1. The standard reduction electrode (E2) for some half cells are given in the table below.

Half cell	E2(v)
$Fe^{3+}_{(aq)}$, $Fe^{2+}_{(aq)}$	+0.77
$S_{(s)}$, $H_2S_{(g)}$	+0.14

a) Write the:

i.   Cell notation.   (01 mark)

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ii.   Equation of reaction that takes place at the cathode and anode respectively.   (@01 mark)
Anode:

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Cathode:

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b) Write the overall equation for the cell notation.   (01 mark)

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c) State whether the reaction is feasible or not and give a reason for your answer.   (0½ mark)

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2. The decay law is given in the expression as shown below.

$$-\frac{dN}{dt} = \lambda N$$

a) (i) State what each symbol represent.   (01½ marks)

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(ii) Using the above expression derive the expression for the relation between half-life and the decay constant.

(02 marks)

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b) Nickel (^{63}Ni) decays to copper (^{63}Cu).

i.   Name the particle emitted and write the equation for the reaction:

Name of particle: (0½ mark)

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Equation: (0½ mark)

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ii. Calculate the time taken for $\frac{15}{16}$ of Nickel to decayed or changed to copper. [The half-life for Nickel is 120 years] (02 marks)

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3. (a) State conditions for the reaction between aluminium oxide and sulphuric acid.

Condition (s): (0½ mark)

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Equation (s): (01½ marks)

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(b) The resultant solution in (a) above was mixed with aqueous sodium carbonate solution. State what would be observed and write equation for the reaction that takes place.

Observation: (02 marks)

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Equation (s):   (01½ marks)

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4. The following experimental results were obtained for the reaction,   A + 2B $\longrightarrow$ Products

Experiments	Initial concentrations (mol/ℓ)		Initial rate (mol/ℓ/s)
	A	B	
1	3.0×10^{-2}	3.0×10^{-2}	2.7×10^{-5}
2	3.0×10^{-2}	6.0×10^{-2}	5.4×10^{-5}
3	6.0×10^{-2}	3.0×10^{-2}	10.8×10^{-5}

a) (i) Deduce the order of reactions with respect to:

A: (0½ mark)

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B: (0½ mark)

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(ii) Write the expression for the rate equation. (0½ mark)

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b) The rate of reaction under certain conditions for temperature and pressure is X. Express the rate in terms of X when the following changes are made.

i. The concentration B is halved while the concentration of A remains unchanged. (0½ mark)

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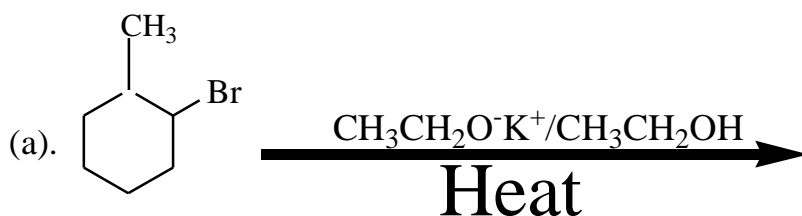
ii. The rate constant is doubled by increasing temperature but keeping the concentration of A and B unchanged. (0½ mark)

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iii. **If 90% of B is removed by precipitation without affecting concentration of A.** (0½ mark)

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c) **Calculate the value of the rate constant and state its S.1 units.** (02 marks)

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5. **Complete the following reactions equations and write the IUPAC names of the main product in each case.** (@01½ marks)

(a).

$$CH_3CH_2O^-K^+/CH_3CH_2OH \xrightarrow{\text{Heat}}$$

Name of product: ....

(b). [cyclohexane ring with CHO group] $\xrightarrow[\text{Zn/Hg}]{\text{Concentrated HCl}}$

Name of product: ....

(c). $(CH_3)_3COH$ $\xrightarrow{\text{Anhydrous ZnCl}_2/\text{Conc.HCl}}$

Name of product: ....

6. **Write half equation (s) to show the action of hydrogen peroxide solution as:**
   a) (i) an oxidizing agent. (01 mark)

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   ....

   (ii) a reducing agent. (01 mark)

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   b) State what's observed and in each case write equation of reaction that take place when hydrogen peroxide solution is added to the following mixtures: (@01½ marks)
   (i)   Acidified potassium chromate (VI) solution.
   Observation:

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   Equation:

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(ii)   Iron (II) sulphate solution in dilute sulphuric acid
        Observation:

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Equation:

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7. (a) Explain what is meant by the term first electron affinity.
                                                        (01 mark)

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(b) State three factors that can affect electron affinity.
                                                        (01½ marks)

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(c) The first electron affinities of some elements of period (III) are given in the table below.

elements	Al	Si	P	S
1st electron affinities (KJ/mol)	⁻44	⁻134	⁻71.7	⁻200

i. State the trend in variation of electron affinities.

(0½ mark)

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ii. Explain ypur answer in c (i) above.   (02 marks)

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8. The enthalpies of some reactions are given below:

(i). $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ ⁻393.5 KJ/mol

(ii). $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$ ⁻285.9 KJ/mol

(iii).$C_6H_5OH_{(s)} + 7O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$ ⁻3009 KJ/mol

a) Calculate the standard enthalpy of formation of phenol from its elements. (03 marks)

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b)(i) From your answer in (a) above state whether phenol is a stable compound or not. (0½ mark)

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(ii)Give a reason for your answer in (b) (i) above. (0½ mark)

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9. Ethylamine ionizes when dissolved in water.
   a) Write.
      (i)Equation for the ionization of ethylamine. (01½ marks)

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(ii) The expression for the ionization constant, K_b. (0½ marks)

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b) If the ionization constant of ethylamine is 1.78×10^{-4} mol/dm^3 at 25°C. Calculate the ^{pH} of a 0.01M solution of ethylamine. [$Kw = 1.0 \times 10^{-14}$ mol^2/dm^3 at 25°C]   (03 marks)

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SECTION B–54 MARKS

ATTEMPT <u>ANY</u> SIX QUESTIONS IN THIS SECTION.

10. Nitrogen reacts with hydrogen in a mole ratio of 1:3 to form ammonia gas.

a) Write:

(i)   Equation for the reaction that takes place.

(01½ marks)

....

(ii)   The expression for the equilibrium constant, Kc.

(0½ mark)

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b) State the condition (s) used to obtain maximum yield of ammonia during its manufacture by Haber process.

(01½ marks)

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c) The percentage of ammonia in the equilibrium mixture of gases was found to be 15% at 600°C. Calculate the equilibrium constant (K_C) for the reaction at 600°C.

(04 marks)

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d) State what would happen to the equilibrium position of the reaction in a (i) above when hydrogen chloride gas is added to the equilibrium mixture. Give a reason for your answer.

(01½ marks)

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11. (a) Explain what meant by the term partition coefficient.

(02 marks)

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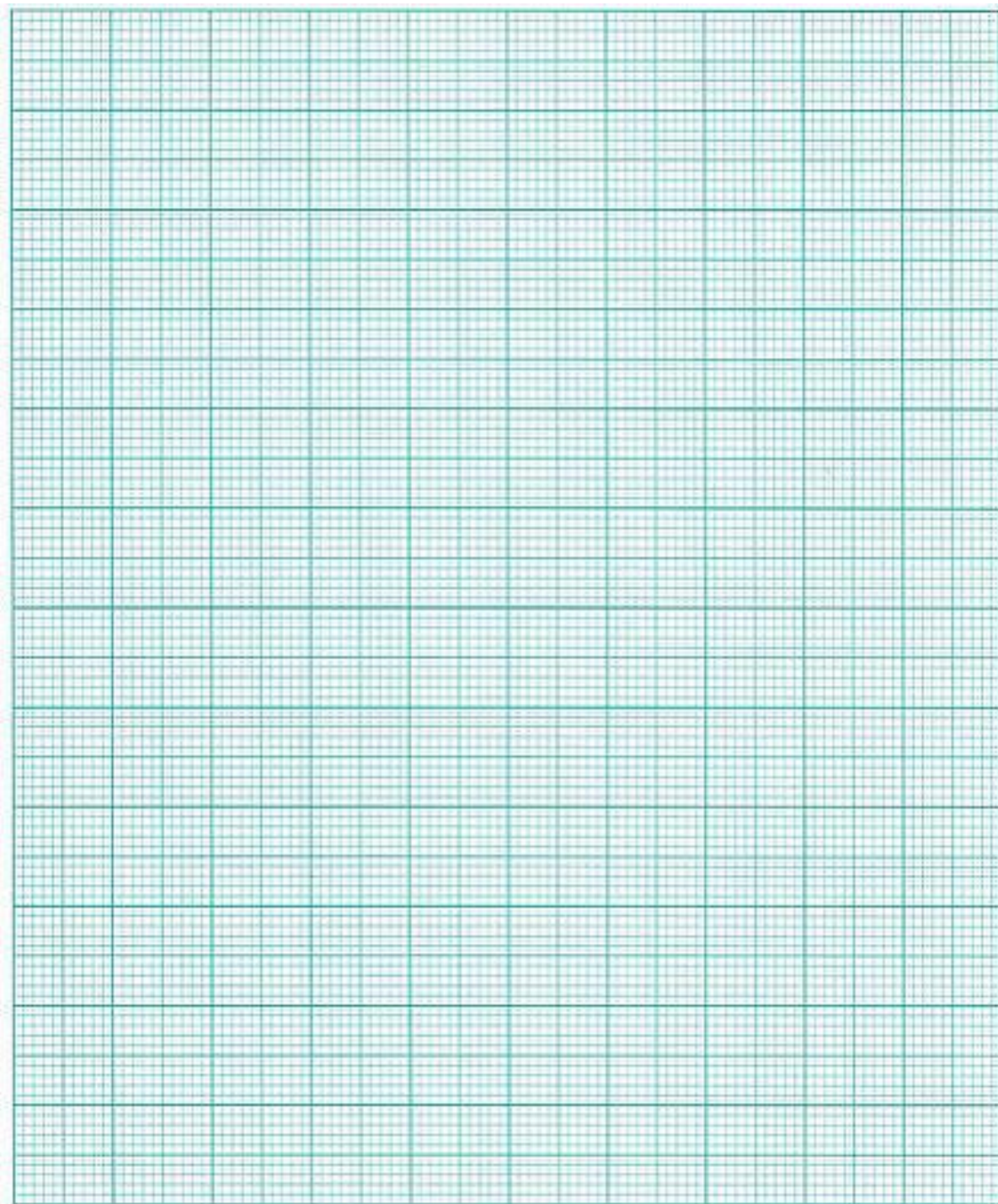
(b) The table shows the concentrations of iodine in the two layers when shaken with a mixture of carbon tetrachloride and water at 250°C.

Concentration of I_2 in CCl_4 (mol/dm^3)	6.12	12.24	15.20	22.38
Concentration of I_2 in H_2O(mol/dm^3)	0.072	0.143	0.178	0.260

(i)Plot a graph of concentration of iodine in carbon tetrachloride against concentration of iodine in water.

(03 marks)

(ii) From the graph determine the partition coefficient for iodine distributed between carbon and tetrachloride and water. (02 marks)

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c) State two applications of partition coefficient. (02 marks)

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12. Compare the reactivity of hydrides of group (VII) elements with concentrated sulphuric acid.

a)(i) Write equation (s) for the reaction (s) which take place if any. (04 marks)

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(ii)Give a reason for the difference in reactivity shown by the hydrides in a (i) above. (01 mark)

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b)The bond lengths of the hydrides of group (VII) elements are given in the table below.

Hydrides	HF	HCl	HBr	HI
Bond length (A°)	0.86	1.28	1.42	1.60

(i) State the trend in variation of bond length of the hydrides. (01 mark)

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(ii) Explain your answer in b (i) above. (03 marks)

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13. Write equations to show how the following conversions can be effected.
   a) Ethanol to benzene. (04 marks)

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b) 1,2-dibromoethane to ethanol. (03 marks)

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c) 1-bromopropane from propan-2-ol. (02 marks)

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14. (a) Write the general outer most electronic configuration of group (IV) elements. (0½ mark)

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(b)Explain why carbon show differences from the rest of the group elements. (01½ marks)

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(c)State three differences between the chemistry of carbon and the rest of group (IV) members. (03 marks)

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(d)Explain why carbon tetrachloride does not undergo hydrolysis in water whereas silicon (IV) chloride does. (03 marks)

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(e)Write the equation for the reaction between silicon (IV) chloride and water.   (01 mark)

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15. **A compound Y contains 64.9% by mass carbon, 13.5% by mass hydrogen and the rest is oxygen.**
    a)(i) Calculate the empirical formula of compound Y. (03½ marks)

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(ii)When 1.84g of compound Y is vapourized at 200°C and 760mmHg pressure, it occupied a volume of 969.8cm^3.Determine the molecular formula of compound Y.[Molar gas volume, R = 8.31J/K/mol]   (03½ marks)

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b) Compound Y forms two layers after 8 minutes with anhydrous zinc chloride in the presence of concentrated hydrochloric acid. Identify compound Y. (01 mark)

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c) Write an equation for the reaction between compound Y and hot concentrated phosphoric acid. (01 mark)

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16. Complete the following equations and outline the mechanism for each reaction. [a (03½ marks), b (02½ marks), c (03 marks)]

(a). $(CH_3)_2C{=}CH\ CH_3 \xrightarrow[\text{Heat}]{H_2O/H^+}$

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(b). $(CH_3)_3CBr$ $\xrightarrow[\text{Heat}]{\text{KOH/CH}_3\text{CH}_2\text{OH}}$

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(c). $+$ Conc.$HNO_{3(aq)}$ $\xrightarrow[\text{60°C}]{\text{Conc.H}_2\text{SO}_{4(l)}}$

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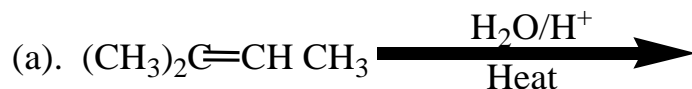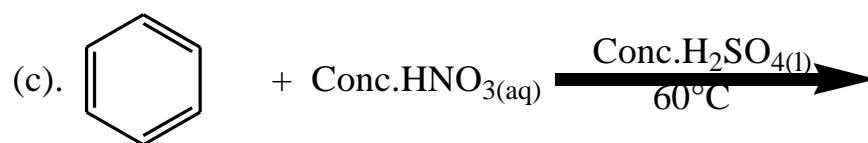
17. (a) Define the term osmotic pressure. (01 mark)

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(b) Explain why determination of molar mass of polymer, osmotic pressure is preferred than boiling point elevation method. (01 mark)

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(c) The Osmotic pressure of various concentrations of solute X in methylbenzene at 25°C are given in the table below.

Concentration (g/dm^3)	1.0	2.0	3.0	4.0	5.0	6.0
Osmotic pressure (Nm^{-2})	23	37	53	75	92	109

(i)Plot a graph of osmotic pressure against concentration. (03 marks)
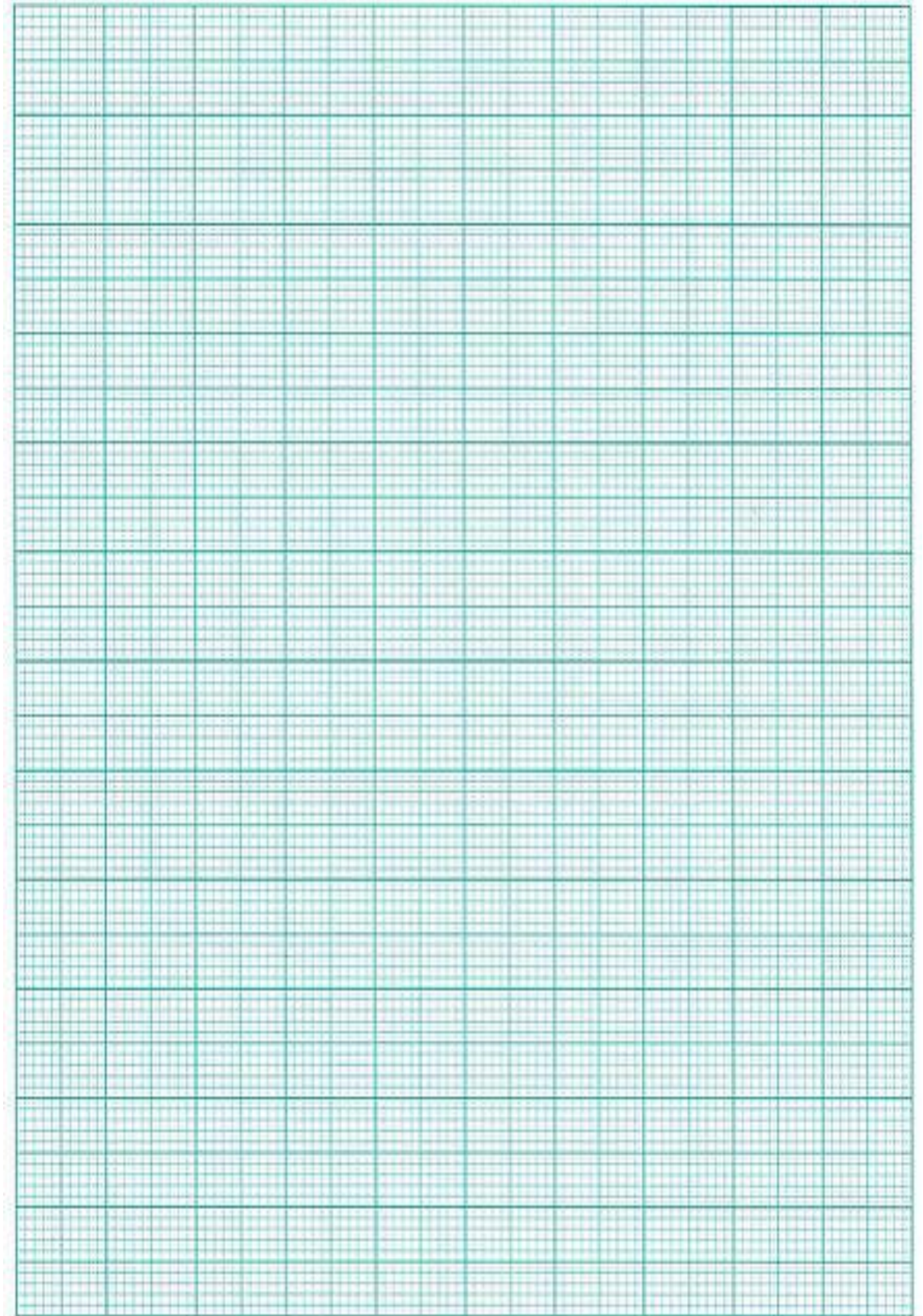
(ii) Use the graph to determine the molecular mass of X.[Universal gas constant, R = 8.314J/K/mol] (04 marks)

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THE PERIODIC TABLE

1	2														3	4	5	6	7	8
1.0 H 1																			1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4														10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12														27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30				69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48				115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89																		

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

♥ ===END===

WELCOME TO SENIOR SIX, YEAR 2022

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