

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
SECOND SEMESTER EXAMINATION
CH112 / AS112- FOUNDATION CHEMISTRY
MONDAY 31ST OCTOBER 2022- 8.20 AM

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES

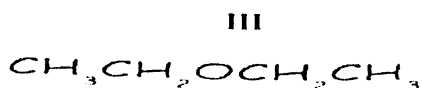
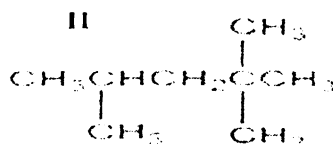
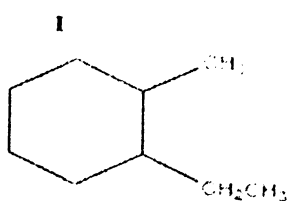
- 1 You have 10 minutes to read through the question paper. You **MUST NOT** begin writing in the answer booklet during this Time.
- 2 **ANSWER ALL QUESTIONS.**
- 3 Answers must be written on the Answer Booklet provided, show all working out and Calculations where required.
- 4 Write your full Name, Student Number, and course code clearly on the Answer Booklet. **Do that Now.**
- 5 Calculators are permitted in the Examination room. Lecture notes, note books, plain papers and textbooks are **NOT** allowed.
- 6 Mobile Phones and other electronic devices are not allowed.
- 7 **DO NOT** over write.

MARKING SCHEME: [100 marks]

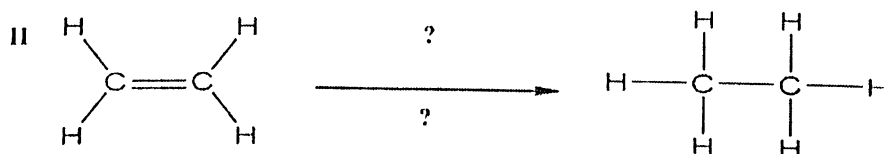
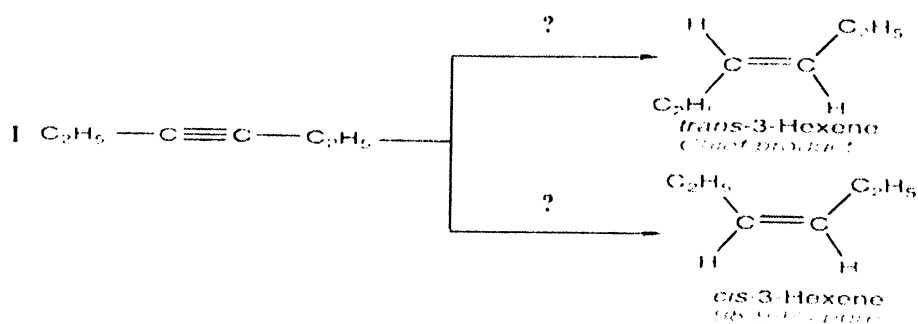
- 1 (b) What are functional groups and their importance? [3 marks]
 (c) Differentiate between sigma and pi bonds. [4 marks]

(Total = 7 marks)

- 2 (a) Determine the hybridization of nitrogen in Ammonia [3 marks]
 (b) Differentiate between alkanes, alkenes, and alkynes [6 marks]
 (c) Name the following organic compounds using IUPAC naming system [6 marks]



- (d) Complete the following chemical reactions by inserting the appropriate catalyst. [8 marks]



(Total = 23 marks)

3 (b) How much heat is required to raise the temperature of 9.89 grams of water from 20 °C to 89 °C, assume that the specific heat capacity of water is $4.18 \text{ J.g}^{-1} \text{ } ^\circ\text{C}^{-1}$ [4 marks]

(c) In a bomb calorimeter with heat capacity of 4.90 kJ/°C, the combustion of 2.28 grams sample of acetic acid (CH_3COOH) causes a temperature increase from 30°C to 59 °C. What is the heat of combustion of acetic acid in kJ/mol? [6 marks]

(Total = 10 marks)

4 (a) Describe the first and second law of thermodynamics. [4 marks]

(b) What is the molar entropy for the vaporization of water at 373 K given that the standard molar enthalpy of water is 40.7 kJ/mol? [4 marks]

(c) Define enthalpy, entropy and Gibbs free energy of the system and explain what will happen to these state functions during cooling process. [8 marks]

(Total = 16 marks)

5 (a) What is the difference between the reactions quotient (Q) and equilibrium constant (K)? [3 marks]

(b) Consider the following chemical equation for Ammonia



i. Plot its concentration versus time graph. [4 marks]

ii. Provide the equilibrium constant expression [3 marks]

iii. What will happen if the pressure is decreased

on the product side [3 marks]

iv. If $K = 1.0 \times 10^{-4}$ at 300 °C, and $P_{\text{N}_2} = 8 \text{ atm}$, $P_{\text{H}_2} = 6 \text{ atm}$, and $P_{\text{NH}_3} = 3.3 \text{ atm}$. What will be the direction of the reaction [5 marks]

v. How can the yield of ammonia be maximized? [3marks]

(Total = 21 marks)

- 6 (a) A 0.11 M acetic acid (CH_3COOH), with $K_a = 1.8 \times 10^{-5}$,
Calculate $[\text{H}_3\text{O}^+]$ and pH using 'ICE' table.
Ionization: $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{CH}_3\text{COO}^-$ [5 marks]
- (b) Give Bronsted Lowry Definition of acid and bases. [2 marks]
- (b) Draw and label the Titration curve of weak acid versus strong
base with specific labels for equivalence point, buffering
region, half equivalence point. [6 marks]

(Total = 13 marks)

7. (a) Explain why conversion of diamonds to graphite is at room
Temperature thermodynamically favourable with a $-\Delta G$
but not possible in real life. [3 marks]
- (b) List any five main factors that affect the rate of reaction. [3 marks]
- (c) The table below shows the concentration of NO with respect to
time. Calculate the average rate of disappearance of NO in the
first 30 seconds. $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ [4 marks]

[NO]	Time (second)
0.750M	0 s
0.645M	10 s
0.586M	20 s
0.539M	30 s
0.496M	40s

(Total = 10 marks)

Data Sheet
Periodic Table

1 H 1.0																	18 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	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 183.0	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 (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Ha (262)	106 Sg (263)	107 Uns (262)	108 Uno (265)	109 Uue (266)									

6 C 12.0	Atomic number Symbol Name Atomic mass
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$$\Delta G_m = \Delta H_m - T \Delta S_m$$

$$Q = c \Delta T$$

$$\Delta S = \frac{Q_{\text{rev}}}{T}$$

$$\Delta S = C \ln \frac{T_2}{T_1} \quad \Delta G = \Delta G^\circ + RT \ln Q$$

$$\Delta S^\circ = \sum n S_m^\circ(\text{products}) - \sum n S_m^\circ(\text{reactants})$$