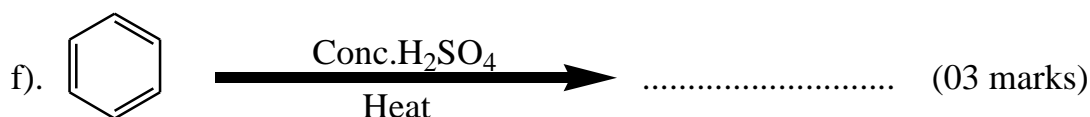
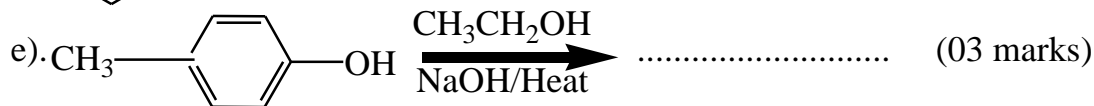
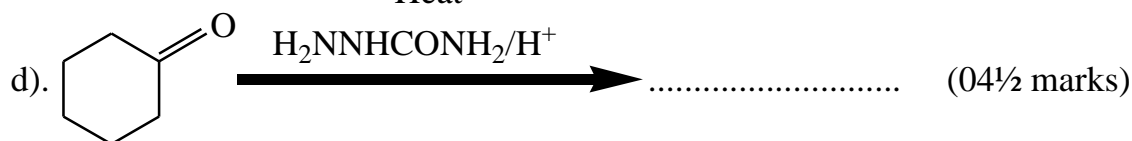
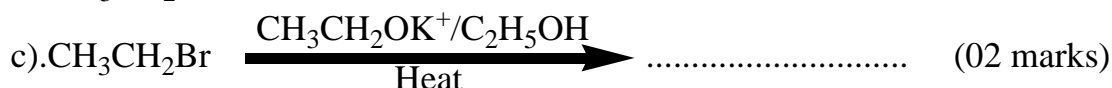


SECTION A (60 Marks)

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

1. Complete the following equations and outline the mechanisms.



2. Water boils at 100°C and a pressure at 101.3kPa. Aminobenzene boils at 112°C. A mixture of water and aminobenzene boils at 96°C.

a. Explain the above observation. (05 marks)

b. (i). Define what is meant by the term steam distillation? (01 mark)

(ii). Explain the principle of steam distillation. (04 marks)

(iii) **State the requirements for a substance to be isolated by steam distillation.** (01½ marks)

(iv) Name one substance apart from aminobenzene that can be isolated by steam distillation. (0½ mark)

(v) State 2 advantages of steam distillation. (01 mark)

c. When compound Y was steam distilled at standard atmospheric pressure, the temperature of distillation was 96°C. The vapour pressure of water at this temperature is 730 mmHg and the distillate contained 74% of water. Calculate the relative molecular mass of Y. (03 marks)

d. The vapour pressure of water at 50°C is 92mmHg. A solution containing 18.1g of a non-volatile solute X in 100g of water has a

vapour pressure of 87mmHg at the same temperature. Calculate the relative molecular mass of X.

- (i) Calculate the vapour pressure of the solution. (02 marks)
- (ii) State and explain the effect of the concentration of the solute on the boiling point of Y. (02 marks)

3. 25cm³ of 0.1M ammonia solution was titrated with hydrochloric acid and the pH of the solution was measured at intervals. The table below gives the pH of the solution when measured volumes of hydrochloric acid were added.

Volume of hydrochloric acid (cm ³)	0.0	10.0	15.0	16.5
pH of the solution	10.20	9.08	8.30	6.70

- a. (i) Plot a graph of pH against volume of hydrochloric acid. (03 marks)
- (ii) Explain the shape of the graph. (05 marks)
- (iii) Calculate the molarity of the hydrochloric acid. (03 marks)
- b. The PH ranges of some indicators are shown below.

Indicators	pH range
Thymol blue	1.2 - 2.8
Methyl red	4.8 - 6.0
Phenolphalein	6.6 - 8.0

Which one of the above indicators is most suitable for the above titration? Explain your answer. (02 marks)

- c. (i) What is a 'buffer solution'? (01 mark)
- (ii) Explain the working of an alkaline buffer. Use suitable examples to illustrate your answer. (05 marks)
- d. State 2 uses of buffer solutions. (02 marks)

- 4. (a) (i). Write the outermost electronic configuration of group (IV) elements. (0½ mark)
- (ii). State the oxidation states of the elements. (01 mark)
- (iii). Explain the trend in the stability of oxidation states. (01½ marks)

- b) The table below shows atomic numbers and melting points of some group (IV) elements. Explain the trend in melting points.

(04 marks)

Elements	${}_6\text{C}$	${}_{14}\text{Si}$	${}_{32}\text{Ge}$	${}_{82}\text{Pb}$
Melting point ($^{\circ}\text{C}$)	3,750	1,420	950	327

- c) Describe the reaction of the elements with:

- (i) Water
- (ii) sulphuric acid

SECTION B (40 Marks)

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

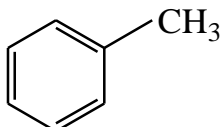
5. Explain the following observations. Write equations for the reactions that take place where necessary.
- (a) When a concentrated solution of sodium carbonate is added to a solution of potassium chromium (iii) sulphate ($\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$), a green precipitate is formed with bubbles of a colourless gas. (04½ marks)
 - (b) Methanoic acid reacts with ammoniacal silver nitrate solution to form a silver mirror but ethanoic acid does not. (04 marks)
 - (c) A solution of sodium thiosulphate becomes cloudy when it is exposed to air for some time. (02 marks)
 - (d) When concentrated hydrochloric acid is added to a solution of cobalt (II) chloride, the pink solution turns blue. (02 marks)
 - (e) The ionization energy of period (III) elements increase across the period but the first ionization energy of aluminium is lower than that of magnesium and that of sulphur is lower than that of phosphorus. (05 marks)
 - (f) When a solution of manganese (II) chloride is heated with concentrated nitric acid and lead (IV) oxide, the colourless solution turns purple. (02½ marks)

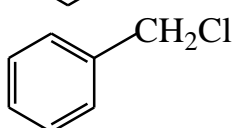
6. Write equations to show how the following compounds can be synthesized. Indicate the reagents and conditions.

a). $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ from Ethene (04½ marks)

b). $\text{CH}_3\text{CH}_2\text{NH}_2$ from $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (03 marks)

c). $\text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_3$ from Propyne (04 marks)

d).  from Ethene (04 marks)

e).  from Benzene (04½ marks)

7. Phosphorus (V) chloride decomposes when heated according to the equation.



The enthalpies of formation of phosphorus (V) chloride and phosphorus (III) chloride are -398.8 and -306.0 KJ/mole respectively.

(a) Calculate the enthalpy of dissociation of phosphorus (V) chloride. (02 marks)

(b) Explain the effect of the following on the position of equilibrium, value of the equilibrium constant and rate of attainment of equilibrium:

(i) Increasing temperature. (04 marks)

(ii) Increasing pressure. (04 marks)

(iii) Adding a catalyst. (02½ marks)

(c) Nitrogen monoxide reacts with oxygen according to the equation:



3 moles of nitrogen monoxide and 1.5 moles of oxygen were heated in a 1dm^3 closed vessel at 450°C . at equilibrium the vessel was found to contain 0.5 moles of oxygen.

- (i) Calculate the equilibrium constant at this temperature.
(03 marks)
- (ii) When the temperature was raised to 600°C the mixture in (a) was found to contain 25% of the initial nitrogen monoxide.
Calculate the equilibrium constant at 600°C . (02½ marks)
- (d) Deduce whether the reaction is exothermic or endothermic.
Explain your answer. (02 marks)
8. Describe the industrial manufacture of sulphuric acid starting with iron pyrites. (07½ marks)
- (ii) State 2 uses of sulphuric acid (other than manufacture of fertilizers) (01 mark)
- (b) Concentrated sulphuric acid is 98% acid and has a density of 1.84 gcm^{-3} .
(i) Calculate the molar concentration of the acid. (02½ marks)
(ii) Calculate the volume of acid required to prepare 1 litre of 0.2M solution. (02 marks)
- (c) Write an equation to show how sulphuric acid is used to prepare a superphosphate fertilizer. (01 mark)
- (d) Describe the reaction of sulphuric acid with:
(i) Copper. (02 marks)
(ii) Iron. (04 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

♥ ===END===

WELCOME TO SENIOR SIX, YEAR 2023
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