SECTION A (60 Marks)

Answer only **three** questions from this section.

1.(a) Describe, using equations where applicable, the reactions of chromium with:
   (i) Air.
   (ii) Sodium hydroxide solution.
   (iii)Sulphuric acid.   (08 marks)

   b) (i).Explain why chromium is considered a typical transition metal element.   (02 marks)
   (ii) State five ways in which the chemistry of chromium is similar to that of aluminium.   (05 marks)

   c)(i) State what is observed when a small piece of magnesium ribbon is dropped in to a solution of chromium (III) sulphate.   (02 marks)
   (ii) Explain the observation in c (i) above.   (03 marks)

2. The mass spectrometer can be used to determine the relative atomic mass of elements consisting of various isotopes.
   a) What is meant by the following terms: (@01 mark)
      (i)Relative intensities.
      (ii) Relative abundance.
      (iii)Relative atomic mass.
   b) Briefly describe how the relative atomic mass of mass metal which consists of three isotopes can be determined using a mass spectrometer.[Diagram not required]   (06 marks)
   c) The relative atomic mass of magnesium with isotopes $^{24}_{12}Mg$, $^{25}_{12}Mg$ & $^{26}_{12}Mg$ is 24.3.If the percentage abundance of $^{25}_{12}Mg$ & $^{26}_{12}Mg$ are equal.
      (i) Calculate the percentage abundance of each isotope of magnesium.   (01$\frac{1}{2}$ marks)
      (ii)Sketch the mass spectrum of magnesium.   (02 marks)
   d) The table below shows the results of radioactive decay of a radioactive isotope of magnesium $^{26}_{12}Mg$.Use the data to plot a graph of log(mass) against time.   (04 marks)

Mass of $^{26}_{12}Mg(g)$	18.7	14.6	11.3	8.8	6.9	5.4
Time (s)	300	600	900	1,200	1,500	1,800

e) Using the graph plotted in (d) above determine the:

(i) Order of radioactive decay of $^{26}_{12}Mg$.   (01 mark)

(ii) Rate constant and hence half-life of $^{26}_{12}Mg$.   (01$\frac{1}{2}$ marks)

(iii) Original mass of $^{26}_{12}Mg$.   (01 mark)

3. A saturated bromocompound, G $C_nH_{2n-1}Br$ contains 49.08% by mass of bromine.

a) (i) Determine the molecular formula of saturated
bromocompound, G.   (02 marks)

(ii) Write the structural formula and name of saturated
bromocompound, G.   (01 mark)

b) Phenol was reacted with saturated bromocompound, G.

(i) State the condition (s) for the reaction.   (01 mark)

(ii) Write the equation and mechanism for the reaction that took
place.   (04 marks)

c) Saturated bromocompound, G can be distinguished from
bromobenzene

(i) Name the reagent (s) that can be used to distinguish the two
compounds and state what is observed.   (03 marks)

(ii) Using relevant illustrations and equations explain the
difference in the observations.   (05 marks)

d) Using equations while stating conditions for each step clearly
show saturated bromocompound, G can be converted to Hexan-
1,6-dioic acid.   (04 marks)

4. Explain the following observations:

a) Hydrogen fluoride is a liquid at 19°C while hydrogen chloride is a
gas.   (03$\frac{1}{2}$ marks)

b) When sodium hydroxide is added to manganese (II) chloride, a
white precipitate is formed that is insoluble in excess sodium
hydroxide but turns brown on standing.   (04$\frac{1}{2}$ marks)

c) Carbon tetrachloride molecule is non-polar yet the bonds in it are polar. (04½ marks)

d) Phenol is a stronger acid than cyclohexanol. (03½ marks)

e) A mixture of 50cc of 0.1M ammonium hydroxide solution and 50cc of 0.1M solution of hydrochloric acid gives a solution which is less than seven. (04 marks)

SECTION B (40 Marks)

Answer only **two** questions from this section.

5.(a) Write equations to show how each of the following compounds can be synthesized. In each case, indicate a mechanism for the reaction.

  a). $(CH_3)_2C=NOH$ from Propanone (05 marks)

  b). from Benzene (03 marks)

  b) Name the reagent (s) that can be used to differentiate between the compounds in each of the following pairs. In each case, state what would be observed and write the equation (s) for the reaction if any when when each member of the pairs is treated with the reagent (s) stated.
  (i) Phenol and cyclohexanol. (04 marks)
  (ii) Ethanal and phenylmethanal (04 marks)

  c) Using equations while stating conditions for each step clearly show how 2-bromopropane can be converted to phenol. (04 marks)

6.(a) The melting points of magnesium, silicon, & sulphur are 650°C, 1,423°C & 120°C respectively. Explain the difference in the melting of the elements. (06 marks)

  b)(i).Name the type of bond that exists in the hydride of magnesium, silicon & sulphur. (01½ marks)

  (ii).Write the equation to show the reaction of any of the hydride with water. (04½ marks)

  c) Describe the reactions of the oxide of silicon with: (08 marks)

3

(i) Hydrofluoric acid.

(ii) Sodium hydroxide solution.

(iii)Water

7.(a) (i).Write balanced equations to illustrate the main stages of the contact process.   (03 marks)

(ii).Explain the conditions used in the contact process to ensure maximum yield.   (05 marks)

b) Sulphuric acid vapour dissociates when heated according to the equation below:

$$H_2SO_{4(g)} \rightleftharpoons H_2O_{(l)} + SO_{3(g)}$$

Write an expression for the equilibrium constant,Kp for the reaction and state its SI units. $(01\frac{1}{2}$ marks)

c) The following data shows the equilibrium partial pressure of sulphuric acid vapour, steam and sulphur trioxide gas at two different temperature and pressure of 1atm:

Temperature (K)	Partial pressures (Pa)		
	H_2SO_4	H_2O	SO_3
400	4.5	3.2	2.9
493	470	300	270

(i)Calculate the equilibrium constant,Kp at each temperature. Hence deduce with an explanation whether the dissociation sulphuric acid vapour is exothermic or endothermic.   (04 marks)

(ii) Explain the effect of increasing pressure on the equilibrium position and equilibrium constant, kp at 400K. $(02\frac{1}{2}$ marks)

d)(i).Sketch the structure and name of the shape of the sulphuric acid molecule.   (02 marks)

(ii) Explain why sulphuric acid molecule adopts the shape named.
                                          (02 marks)

8.(a) (i) What is meant by the term Ore?   (01 mark)
       (ii)Write the formula and name of one ore from which copper is
           extracted.   (01 mark)
   b) Describe how pure copper can be extracted from the (a) (ii)
       above.   ($11\frac{1}{2}$ marks)
   c) Discuss the reactions of copper with:
       (i) Nitric acid.
       (ii) Concentrated hydrochloric acid.   (04 marks)
   d) Few drops of potassium hexacyanoferrate (II) solution were
       added to copper (II) sulphate solution:
       (i) State what would be observed.   (01 mark)
       (ii) Write equation for the reaction.   ($01\frac{1}{2}$ marks)

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

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