SECTION A-46 MARKS

Attempt <u>all</u> questions in this section.

1. (a) Complete the following equations.

   i. $^{236}_{92}U \longrightarrow {}^{92}_{36}Kr$ + …… + $^{141}_{56}Ba$ (01 mark)

   ii. $^{214}_{83}Bi \longrightarrow {}^{0}_{1}e$ + …… (01 mark)

   (b) The **half-life** of bismuth is **20 minutes**. Determine the **time taken** form Bismuth to decay by **75%**. (02½ marks)

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2. Beryllium, magnesium & calcium are group II elements.

   a. Write the general outer configuration of the elements. (01 mark)

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   b. Each of these elements reacts with carbon to form carbides. Write the equation for the reaction which occurs when each carbide reacts with water. (03 marks)

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3. **10.0cm^3** of a hydrocarbon **P (C_xH_y)** was exploded in **90.0cm^3** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm^3**, when the residual gases were passed through potassium hydroxide solution, the volume reduced to **40.0cm^3**.

   a. (i). Write the **equation** for the reaction between hydrocarbon **P** and **oxygen gas**. (01 mark)

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(ii).Determine the **molecular formula** of hydrocarbon P. (03 marks)

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   b. Write equations to show how hydrocarbon **P** can be prepared from **propan-2-ol**. (02 marks)

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4. Complete the **equation** below and write the **suggested mechanism** for the reaction.

$CH_3HC=CH_2 + Br_2 \xrightarrow{H_2O}$ ..... (04 marks)

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5. Write equations for the reaction of the following oxides with sodium hydroxide

(a) Aluminium oxide. (1 ½ marks)

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(b) Beryllium oxide (1 ½ marks)

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(c) Lead (II) oxide (1 ½ marks)

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6. (a) State what is meant by the term **diagonal relationship?**.(1mark)

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(b) State three reasons why lithium and magnesium resemble in their chemical properties. (1 ½ marks)

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(c) Mention three properties to show the diagonal relationship between lithium and magnesium. (3marks)

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7. Methane reacts with steam according to the following equation:

$$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)} \quad H_r = ?$$

The enthalpy of formation of methane, water & carbon dioxide gas are ---- 76, ⁻242 & ⁻394KJ/mol.

$$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)} \quad \Delta H_f \ ^-76KJ/mol$$
$$H_{2(g)} + ½O_{2(g)} \longrightarrow H_2O_{(l)} \quad \Delta H_f \ ^-242KJ/mol$$
$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_f \ ^-394KJ/mol$$

a. Calculate the **enthalpy of reaction**. (03 marks)

$$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)}$$

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b. State whether the reaction above is **feasible**, give a **reason** for your answer. (01 mark)

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8. Sodium propanoate undergoes hydrolysis when dissolved in water.

a) Write equation for the hydrolysis of sodium propanoate (1mark)

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b) Write the expression for the hydrogen constant, Kh (1mark)

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c) The hydrolysis constant, K_h for sodium propaonate is 5.9×10^{-10} $moldm^{-3}$ at 25°C. What is the concentration of hydrogen ions in solution at equilibrium for a 0.1M sodium propanoate? (2marks)

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9 (a). Define the **order of reaction**. (01 mark)

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(b).The experimental results in the table were obtained for the reaction between nitrogen monoxide gas and oxygen gas.

$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$$

Initial concentrations (mol/dm^3)		Rate of reaction ($mol/dm^3/s$)
NO	O_2	
0.03	0.03	2.7×10^{-5}
0.03	0.06	5.5×10^{-5}
0.06	0.03	10.8×10^{-5}

(i). Determine the **order of reaction** with respect to:
Nitrogen monoxide. (01 mark)

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Oxygen. (01 mark)

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(ii).Write the **rate equation** for the reaction. ($0\frac{1}{2}$ mark)

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(c).Calculate the:

(i). **Overall order of reaction**. ($0\frac{1}{2}$ mark)

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(ii).**Rate constant** for the reaction and **state it's S.I unit**.
($0\frac{1}{2}$ mark)

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SECTION B-54 MARKS

Attempt Any six questions in this section.

10 (a). Define the term **radioactivity**. (01 mark)

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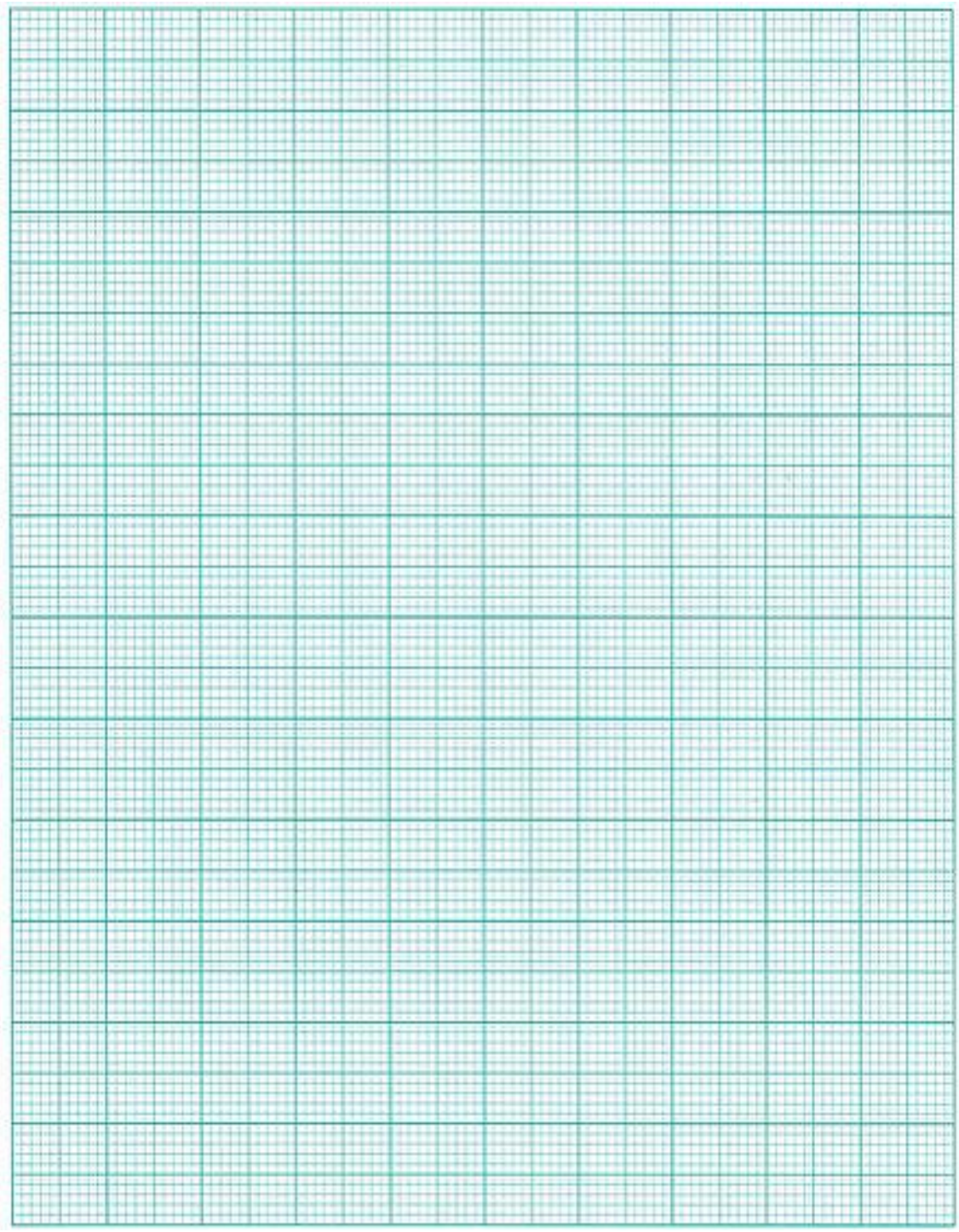
(b).The table below shows how the mass of radioactive protactinium, $^{234}_{91}Pa$ varies with time.

mass of protactinium (g)	60.0	38.5	26.0	17.2	11.1
Time (s)	0	40	80	120	160

(i).Plot a **graph of mass** of protactinium against **time**. (03 marks)



(ii).Use your graph to determine the **half-life** of protactinium.

(01 mark)

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(iii).Calculate the **radioactive decay** of protactinium. (02 marks)

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11. Name one reagent that can be used to distinguish between the following pairs of compounds. In each case state what would be observed if each member of the pair is treated with the named reagent.

a) But-2-yne and But-1-yne

Reagent. (01 mark)

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Observations. (02 marks)

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b) Bromobenzene and bromoethane

Reagent. (01 mark)

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Observations. (02 marks)

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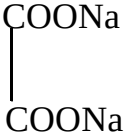
CH_3COONa and 

Reagent. (01 mark)

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Observations. (02 marks)

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12. (a) State three characteristics of a **chemical equilibrium**.(1 ½ marks)

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(b) Dinitrogentetraoxide dissociates at 40°C and **1 atm** according to the following equation.

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$ $\Delta H = +57\ KJmol^{-1}$

(i) Write an expression for the equilibrium constant, Kp (½ mark)

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(ii) Draw a labelled energy level diagram for the reaction in (b) (2marks)

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(c) The reaction mixture in (b) was found to contain 60% by volume of nitrogen dioxide. Calculate the equilibrium constant Kp at 60°C for the reaction. (3marks)

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(e) Explain the effect of increasing pressure on the position of the above equilibrium. (2marks)

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13. Complete the following equations and write the suggested mechanism for the reaction.

a. $CH_3CH_2CH_2CH_2OH \xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4}$ ..... (03½ marks)

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b.  $\xrightarrow[35^0C]{\text{Fuming } H_2SO_4}$ ..... (03 marks)

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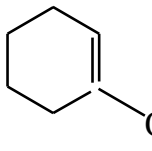
c.  $\xrightarrow{HBr}$ ..... (02½ marks)

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14. The table shows the atomic radius and first ionization energy of some elements in period 3 of the periodic table.

Elements	Na	Mg	Al	Si	P	S	Cl
Atomic radius	0.186	0.160	0.143	0.117	0.110	0.104	0.099
1^{st} I.E(KJ/mol)	496	738	577	787	1060	1000	1251

a. (i). State how **atomic radius** of the elements **varies across** the period. (01 mark)

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(ii).Explain your answer in a (i). (03 marks)

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b. (i).Explain how atomic radius affects the ionization energy. (02 marks)

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(ii). Why the first ionization energy of aluminium is lower than that of magnesium. (03 marks)

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15. (a). Silver chromate is sparingly soluble in water. Write:

i. An **equation for the solubility of silver chromate in water**. (01 mark)

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ii. Write **an expression of the solubility product constant**, Ksp for silver chromate. (01 mark)

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b. The solubility of silver chromate is **6.64×10^{-4}g/100g** of water at a certain temperature. Calculate the **solubility product** of silver chromate. (04 marks)

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c. Calculate the **solubility of silver chromate in 1.0dm^3 of 1.0M** silver nitrate. (03 marks)

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16. Complete the following equations and in each case outline a suitable **mechanism** for the reaction.

a. $CH_3CH_2C{\equiv}CH \xrightarrow{2HBr}$ ..... (03 marks)

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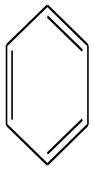
b.  + $Conc.H_2SO_4 \xrightarrow{Conc.HNO_3}$ ..... (02 ½ marks)

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c. $C(CH_3)_3Br \xrightarrow[Heat]{NaOH_{(aq)}/CH_3CH_2OH}$ ..... (03½ marks)

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17. Carbon, silicon, germanium, tin and lead are some of group(IV) elements on a periodic table. These elements exhibit **inert pair effect**

a) What is meant by the term **inert pair effect** (01 mark)

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b) Briefly explain inert pair effect among group(IV) elements using their dioxides. (02 marks)

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c)Describe the reaction of silicon and lead with

(i) air (03marks)

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(ii) hot concentrated sodium hydroxide solution (03marks)

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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 TI 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===

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