

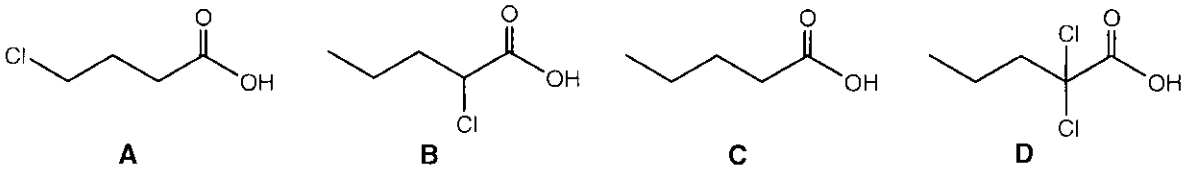
(1) *n*-butane < 1-butanol < diethyl ether < 2-butanone

(2) 2-butanone < *n*-butane < diethyl ether < 1-butanol

(3) *n*-butane < diethyl ether < 2-butanone < 1-butanol

(4) *n*-butane < diethyl ether < 1-butanol < 2-butanone

38 List the following weak acids in order of increasing acidity (from lowest to highest)



(1) D < C < B <A

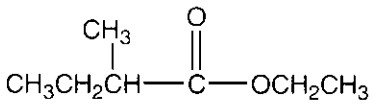
(2) D < A < B < C

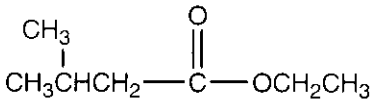
(3) C < A < B < D

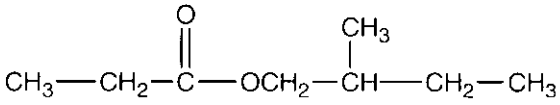
(4) B <C < A < D

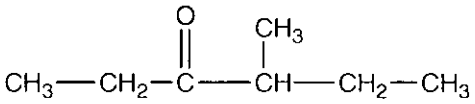
39 What is the correct structure of ethyl 3-methylbutanoate?

(1)

(2) 

(3) 

(4) 



40 Amides are less basic than amines because

(1) the carbonyl group withdraws electrons by resonance

(2) the carbonyl group donates electrons by resonance

(3) the nitrogen does not have a lone pair of electrons

(4) the nitrogen has a full positive charge

[80]

SECTION B

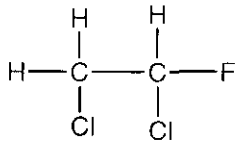
Answer ALL the questions in this section.

Answer this section in the GREEN EXAMINATION BOOK.

Question 1

(a) Draw the Newman projections of the different conformations of the compound shown below

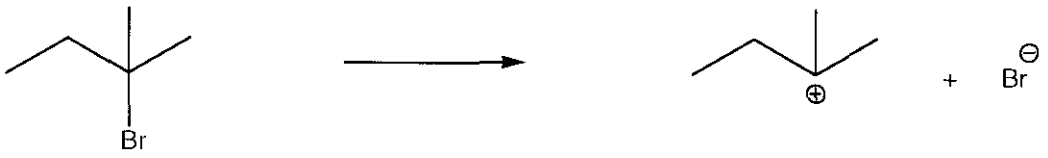
Label the most stable and least stable conformation



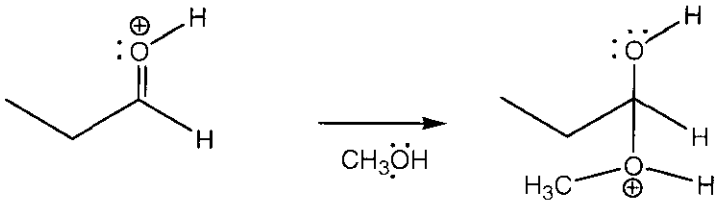
(6)

(b) Use curved arrows to show how the bond(s) break /form in the following processes

(i)



(ii)



(4)
[10]

Question 2

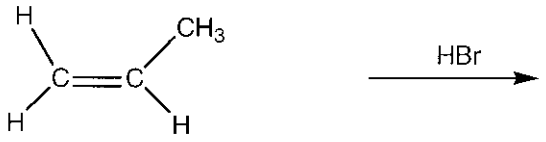
(a) Draw the 3-dimensional structure of *R*-2-butanol

(2)

(b) Draw the geometric isomers of 3-bromo-4-methylhept-3-ene Provide the IUPAC name of each isomer

(4)

(c) Alkenes react with hydrogen halides to give alkyl halides as products Give the step-wise mechanism for the following reaction



(4)
[10]

TOTAL MARKS [100]

Periodic Table of Elements

1 1A																		18 VIIIA
1 H 1 008	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4 003
3 Li 6 941	4 Be 9 012											5 B 10 81	6 C 12 01	7 N 14 01	8 O 16 00	9 F 19 00	10 Ne 20 18
11 Na 22 99	12 Mg 24 31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 Al 26 98	14 Si 28 09	15 P 30 97	16 S 32 07	17 Cl 35 45	18 Ar 39 95
19 K 39 10	20 Ca 40 08	21 Sc 44 96	22 Ti 47 88	23 V 50 94	24 Cr 52 00	25 Mn 54 94	26 Fe 55 85	27 Co 58 93	28 Ni 58 69	29 Cu 63 55	30 Zn 65 39	31 Ga 69 72	32 Ge 72 59	33 As 74 92	34 Se 78 96	35 Br 79 90	36 Kr 83 80
37 Rb 85 47	38 Sr 87 62	39 Y 88 91	40 Zr 91 22	41 Nb 92 91	42 Mo 95 94	43 Tc (98)	44 Ru 101 1	45 Rh 102 9	46 Pd 106 4	47 Ag 107 9	48 Cd 112 4	49 In 114 8	50 Sn 118 7	51 Sb 121 8	52 Te 127 6	53 I 126 9	54 Xe 131 3
55 Cs 132 9	56 Ba 137 3	57 La* 138 9	72 Hf 178 5	73 Ta 180 9	74 W 183 8	75 Re 186 2	76 Os 190 2	77 Ir 192 2	78 Pt 195 1	79 Au 197 0	80 Hg 200 6	81 Tl 204 4	82 Pb 207 2	83 Bi 209 0	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac** (227)	104 Unq (257)	105 Unp (260)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)									

1 H 1 008 — Atomic number / Symbol / Atomic weight

*Lanthanides	58 Ce 140 1	59 Pr 140 9	60 Nd 144 2	61 Pm (147)	62 Sm 150 4	63 Eu 152 0	64 Gd 157 3	65 Tb 158 9	66 Dy 162 5	67 Ho 164 9	68 Er 167 3	69 Tm 168 9	70 Yb 173 0	71 Lu 175 0
**Actinides	90 Th 232 0	91 Pa (231)	92 U 238 0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lw (257)

ROUGH WORK

ROUGH WORK

ROUGH WORK

ROUGH WORK

ROUGH WORK

UNIVERSITY OF SOUTH AFRICA UNISA university of south africa UNIVERSITEIT VAN SUID-AFRIKA

EXAMINATION MARK READING SHEET EKSAMEN-MERKLEESBLAD

PART 1 (GENERAL/ALGEMEEN) DEEL 1

STUDY UNIT e.g. PSY100-X
STUDIE EENHEID bv. PSY100 X

1

PAPER NUMBER
VRAESTELNOMMER

2

INITIALS AND SURNAME
VOORLETTERS EN VAN

3

DATE OF EXAMINATION
DATUM VAN EKSAMEN

4

EXAMINATION CENTRE (E.G. PRETORIA)
EKSAMENSENTRUM (BV. PRETORIA)

5

STUDENT NUMBER
STUDENTENOMMER

6

UNIQUE PAPER NO
UNIEKE VRAESTEL NR

8

7

9

For use by examination invigilator

Vir gebruik deur eksamenopsiener

IMPORTANT

1. USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET
2. MARK LIKE THIS
3. CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY
4. ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT
5. CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY
6. CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY
7. CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED
8. DO NOT FOLD

BELANGRIK

1. GEBRUIK SLEGS 'N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI
2. MERK AS VOLG
3. KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
4. VUL U STUDENTENOMMER VAN LINKS NA REGS IN
5. KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET
6. KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS
7. MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS
8. MOENIE VOU NIE

PART 2 (ANSWERS/ANTWOORDE) DEEL 2

10

1	c1 c2 c3 c4 c5	36	c1 c2 c3 c4 c5	71	c1 c2 c3 c4 c5	106	c1 c2 c3 c4 c5
2	c1 c2 c3 c4 c5	37	c1 c2 c3 c4 c5	72	c1 c2 c3 c4 c5	107	c1 c2 c3 c4 c5
3	c1 c2 c3 c4 c5	38	c1 c2 c3 c4 c5	73	c1 c2 c3 c4 c5	108	c1 c2 c3 c4 c5
4	c1 c2 c3 c4 c5	39	c1 c2 c3 c4 c5	74	c1 c2 c3 c4 c5	109	c1 c2 c3 c4 c5
5	c1 c2 c3 c4 c5	40	c1 c2 c3 c4 c5	75	c1 c2 c3 c4 c5	110	c1 c2 c3 c4 c5
6	c1 c2 c3 c4 c5	41	c1 c2 c3 c4 c5	76	c1 c2 c3 c4 c5	111	c1 c2 c3 c4 c5
7	c1 c2 c3 c4 c5	42	c1 c2 c3 c4 c5	77	c1 c2 c3 c4 c5	112	c1 c2 c3 c4 c5
8	c1 c2 c3 c4 c5	43	c1 c2 c3 c4 c5	78	c1 c2 c3 c4 c5	113	c1 c2 c3 c4 c5
9	c1 c2 c3 c4 c5	44	c1 c2 c3 c4 c5	79	c1 c2 c3 c4 c5	114	c1 c2 c3 c4 c5
10	c1 c2 c3 c4 c5	45	c1 c2 c3 c4 c5	80	c1 c2 c3 c4 c5	115	c1 c2 c3 c4 c5
11	c1 c2 c3 c4 c5	46	c1 c2 c3 c4 c5	81	c1 c2 c3 c4 c5	116	c1 c2 c3 c4 c5
12	c1 c2 c3 c4 c5	47	c1 c2 c3 c4 c5	82	c1 c2 c3 c4 c5	117	c1 c2 c3 c4 c5
13	c1 c2 c3 c4 c5	48	c1 c2 c3 c4 c5	83	c1 c2 c3 c4 c5	118	c1 c2 c3 c4 c5
14	c1 c2 c3 c4 c5	49	c1 c2 c3 c4 c5	84	c1 c2 c3 c4 c5	119	c1 c2 c3 c4 c5
15	c1 c2 c3 c4 c5	50	c1 c2 c3 c4 c5	85	c1 c2 c3 c4 c5	120	c1 c2 c3 c4 c5
16	c1 c2 c3 c4 c5	51	c1 c2 c3 c4 c5	86	c1 c2 c3 c4 c5	121	c1 c2 c3 c4 c5
17	c1 c2 c3 c4 c5	52	c1 c2 c3 c4 c5	87	c1 c2 c3 c4 c5	122	c1 c2 c3 c4 c5
18	c1 c2 c3 c4 c5	53	c1 c2 c3 c4 c5	88	c1 c2 c3 c4 c5	123	c1 c2 c3 c4 c5
19	c1 c2 c3 c4 c5	54	c1 c2 c3 c4 c5	89	c1 c2 c3 c4 c5	124	c1 c2 c3 c4 c5
20	c1 c2 c3 c4 c5	55	c1 c2 c3 c4 c5	90	c1 c2 c3 c4 c5	125	c1 c2 c3 c4 c5
21	c1 c2 c3 c4 c5	56	c1 c2 c3 c4 c5	91	c1 c2 c3 c4 c5	126	c1 c2 c3 c4 c5
22	c1 c2 c3 c4 c5	57	c1 c2 c3 c4 c5	92	c1 c2 c3 c4 c5	127	c1 c2 c3 c4 c5
23	c1 c2 c3 c4 c5	58	c1 c2 c3 c4 c5	93	c1 c2 c3 c4 c5	128	c1 c2 c3 c4 c5
24	c1 c2 c3 c4 c5	59	c1 c2 c3 c4 c5	94	c1 c2 c3 c4 c5	129	c1 c2 c3 c4 c5
25	c1 c2 c3 c4 c5	60	c1 c2 c3 c4 c5	95	c1 c2 c3 c4 c5	130	c1 c2 c3 c4 c5
26	c1 c2 c3 c4 c5	61	c1 c2 c3 c4 c5	96	c1 c2 c3 c4 c5	131	c1 c2 c3 c4 c5
27	c1 c2 c3 c4 c5	62	c1 c2 c3 c4 c5	97	c1 c2 c3 c4 c5	132	c1 c2 c3 c4 c5
28	c1 c2 c3 c4 c5	63	c1 c2 c3 c4 c5	98	c1 c2 c3 c4 c5	133	c1 c2 c3 c4 c5
29	c1 c2 c3 c4 c5	64	c1 c2 c3 c4 c5	99	c1 c2 c3 c4 c5	134	c1 c2 c3 c4 c5
30	c1 c2 c3 c4 c5	65	c1 c2 c3 c4 c5	100	c1 c2 c3 c4 c5	135	c1 c2 c3 c4 c5
31	c1 c2 c3 c4 c5	66	c1 c2 c3 c4 c5	101	c1 c2 c3 c4 c5	136	c1 c2 c3 c4 c5
32	c1 c2 c3 c4 c5	67	c1 c2 c3 c4 c5	102	c1 c2 c3 c4 c5	137	c1 c2 c3 c4 c5
33	c1 c2 c3 c4 c5	68	c1 c2 c3 c4 c5	103	c1 c2 c3 c4 c5	138	c1 c2 c3 c4 c5
34	c1 c2 c3 c4 c5	69	c1 c2 c3 c4 c5	104	c1 c2 c3 c4 c5	139	c1 c2 c3 c4 c5
35	c1 c2 c3 c4 c5	70	c1 c2 c3 c4 c5	105	c1 c2 c3 c4 c5	140	c1 c2 c3 c4 c5