

SECTION A-46 MARKS

ATTEMPT ALL QUESTIONS IN THIS SECTION.

- 1.(a) A solution containing 1.5% of a polymer was found to have an osmotic pressure of 3.6×10^{-4} atmospheres at room temperature. Calculate the molecular mass of the polymer.

(02½ marks)

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- b) Explain why in the determination of molecular mass of polymers, osmotic pressure is used instead of ebullioscopic and cryoscopic methods.

(02 marks)

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

a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ & $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ (03 marks)

Reagent:

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Observation (s):

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b) 2-phenyl-2-methylethan-2-ol & 3-phenylpropan-1-ol (03 marks)

Reagent:

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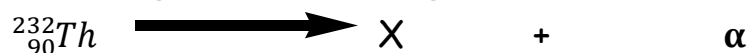
Observation (s):

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3.(a) Thorium, ${}^{232}_{90}\text{Th}$ undergoes radioactive decay to give element, X according to the following equation below:



Calculate:

i. The atomic number of element, X. (01 mark)

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$$X \longrightarrow Y + \beta$$

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A radioactive isotope of element, X had an initial activity of **250 counts per second** on a Geiger counter. After **40 minutes**, the activity had declined to **240 counts per second**. Calculate the **half-life** of element, X. (03 marks)

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- b) State two factors which affect the magnitude of hydration energy. (03 marks)

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- c) The table below shows enthalpies of hydration of Ca^{2+} & Cl^- ions.

Ions	Enthalpy of hydration [kJ/mol]
Ca^{2+}	1,577
Cl^-	381

- i. State whether the values of enthalpies of hydration of Ca^{2+} & Cl^- given in the table above are positive or negative. Give a reason for your answer. (01½ marks)

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- ii. Calculate the enthalpy of hydration of calcium chloride. (01½ marks)

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5. The table below shows the first ionization energies and melting points of some group (II) elements of the periodic table. Use the information in it to answer the followings questions.

Elements	Mg	Ca	Sr	Ba
1 st Ionization energy [kJ/mol]	738	590	549	505
Melting points [°C]	649	839	769	729

Briefly explain the variation in trends of:

a) First ionization energy. (02½ marks)

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b) Melting points. (02½ marks)

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6. Complete the following equations and write a mechanism for the reaction in each case.



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7.(a) State what would be observed and write equation for the reaction that would take place when:

- i. Potassium iodide was added to acidified potassium dichromate solution. (02½ marks)

Observation (s):

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Equation:

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- ii. Sodium thiosulphate was added to the mixture in a (i) above.
(02½ marks)

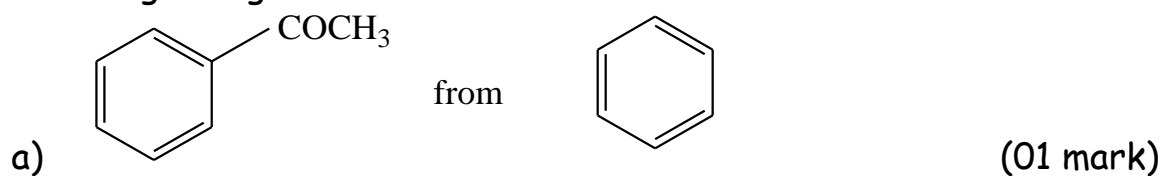
Observation (s):

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Equation:

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8. Name the reagent(s) and condition(s) that can be used to effect the following changes.

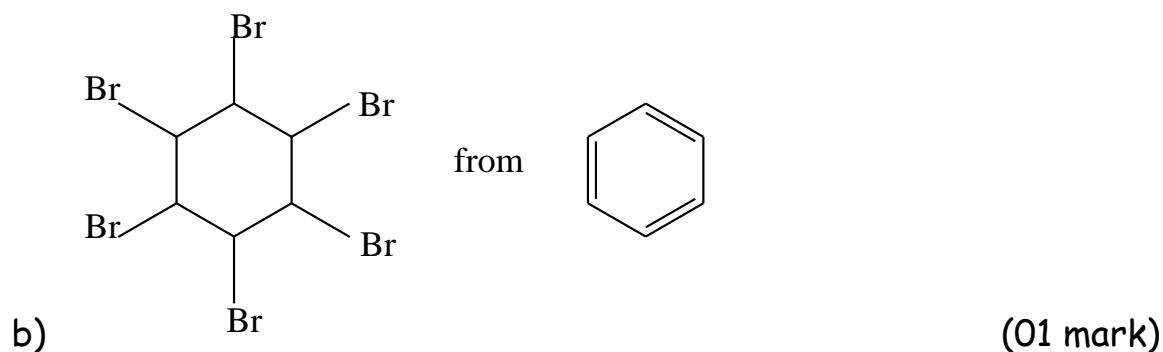


Reagent (s):

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Observation (s):

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Reagent (s):

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Observation (s):

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Reagent (s):

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Observation (s):

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- 9.(a) Draw the structures and name the shape of the following oxides.
In each case state the oxidation state of sulphur atom.

(03 marks)

Oxide (s)	Structure	Shape	Oxidation state of sulphur
SO ₂			
SO ₃			

b)(i) Name the reagent that can be used to distinguish the oxides in (a). (01 mark)

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ii. State what would be observed if each oxide is separately treated with the reagent you have named in b (i) above. (01 mark)

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iii. Write equation(s) for the reaction(s) that would take place when each oxide is separately treated with reagent you have named b (i). (01½ marks)

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SECTION B-54 MARKS

ATTEMPT ANY SIX QUESTIONS IN THIS SECTION.

10.(a) Write an equation of reaction between water and the oxides of: (@01½ marks)

i. Sodium.

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ii. Magnesium.

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iii. Phosphorous.

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b) Write equation for the reaction between concentrated sulphuric acid and: (@01½ marks)

i. Magnesium.

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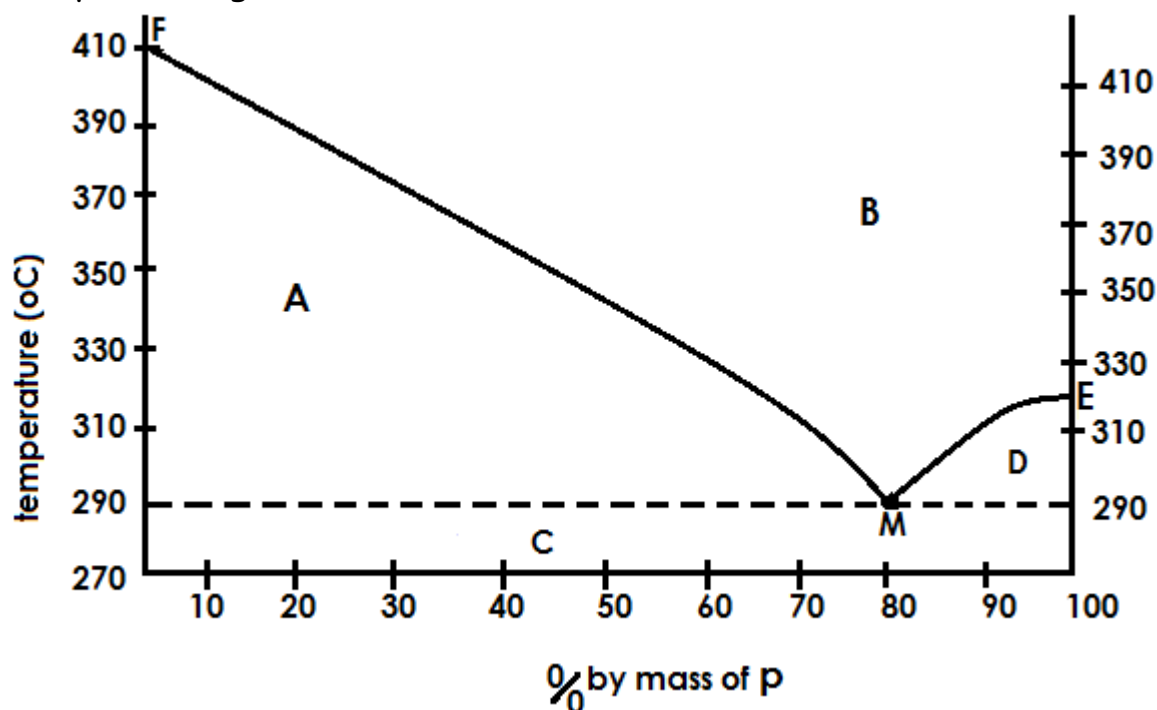
ii. Hydrogen bromide.

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iii. Phosphorous.

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11. The phase diagram for a mixture of metals P & Q is shown below.



a) Identify the regions A, B, C & D.

(02 marks)

A:.....

B:.....

C:.....

D:.....

b) State what point M represent. (01 mark)

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c) Using the diagram, estimate the melting point of: (01 mark)

P:.....

Q:.....

d) Describe what would happen if a mixture containing **50%** by mass of P and Q is cooled from **410°C** to **270°C**. (03 marks)

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e) State one each difference and similarity between the substance at point M and a pure compound. (@01 mark)

i. Difference:

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ii. Similarity:

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12.(a) Define the term enthalpy of solution. (01 mark)

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b) In an experiment to determine the enthalpy of solution of anhydrous and hydrated copper (II) sulphate salts, **4.0g** of anhydrous salt was added to **50g** of water and temperature of water rose by **8.0°C**. When **4.0g** of the hydrated salt $[\text{CuSO}_4 \cdot 5\text{H}_2\text{O}]$ was added to **50g** of water, the temperature of water dropped by **1.3°C**. Calculate the enthalpy of solution in **kJ/mol** of: [Specific heat capacity of solution = **4.2J/g/°C**]

i. Anhydrous copper (II) sulphate. (02½ marks)

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ii. Hydrate copper (II) sulphate. (02 marks)

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iii. Comment on the difference in values of enthalpy of solution calculated in (b) above. (02 marks)

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c) Calculate the enthalpy change for the reaction:



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13. Nitrogen and hydrogen react to form ammonia according to



a) State the industrial conditions used to obtain a maximum yield of ammonia gas. (01½ marks)

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b) During the manufacture of nitric acid, ammonia is catalytically oxidized to P which is further oxidized to Q. Q is then reacted with water to produce nitric acid.

i. Name P and Q. (@0½ mark)

P =

Q =

ii. Write equations for the formation of: (@01½ marks)

P:

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Q:

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Nitric acid:

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c) Write equations for the reaction of concentrated nitric acid

and: (@01½ marks)

i. Carbon.

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ii. Copper.

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14. Write equations to show how the following compounds can be synthesized.

a) Butanone from calcium carbide. (03½ marks)

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b)Phenylmethanol from benzene. (03½ marks)

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c) But-2-yne from ethyne. (02 marks)

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15.(a) The saturated vapour pressures of liquids **A** & **B** which form an ideal solution at **20°C** are **15kN/m²** and **35kN/m²** respectively. If the total pressure above the solution is **29kN/m²**, Calculate the:

i. Mole fraction of A in the liquid mixture. (02 marks)

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ii. Composition of the vapour above the liquid mixture of A and B. (02 marks)

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b) The boiling point-composition diagram for a mixture of hydrochloric acid and water is shown below:
(Diagram needed)

i. State how the mixture deviates from Raoult's law. Give a reason for your answer. (02 marks)

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- ii. Explain the causes of the deviation you have stated in b (i) above. (03 marks)

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16.(a) An organic compound, **P** has a molecular formula **C₄H₉Br**.

- i. Name the functional group in organic compound, P. (01 mark)

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- ii. Write the structural formulae and names of all possible isomers of organic compound, P. (04 marks)

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- iii. Identify two isomers in a (ii) that when reacted with hot ethanolic potassium hydroxide solution give the same product. (01 mark)

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- iv. Write the structural formula and name of the product in a (iii). (01 mark)

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- b) Outline the mechanism for the reaction between the product in a (iii) and benzene in presence of an acid. (02 marks)

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17. The table below shows values for the atomic and ionic radii of the alkali metals.

Element	Atomic radius [$\times 10^{-10}\text{m}$]	Ionic radius [$\times 10^{-10}\text{m}$]
Lithium	1.23	0.68
Sodium	1.57	0.97
Potassium	2.03	1.33
Rubidium	2.16	1.47
Caesium	2.35	1.67

- a) In every case, the radius of an ion is smaller than that of the corresponding atom. Explain. (02 marks)

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b) Explain the increase in atomic radius along the series lithium to Caesium. (02 marks)

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c) The ions Na^+ , Mg^{2+} & Al^{3+} have the same electronic configuration, yet they have different ionic radii. Suggest a reason for this.

(02 marks)

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d) Which of the alkali metal ions in the gaseous state is likely to have the highest hydration energy? Give a reason. (03 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 2023
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