SECTION A–46 MARKS
ATTEMPT ALL QUESTIONS IN THIS SECTION.

1. (a) Complete the following equations for nuclear reactions. (@01 mark)

(i) $^{239}_{94}Pu + {}^{4}_{2}He \longrightarrow$ ..... $+ {}^{27}_{13}Al$

(ii) ..... $\longrightarrow {}^{234}_{90}Th + \alpha$

(iii) $^{214}_{83}Bi \longrightarrow {}^{206}_{82}Pb +$ ..... $+ 2{}^{4}_{2}He$

(iv) $^{250}_{98}Cf +$ ..... $\longrightarrow {}^{257}_{103}Lw + 4{}^{1}_{0}n$

b) Francium isotope $^{223}_{87}\boldsymbol{Fr}$ emits beta particles at a rate of **14.0 counts per second**. The rate of emission decreased by **6.5 counts per second** in **80 seconds**. Calculate the **half-life** of the isotope. (02 marks)

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2. Explain the following observations.
   a. Magnesium carbonate decomposes when **strongly heated** while sodium carbonate does not. (03 marks)

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   b. 1-bromohexane undergoes nucleophilic substitution whereas bromobenzene does not. (04 marks)

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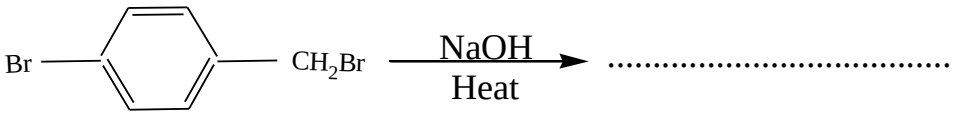
3. (a).An **organic compound X** reacts with hot aqueous sodium hydroxide solution to give **compound W**. complete the **equation of reaction**.

(01 mark)



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(b).Name the **type of reaction mechanism** for the reaction of **X** with hot aqueous sodium hydroxide solution. (0½ mark)

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(c).Explain why **W still contains one bromine atom**. (02½ marks)

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4. Write equations for the reaction of the following oxides with sodium hydroxide. (@01½ marks)

(a) Aluminium (III) oxide.

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(b) Beryllium oxide

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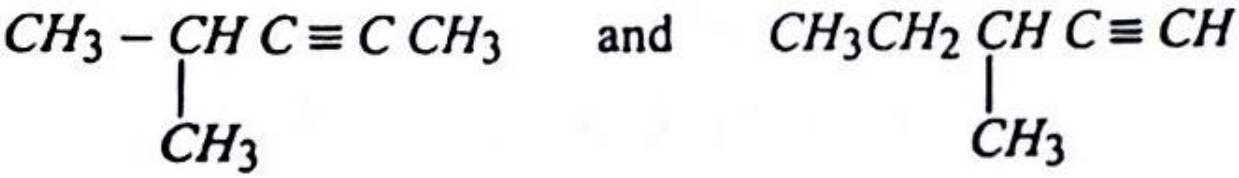
5. Draw the **structures** and name the **shapes** of the following molecules or ions. (04½ marks)

Molecules/ions	Structure	shape
CO_3^{2-}		
H_2S		
SO_2		

6. Name a **reagent** that can be used to **distinguish** between the following pairs of compounds and in each case, **state what would be observed** if each member of the pair was treated with the named reagent.

a)  and

Reagent (01 mark)

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Observations (02 marks)

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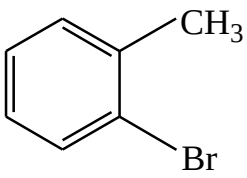
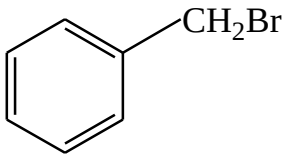
b) 

and 

Reagent (01 mark)

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Observations (02 marks)

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7. (a). State:

(i) Raoult's law. (01 mark)

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(ii) **Two conditions** under which the law is **valid**. (01 mark)

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(b) The vapour pressure of heptane and octane are **472.2Pa** and **139.8Pa** respectively at a temperature of **20°C**.Calculate the:

(i) The vapour pressure of the mixtures containing **0.50 moles** of heptane and **0.25 moles** of octane at a temperature of **20°C**.[Assuming the two solutions forms an ideal solution] (02 marks)

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(ii) Vapour composition. (01 mark)

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8. (a) State what is meant by the term **diagonal relationship?** (01 mark)

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(b) State **three reasons** why lithium and magnesium resemble.

(01½ marks)

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(c) Mention **three properties** to show the diagonal relationship between lithium and magnesium. (03 marks)

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9. Complete the following reaction equations and write the accepted mechanism.

a) $CH_3C \equiv CH \xrightarrow[Hg^{2+}60^{\circ}C]{H_2O/H^+}$

(03 marks)

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b) $CH_3CH = CH_2 + HCl \longrightarrow$ (02 marks)

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SECTION B–54 MARKS

ATTEMPT ANY SIX QUESTIONS IN THIS SECTION.

10. (a) Define the term solvent extraction. (01 mark)

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(b) An aqueous solution contains **10.0g** of hydroxybenzene per litre.When **100.0cm^3** of this solution is shaken with **20.0cm^3** of ether, the layer extracts **0.8g** of hydroxybenzene.Calculate the mass of hydroxybenzene extracted when **500.0cm^3** of aqueous layer was shaken with **50.0cm^3** of ether. (03 marks)

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(c) State any two other application of the partition law. (02 marks)

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(d) State three limitations of distribution law. (03 marks)

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11. Write equations to show how the following compounds can be synthesized and in each case, indicate the conditions for the reaction.
a) $CH_3CH_2C{\equiv}CH$ to $CH_3CH_2CH_2CH_2OH$ (03 marks)

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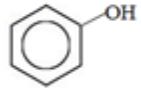
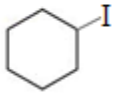
b)  to  (02 marks)

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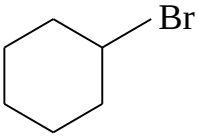
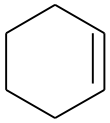
c)  to  (01½ marks)

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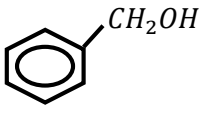
c)  To  (02½ marks)

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12. (a) Define the term **Azeotrope**. (01 mark)

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b) (i) State **three reasons** why **Azeotrope** is a **mixture** and **NOT** a **compound**. (01½ marks)

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(ii) Name **two methods** for separating **Azeotropic mixtures** in to **pure** components. (01 mark)

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c) The total vapour pressures of a mixture of propanone and trichloromethane.And the mole fraction of trichloromethane at constant temperature are given in the table below.

Mole fraction of $HCCl_3$	0.0	0.2	0.4	0.6	0.8	1.0
Total vapour pressure of the mixture (mmHg)	347	305	267	244	256	293

(i) Plot a graph of total vapour pressure of the mixture against the mole fractions of trichloromethane. (03 marks)

(ii) Use the graph you have drawn to determine the composition of the Azeotrope. (01 mark)

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d) State how the mixture in (c) deviates from **Raoult's law**. Give a **reason** for your answer. (01½ marks)

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13. In an experiment it was found that **35.0g** of pure alkene reacted with **100.0g** of bromine gas in presence of carbontetrachloride.

(a) (i) Calculate the **molecular mass** of the alkene. (01½ marks)

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(ii) Determine the **molecular formula** of the alkene. (01½ marks)

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(b) Write the **IUPAC names** of all the possible isomers and **structural** formulae of the alkene. (05 marks)

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(c) Write the equation of reaction between any isomers of the alkene with bromine gas in presence of carbontetrachloride. (01 mark)

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14. Beryllium and magnesium are some of the elements in group (II) of the periodic table.

a) Write the equation for the reaction between **water** and the **carbide** of:

(i) Beryllium (01½ marks)

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(ii) Magnesium (01½ marks)

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b) A sample of nitrogen gas completely reacted with heated magnesium to form **product Q**. **Product Q** reacted with water and all the ammonia gas produced was absorbed in **50.0cm³** of **0.05M** sulphuric acid. **12.5cm³** of **0.1M** sodium hydroxide solution was required to completely neutralize the remaining acid. Write equation for the reaction between:

(i) Nitrogen gas and Magnesium. (01 mark)

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(ii) **Product Q** and water. (01 mark)

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c) Calculate the **volume** of nitrogen gas at **s.t.p** that reacted with magnesium. (04 marks)

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15. **(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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16. (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. (02 marks)

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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] (03 marks)

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17. 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). $(CH_3)_3CBr \xrightarrow[Heat]{KOH/CH_3CH_2OH}$

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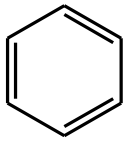
(c).  + $Conc.HNO_{3(aq)} \xrightarrow[60^oC]{Conc.H_2SO_{4(l)}}$

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WELCOME TO SENIOR SIX, YEAR 2022

This is the last page of the printed paper, Page 20

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