

NATIONAL UNIVERSITY OF LESOTHO
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF PHARMACY
PHA 2401 : ALIPHATIC CHEMISTRY
FINAL EXAMINATION PAPER

JAN 2024

TIME: 3 HOURS

100 MARKS

INSTRUCTIONS

- **The paper consists of two sections (2); section A [40 MARKS] and section B [60 MARKS]**
- **Answer all the questions**
- **Begin every question on a NEW PAGE**
- **The paper consists SIX (6) printed pages including the cover page**
- **The periodic table is attached in the last page of the paper**

SECTION A**[40 MARKS]****1. DEFINITIONS AND RULES****[10 marks]**

Definition of terms;

a. Briefly define the following terms:

[5 marks]

I. Hybridization

[1 mark]

II. Hydrocarbon

[1 mark]

III. dipole –dipole interaction

[1 mark]

IV. Isomers

[1 mark]

V. Enynes

[1 mark]

b. State the following rules;

I. Aufbau principle

[1 mark]

II. Pauli Exclusion principle

[1 mark]

III. Hunds rule

[1 mark]

c. Apply the above rules to predict the electronic configuration of carbon atom [2 marks]

2. HYBRIDIZATION**[10 marks]**Using Ethene (C₂H₄) and Methane (CH₄);a. write short notes about SP³ and SP² hybridization

[3 marks each]

b. draw the appropriate types of hybridization for the compounds given above [2 marks each]

3. ELIMINATION AND SUBSTITUTION REACTIONS [12 marks]

Write the difference between the following terms [4 marks] and give examples to support your answer [4 marks]

I. Nucleophile vs Electrophile

[4 marks]

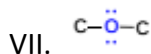
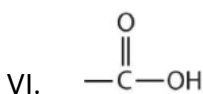
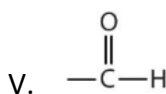
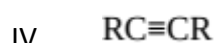
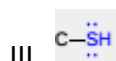
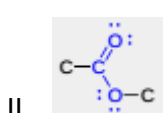
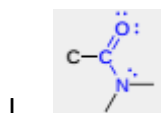
II. Elimination reaction 1 (E1) vs Elimination reaction-2 (E2)

[4 marks]

III. Substitution nucleophilic rxn-1 (SN1) vs Substitution nucleophilic rxn-2 (SN2) [4 marks]

4. HYDROCARBONS FUNCTIONAL GROUPS**[8 marks]**

Identify the functional groups present in each of the following compound types



SECTION B

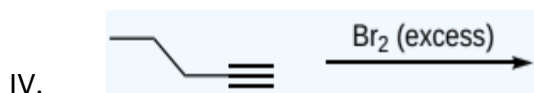
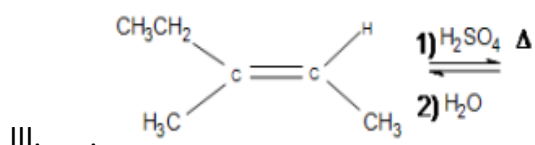
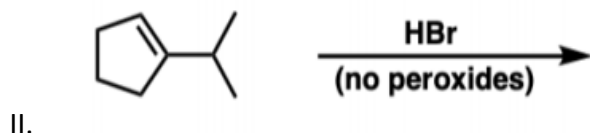
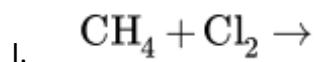
[60 MARKS]

1. ALKANES, ALKENES AND ALKYNES

[25 marks]

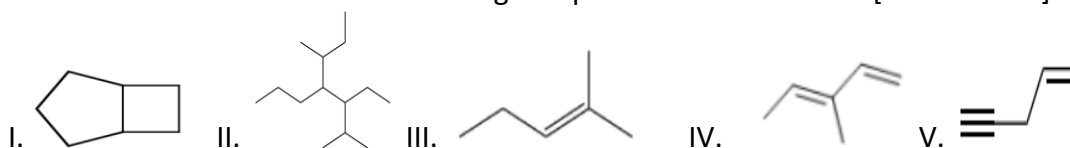
a. Draw the reaction mechanisms for the following reactions:

[3 marks each]



b. Give the IUPAC name for the following compounds.

[1 mark each]



c. Draw the following compounds

[2 mark each]

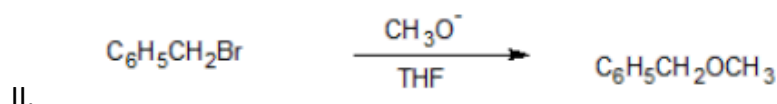
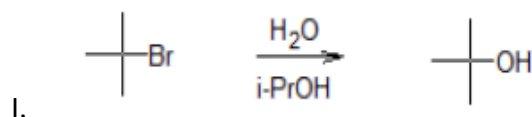
- I. 1-cyclopropylbutane
- II. 1-ethyl-3-methylcyclohexane
- III. 1,3,5,7-Cyclooctatetraene
- IV. 4-methylnon-7-en-1-yne

2. ALKYL HALIDES

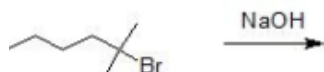
[5 marks]

a. Classify the following reactions as "Substitutions" or "Eliminations"

[1 mark each]



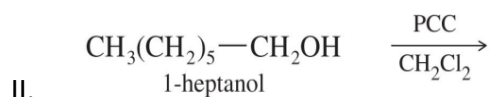
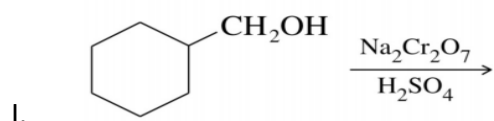
b. State the Zaitsev rule [1 mark] and draw the reaction mechanism predicting the major product (Zaitsev product) for the following reaction [2 marks]:



3. ALCOHOLS AND ETHERS

[8 MARKS]

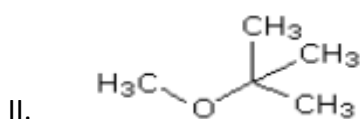
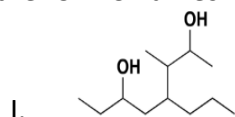
a. Complete the following reaction [1 mark each]



b. Explain why does the oxidation of isopropyl alcohol give a ketone, whereas the oxidation of isobutyl alcohol gives an aldehyde? [2 marks]

c. Write the reaction mechanism for Williamson Ether synthesis that takes place between reaction of 1-propanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$) with iodomethane ($\text{CH}_3\text{-I}$) in the presence of sodium hydride (NaH) [2 marks]

d. Give the IUPAC names for the following compounds [1 mark each]

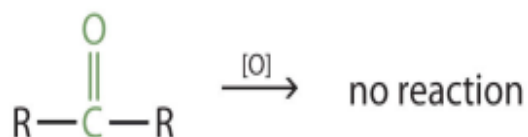


4. ALDEHYDES AND KETONES

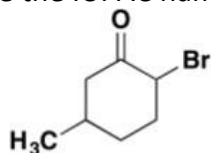
[10 marks]

a. Compare [1 mark] and contrast [2 marks] between aldehyde and ketones = [3 marks]

b. Provide a reason why the following reaction below cannot occur [2 marks]:



c. Give the IUPAC name of the product listed below; [1 mark]



d. Draw the following compounds [4 marks]

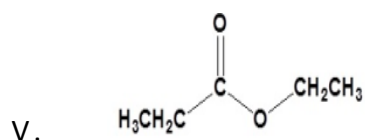
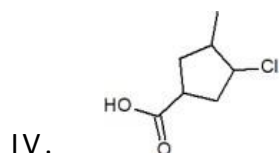
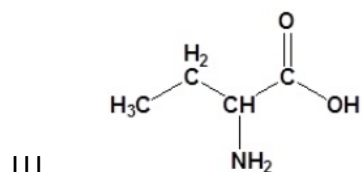
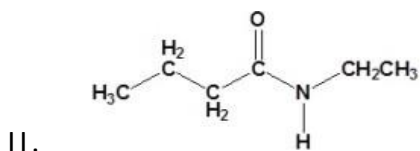
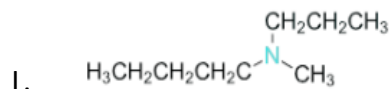
I. 3-hydroxy-2,4-pentanedione [2 marks]

II. 3-bromo-2-methylpropanal [2 marks]

5. AMINES, CARBOXYLIC ACID AND CARBOXYLIC ACID DERIVATIVES [12 marks]

a. Give IUPAC name for the following compounds;

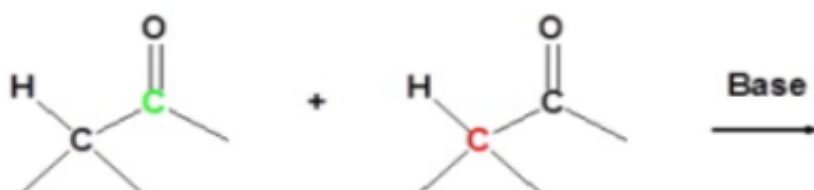
[1 mark each]



b. Provide a reason why methanamide (an amide) is less basic than methylamine (an amine) below; [2 marks]



c. Write down the complete reaction mechanism for the aldol condensation reaction below starting with the production of aldol product [3 marks] and followed by condensation of 2 aldol products to form α, β -unsaturated aldehyde or ketone [2 marks]



APPENDIX 1

PERIODIC TABLE OF THE ELEMENTS

1A 1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305			13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948								
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-71 La-Lu	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89-103 Ac-Lr	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Uun (281)	111 Uuu (272)	112 Uub (285)	114 Uuq (289)					

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
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89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)
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