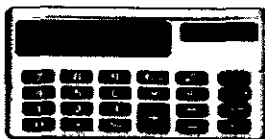


UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA 
university
of south africa

CHE1502

(494714)

May/June 2015

GENERAL CHEMISTRY IB

Duration 2 Hours

100 Marks

EXAMINERS .

FIRST

SECOND

PROF CA SUMMERS

MR KGLL 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: 494714

The examination paper consists of 23 pages plus 5 pages for rough work (pp 24-28) plus instructions for completion of the mark reading sheet.

The examination paper consists of **TWO** parts:

SECTION A: 60 Marks

Consisting of 35 multiple choice questions which must be answered on a marking reading sheet. Each question is allocated **TWO** marks.

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

SECTION B: 40 Marks

This section consists of written questions which must be answered in spaces provided on the examination paper.

The use of molecular models is permissible

ANSWER ALL QUESTIONS IN SECTION A AND SECTION B

SECTION A

This section consists of 30 MULTIPLE CHOICE QUESTIONS.

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

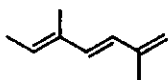
Unique Number 494714

- 1 Which of the following compounds contains the greatest number of sp^2 hybridized carbon atoms?

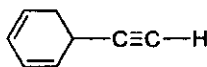
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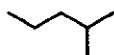
(2)



(3)

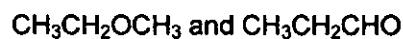


(4)



- 2 Which of the following pairs of compounds are structural / constitutional isomers?

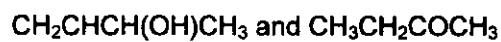
(1)



(2)



(3)



(4)



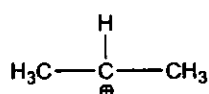
[TURN OVER]

3 Which of the following compounds can easily donate a pair of electrons?

(1)



(2)



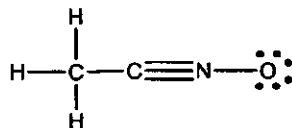
(3)



(4)



4 In the structure below, the NON-ZERO formal charges present in the molecule are



(1) -1 on N and +1 on C

(2) +1 on N and -1 on C

(3) +1 on N and -1 on O

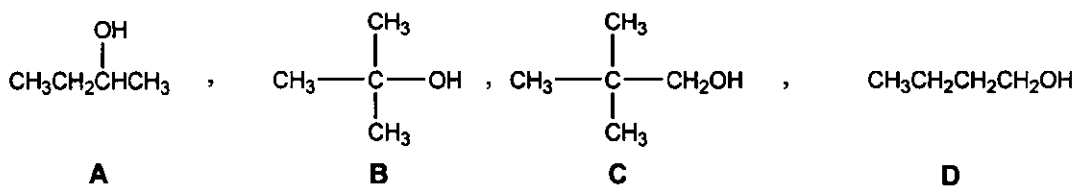
(4) +1 on C and -1 on O

5 Which of the following set of radicals represent AN ORDER OF INCREASING STABILITIES, i.e. from THE LEAST STABLE TO THE MOST STABLE

[TURN OVER]

- (1) $\dot{\text{C}}\text{H}_2\text{CH}_2\text{CH}(\text{CH}_3)_2 < \text{CH}_3\text{CH}_2\dot{\text{C}}(\text{CH}_3)_2 < \text{CH}_3\dot{\text{C}}\text{HCH}(\text{CH}_3)_2$
- (2) $\text{CH}_3\text{CH}_2\dot{\text{C}}(\text{CH}_3)_2 < \text{CH}_3\dot{\text{C}}\text{HCH}(\text{CH}_3)_2 < \dot{\text{C}}\text{H}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$
- (3) $\text{CH}_3\dot{\text{C}}\text{HCH}(\text{CH}_3)_2 < \text{CH}_3\text{CH}_2\dot{\text{C}}(\text{CH}_3)_2 < \dot{\text{C}}\text{H}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$
- (4) $\dot{\text{C}}\text{H}_2\text{CH}_2\text{CH}(\text{CH}_3)_2 < \text{CH}_3\dot{\text{C}}\text{HCH}(\text{CH}_3)_2 < \text{CH}_3\text{CH}_2\dot{\text{C}}(\text{CH}_3)_2$

6 Consider the following compounds



Which statement regarding the above compounds is **INCORRECT**?

- (1) **B** is a tertiary alcohol
- (2) **C** and **D** are secondary alcohols
- (3) All of the compounds contain a poor leaving group
- (4) The compound, **A**, is chiral
- 7 The following compounds have similar molecular weights. Which compound is capable of forming hydrogen bonding?

[TURN OVER]

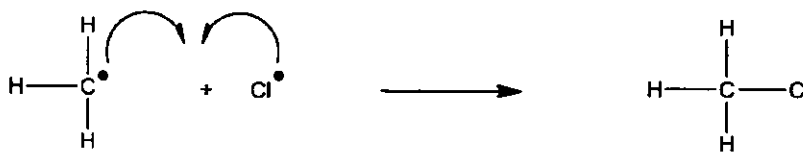
- (1) $\text{CH}_3\text{CH}_2\text{OH}$
- (2) $\text{CH}_3\text{C}(=\text{O})\text{H}$
- (3) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (4) CH_3OCH_3

8 Which of the following processes is a CORRECT representation of HOMOLYTIC BOND FORMATION?

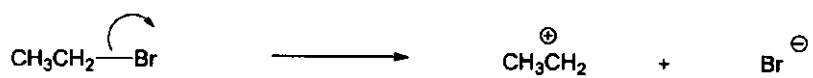
(1)



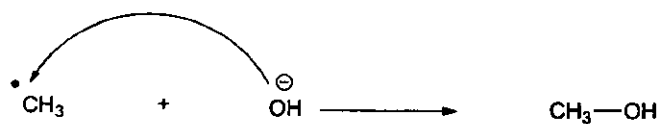
(2)



(3)

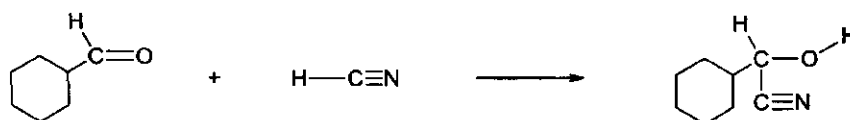


(4)



[TURN OVER]

9 Classify the following reaction

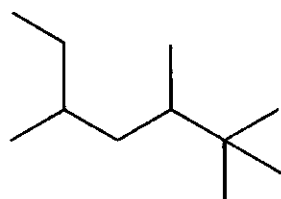


- (1) elimination reaction
- (2) substitution reaction
- (3) addition reaction
- (4) rearrangement reaction

10 In order for a reagent to behave as an electrophile it **must** have

- (1) an overall positive charge or an empty orbital
- (2) a nitrogen or sulfur atom
- (3) a non-bonding electron pair
- (4) an overall negative charge

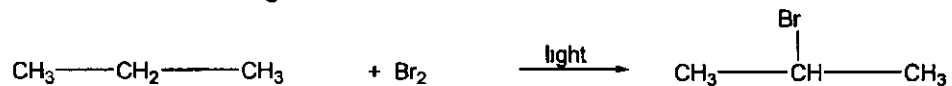
11 What is the IUPAC name of the molecule shown below?



- (1) 1,2,4-trimethylheptane
- (2) 5-ethyl-2,2,3-trimethylhexane
- (3) 2,2,3,5-tetramethylheptane
- (4) 3,5,6,6-tetramethylheptane

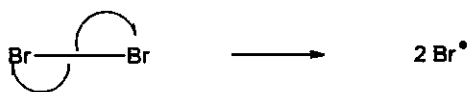
[TURN OVER]

12 Consider the following reaction

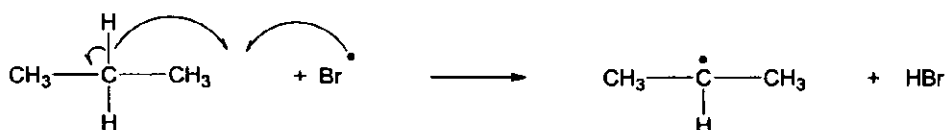


Which step is NOT relevant to the mechanism of the reaction?

(1)



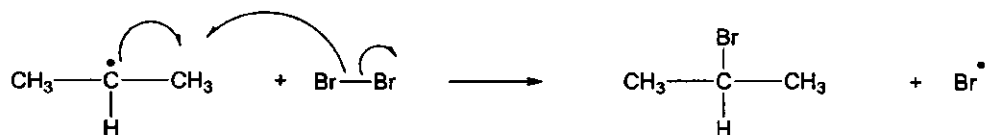
(2)



(3)



(4)



13 Which of the following compounds will be the BEST nucleophile to react in an $\text{S}_{\text{N}}2$ -type reaction?

- (1) $(\text{CH}_3)_2\text{C}=\text{O}$
- (2) CH_3Cl
- (3) CN^-
- (4) CH_3OH

[TURN OVER]

14 Consider the general reaction



Which example below will take place the FASTEST?

(1)



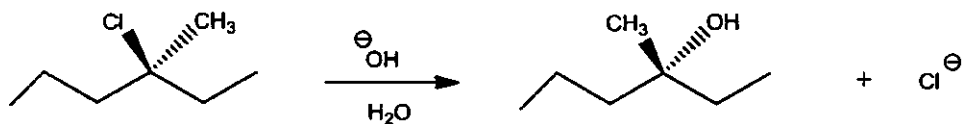
(2)



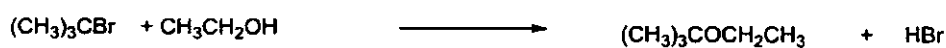
(3)



(4)



15 Ethanol reacts with *tert*-butyl bromide according to the reaction shown below



If the concentration of ethanol is doubled, by what factor will the rate of the reaction change?

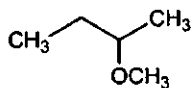
[TURN OVER]

- (1) Remain the same
- (2) Increase by a factor of 2
- (3) Increase by a factor of 4
- (4) Decrease by a factor of 2

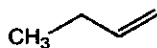
16 Alkyl halides may undergo nucleophilic substitution reactions. Which of the following reaction products is obtained in the following reaction?



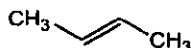
(1)



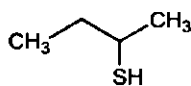
(2)



(3)



(4)



17 Which of the following compounds has cis-trans isomers?

- (1) $\text{BrHC}=\text{C}(\text{CH}_3)_2$
- (2) $\text{CH}_3\text{C}\equiv\text{CH}$
- (3) $\text{CH}_3\text{CH}=\text{CHCH}_3$
- (4) $\text{H}_2\text{C}=\text{C}(\text{CH}_3)_2$

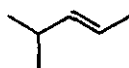
[TURN OVER]

18 Consider the following reaction

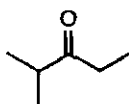


Which compound is the MAJOR PRODUCT of the reaction?

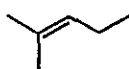
(1)



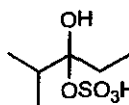
(2)



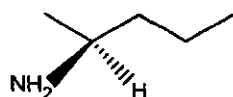
(3)



(4)



19 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)-2-aminopentane

(2) (S)-4-aminopentane

(3) (S)-2-aminopentane

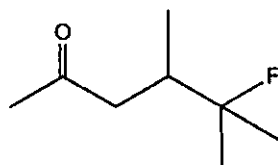
(4) (S)-2-nitropentane

[TURN OVER]

20 Using Zaitsev's rule, choose the most stable alkene among the following

- (1) 3-methylcyclohexene
- (2) 4-methylcyclohexene
- (3) They are all of equal stability
- (4) 1-methylcyclohexene

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



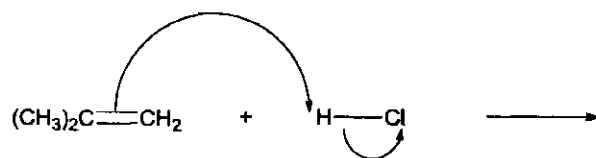
- (1) 5-fluoro-4,5-dimethylhexan-2-one
- (2) 4-fluoro-4,5,5-trimethylpentan-2-one
- (3) 1-fluoro-1,1,2-trimethylpentan-4-one
- (4) 2-fluoro-2,3-dimethylhexan-5-one

22 Consider the compounds, ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) and ethanamine ($\text{CH}_3\text{CH}_2\text{NH}_2$)
Which statement below is INCORRECT?

- (1) Ethanol has a higher boiling point than ethanamine
- (2) The O-H bond is more polar than the N-H because oxygen is more electronegative than nitrogen
- (3) Alcohols form stronger hydrogen-bonds than amines and have higher boiling points
- (4) Ethanamine has a higher boiling point than ethanol

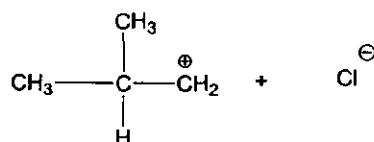
[TURN OVER]

23 Consider the following process

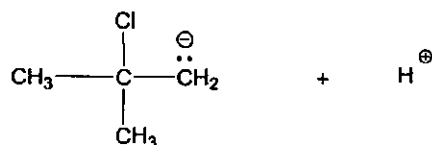


The correct species that is MAINLY formed in the above process is

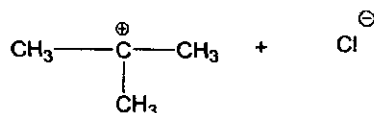
(1)



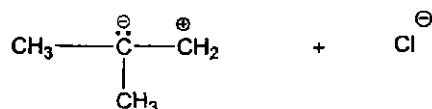
(2)



(3)



(4)

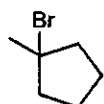


24 Alkenes react with hydrogen halides to give alkyl halides as products. What is the MAJOR organic product formed in the following reaction?

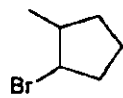
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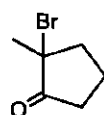
(1)



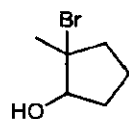
(2)



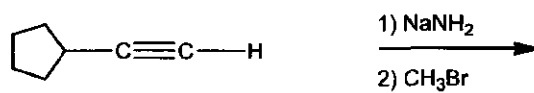
(3)



(4)



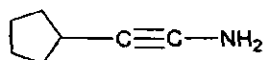
Consider the following reaction sequence TO ANSWER questions 25 and 26 below



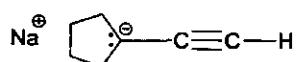
[TURN OVER]

25 What is the structure of the major organic species formed in STEP 1?

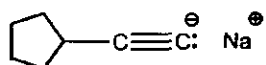
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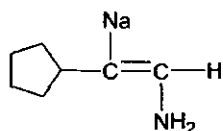
(2)



(3)



(4)

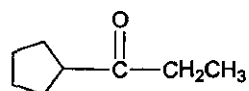


26 What is the structure of the major organic product in the reaction sequence?

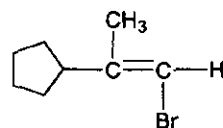
(1)



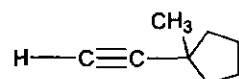
(2)



(3)



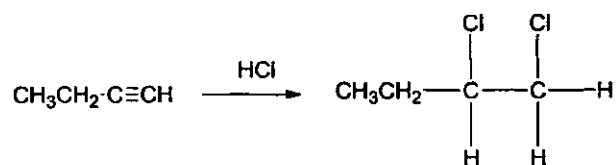
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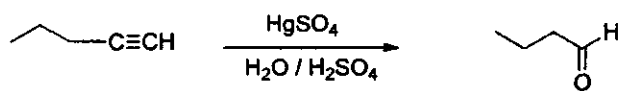
[TURN OVER]

27 Alkynes undergo addition reactions because they contain weak π bonds. Which of the following reactions will take place?

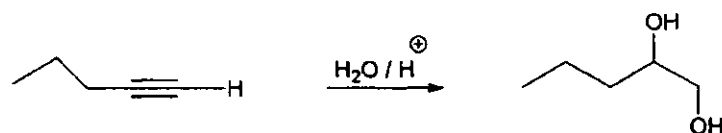
(1)



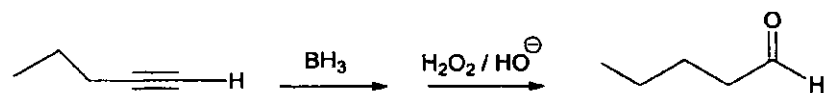
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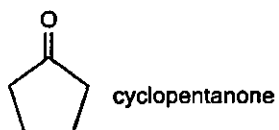
(3)



(4)

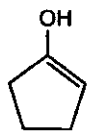


28 Which of the following structures would be considered an enol tautomer of cyclopentanone?

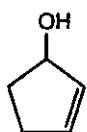


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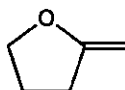
(1)



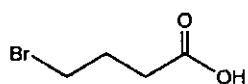
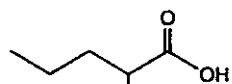
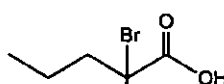
(2)



(3)



(4)

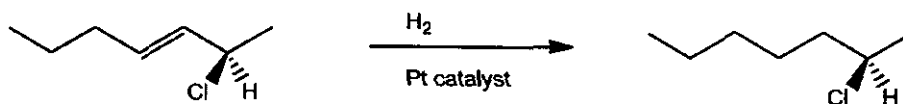
29 Identify the **STRONGEST** acid in the series below**A****B****C**

- (1) A
(2) C
(3) B
(4) A and C

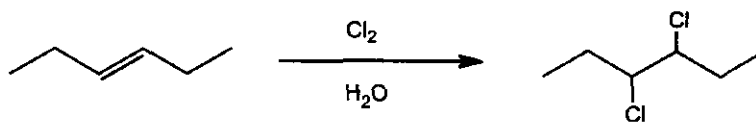
[TURN OVER]

30 Which of the following reactions does NOT produce the MAJOR PRODUCT as shown?

(1)



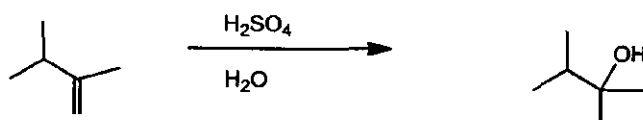
(2)



(3)



(4)



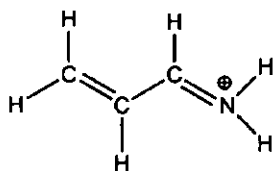
[TURN OVER]

SECTION B

Answer ALL the questions this section in the SPACE PROVIDED AFTER EACH QUESTION.

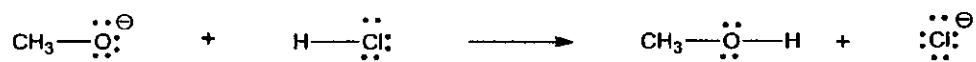
Question 1 [20]

- 1.1 Draw the important resonance forms to show the delocalization of charge in the following species. Indicate the movement of electrons with curved arrows.



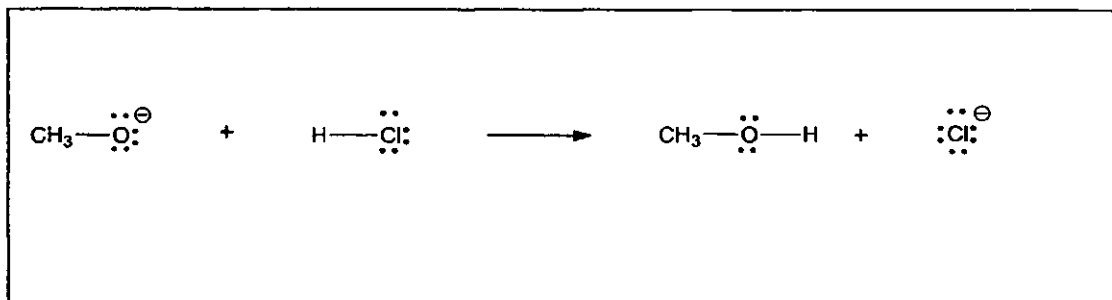
(4)

- 1.2 Use curved arrows to show the movement of electron pairs in the reaction shown below and label the reactants as a Lewis base (nucleophile) or a Lewis acid (electrophile).



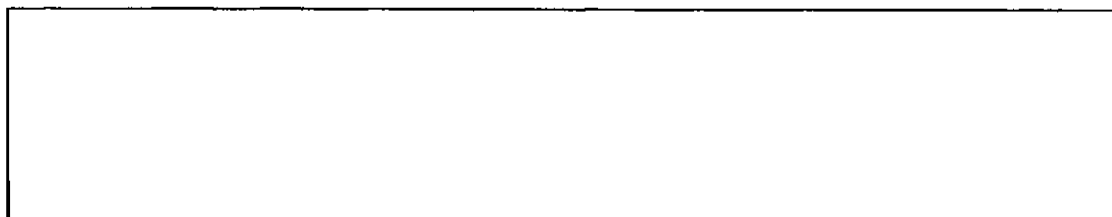
(4)

[TURN OVER]



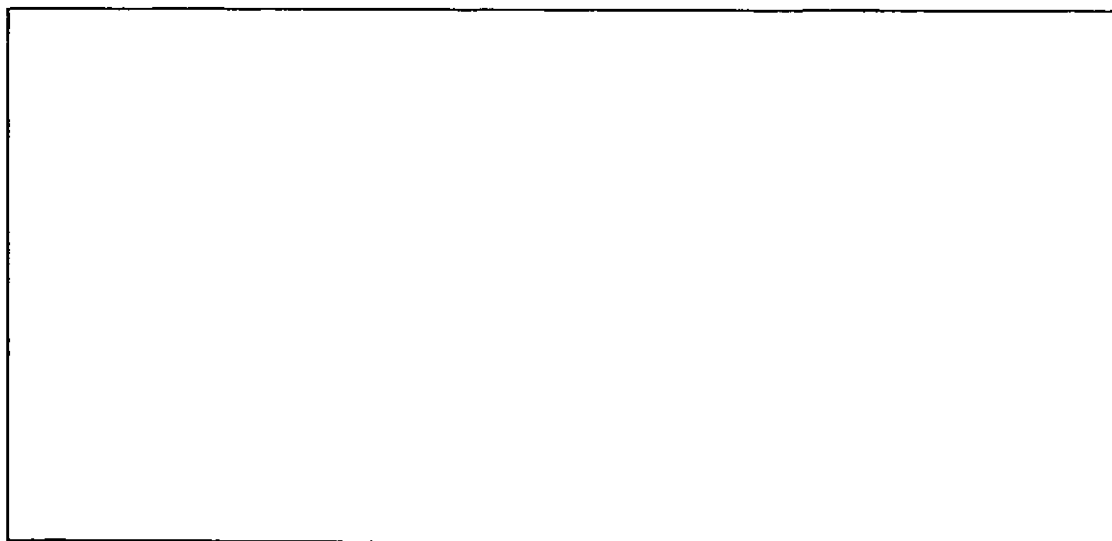
13 (a) Draw the structure of 6-chloro-3,6-dimethyl-2,3-diethylheptane

(2)



(b) Explain what is wrong with the name provided in (a) and give the correct IUPAC name for compound

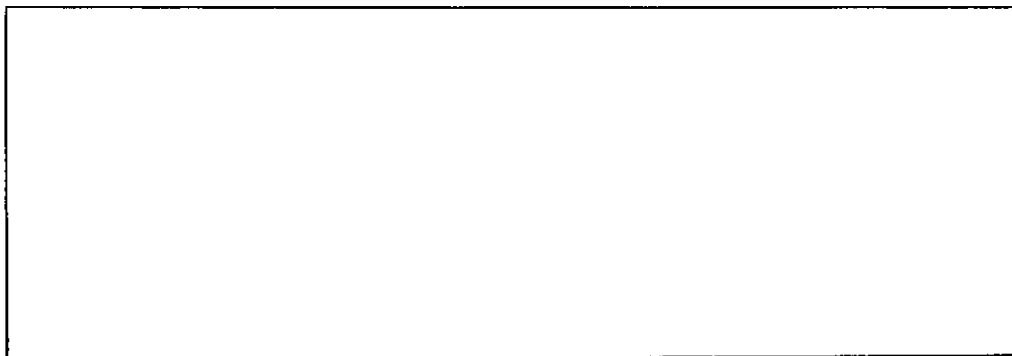
(5)



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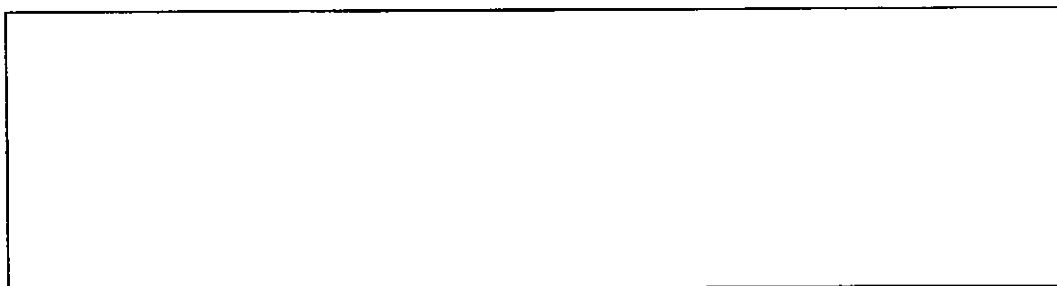
1 4 Draw the geometric isomers of $\text{BrCH}=\text{CHF}$

(2)



1 5 Draw the correct 3-dimensional structure of (R)-2-chlorobutane

(3)



Question 2 [20]

2 1 (a) Write the structure of the MAJOR PRODUCT formed in the reaction of $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$ with H_2O in the presence of an acid catalyst

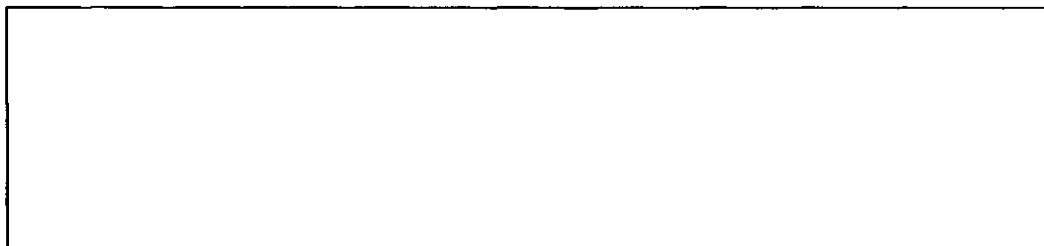
(2)



[TURN OVER]

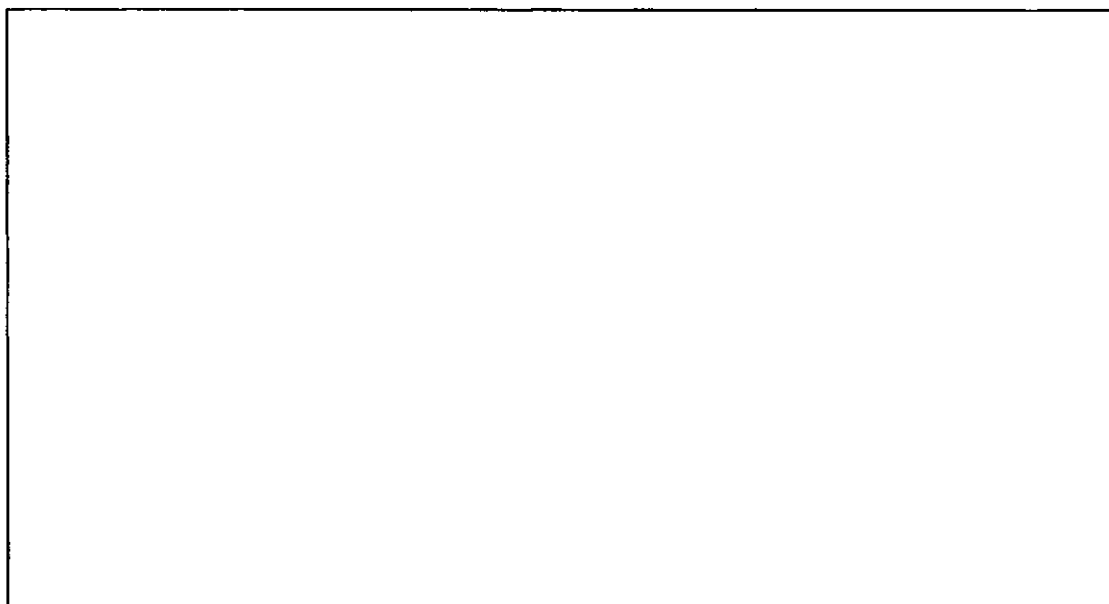
(b) Provide the structure of the intermediate formed in the reaction in (a)

(2)



2.2 Draw the structural formulas for two constitutional / structural isomers for a compound having a molecular formula of C_4H_6

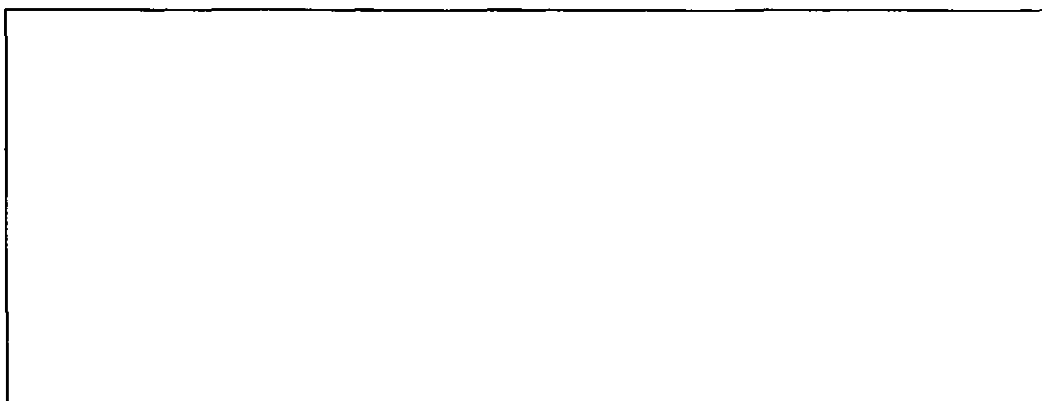
(4)



[TURN OVER]

- 2.3 Draw the Newman projections of the most stable and least stable conformations of 1-bromopropane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$, viewing along the C1-C2- bond. Label the conformations accordingly.

(4)

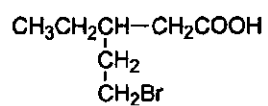


- 2.4 Draw the structure of methyl 2-methylheptanoate.

(2)



- 2.5 Write the IUPAC name of the following compound

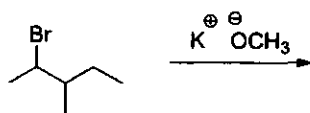


(2)



[TURN OVER]

2.6 Consider the following reaction



- (i) What is the major organic product formed in the following reaction?
(ii) Write the reaction mechanism for the formation of the product given in (i)

(4)

TOTAL MARKS [100]

[TURN OVER]

ROUGH WORK

[TURN OVER]

ROUGH WORK

[TURN OVER]

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ROUGH WORK

PART 1 (GENERAL/ALGEMEEN) DEEL 1

STUDY UNIT e.g. PSY100-X STUDIE-EENHEID by PSY100-X		INITIALS AND SURNAME VOORLETTERS EN VAN	
1		3	
PAPER NUMBER VRAESTELNOMMER		DATE OF EXAMINATION DATUM VAN EKSAMEN	
2		4	
STUDENT NUMBER STUDENTENOMMER		EXAMINATION CENTRE (E.G. PRETORIA) EKSAMENSENTRUM (BY PRETORIA)	
6		5	
7		9	
UNIQUE PAPER NO UNIEKE VRAESTEL NR.		8	

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
6. CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY
8. 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 VOLTOOL
2. MERK AS VOLG. ➡
3. KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
4. VUL U STUDENTENOMMER VAN LINKS NA REGS IN
6. KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET
8. KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS
7. MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS.
8. MOENIE VOU NE.

PART 2 (ANSWERS/ANTWOORDE) DEEL 2

1	1) 2) 3) 4) 5)	36	1) 2) 3) 4) 5)	71	1) 2) 3) 4) 5)	106	1) 2) 3) 4) 5)
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6	1) 2) 3) 4) 5)	41	1) 2) 3) 4) 5)	76	1) 2) 3) 4) 5)	111	1) 2) 3) 4) 5)
7	1) 2) 3) 4) 5)	42	1) 2) 3) 4) 5)	77	1) 2) 3) 4) 5)	112	1) 2) 3) 4) 5)
8	1) 2) 3) 4) 5)	43	1) 2) 3) 4) 5)	78	1) 2) 3) 4) 5)	113	1) 2) 3) 4) 5)
9	1) 2) 3) 4) 5)	44	1) 2) 3) 4) 5)	79	1) 2) 3) 4) 5)	114	1) 2) 3) 4) 5)
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Specimen only