

UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION 2016, JULY

TITLE OF PAPER : Introductory Organic Chemistry

COURSE NUMBER : C203

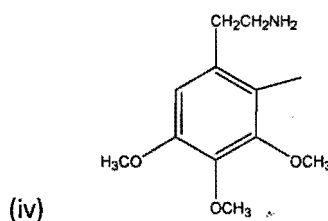
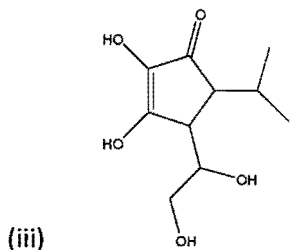
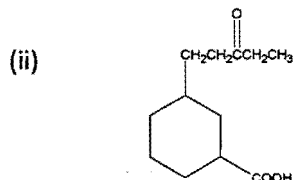
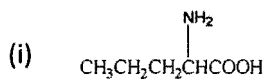
TIME : Three Hours

INSTRUCTIONS : Answer any **FOUR** questions. Each question carries **25** marks

This Examination Paper Contains Five Printed Pages Including This Page
*You are not supposed to open the paper until permission to do so has been granted by
the Chief Invigilator.*

Question 1

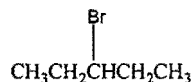
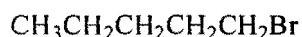
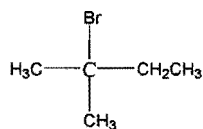
(a) Identify and then name every functional group in each of the following compounds: (9)



(b) Rank the following alkyl halides in order of decreasing reactivity in;

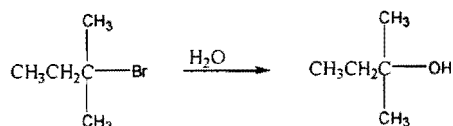
(i) $\text{S}_{\text{N}}1$ mechanism

(ii) $\text{S}_{\text{N}}2$ mechanism



(6)

(c) Show all the steps of the following reaction by $\text{S}_{\text{N}}1$ mechanism.



(10)

Question 2

a) Define the following stereochemical terms (10)

(i) Diastereomers

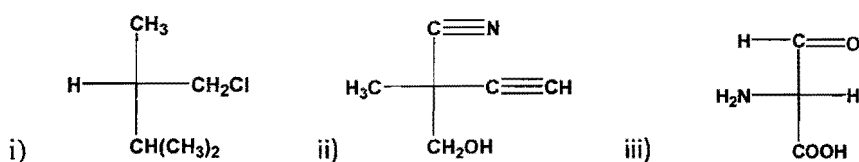
(ii) Chiral centre

(iii) Racemic mixture or racemate

(iv) Chiral molecule

(v) Meso compound

b) Identify each of the following as R or S, and show the priorities assigned to each ligand (6)



- c) How many stereoisomers of 2,3-butanediol are possible? Draw them. (4)
- d) What is racemic resolution? (2)
- e) Describe one method for resolving a racemate (3)

Question 3

- a) What is the general formula for an alkane? (2)
- b) Give the molecular formulas for alkanes with: (4)
- Four C's
 - Seven C's
 - Ten C's
 - 22 C's
- c) Define an alkyl group and give the formula for each of the following alkyl groups (4)
- Butyl
 - Propyl
- d) Provide a structural formula for $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}(\text{CH}_3)_2$, and define and identify all the primary (1°), secondary (2°), tertiary (3°) and quaternary (4°) carbons. (5)
- e) Define the term conformation. (6)
- Name and draw the conformations of ethane with the lowest and highest energies at room temperature.
- f) Write the structures of all the alkenes that can be hydrogenated to form 2-methylpentane. (4)

Question 4

- (a) Account for each of the following observations:
- The boiling points of phenol and toluene are 182°C and 110.6°C , respectively, even though they have almost the same molecular weight (5)
 - Carboxylic acids usually have higher boiling points than alkanes with the same number of carbons (5)

- (b) Write the equations for the reaction of 1-heptanol with
- (i) Pyridiniumchlorochromate (PCC) in dichloromethane
 - (ii) Acidified potassium dichromate (10)
- (c) Explain the reaction of Tollen's reagent with butanal and how this reaction could be used to differentiate butanal from butanone (5)

Question 5

- (b) Give a brief description of how the following classes of compounds could be separated:
- (i) Secondary alcohols and tertiary alcohols
 - (ii) Phenols and carboxylic acids
 - (iii) Aldehydes and ketones
 - (iv) Primary amines and tertiary amines (8)
- (c) Outline the synthesis of 4-octanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$) from butanal ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$) and butylmagnesium bromide ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{MgBr}$) (5)
- (d) (i) How would you prepare phenylmagnesium bromide? (4)
- (ii) What would be the product of the reaction of phenylmagnesium bromide with each of the following reagents?
1. H_2O
 2. $\text{C}_6\text{H}_5\text{COCl}$
 3. H_2CO
 4. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$ (8)

Question 6

- a. Classify these reactions as additions, eliminations, substitutions or rearrangements
- a. $\text{CH}_3\text{Br} + \text{KOH} \longrightarrow \text{CH}_3\text{OH} + \text{KBr}$
 - b. $\text{CH}_3\text{CH}_2\text{OH} \longrightarrow \text{H}_2\text{C}=\text{CH}_2 + \text{H}_2\text{O}$
 - c. $\text{H}_2\text{C}=\text{CH}_2 + \text{H}_2 \longrightarrow \text{CH}_3\text{CH}_3$ (3)
- b. Which of the following would you expect to behave as electrophiles and which as nucleophiles?
- (i) H^+
 - (ii) HO^-
 - (iii) Br^+

(iv) CO_2

(v) NH_3

(vi) Mg^{2+}

(vii) Cr^{3+}

(7)

c. Which reagent in each pair will react faster in an $\text{S}_{\text{N}}2$ reaction with hydroxide ion? (6)

i) CH_3Br or CH_3I

ii) $(\text{CH}_3)_3\text{CCl}$ or CH_3Cl

iv) $\text{H}_2\text{C}=\text{CHBr}$ or $\text{H}_2\text{C}=\text{CHCH}_2\text{Br}$

c. The hydrolysis of 2-iodo-3-methylbutane yields a tertiary alcohol as the major product.

Provide an equation, with mechanism, for this reaction and explain why the tertiary alcohol is the major product. Also, give the name and structure of both the major and minor products.

(9)

UNIVERSITY OF SWAZILAND
Department of Chemistry

1	H 1.0079	Atomic Number																		2	He 4.0026	Atomic Weight																	
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 20.179						
11	Na 22.990	12	Mg 24.305																			13	Al 26.982	14	Si 28.086	15	P 30.974	16	S 32.064	17	Cl 35.453	18	Ar 39.948						
19	K 39.098	20	Ca 40.078	21	Sc 44.956	22	Ti 47.88	23	V 50.942	24	Cr 51.996	25	Mn 54.938	26	Fe 55.847	27	Co 58.933	28	Ni 58.69	29	Cu 63.546	30	Zn 65.39	31	Ga 69.723	32	Ge 72.61	33	As 74.922	34	Se 78.96	35	Br 79.904	36	Kr 83.80				
37	Rb 85.47	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 121.75	52	Te 127.60	53	I 126.90	54	Xe 131.29				
55	Cs 132.91	56	Ba 137.33	57	La 138.91	72	Hf 178.49	73	Ta 180.95	74	W 183.85	75	Re 186.2	76	Os 190.2	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 226.03	89	Ac 227.03																																		

58	Ce 140.12	59	Pr 140.91	60	Nd 144.24	61	Pm 146.92	62	Sm 150.36	63	Eu 151.97	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
90	Th 232.04	91	Pa 231.04	92	U 238.03	93	Np 237.05	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 (260)