P525/2
CHEMISTRY
Paper 2
Oct./Nov. 2022 **S.6**
2 ½ hours.

THE CHEMISTRY DEPARTMENT

2022

CHEMISTRY

TEST NINE , TERM III, Paper 2

2 hours 30 minutes

INSTRUCTIONS:

Answer ***five*** *questions including* **three** *questions from section* **A** *and* any **two** from *section* **B**.

Write the answers in the answer booklet(s) provided.

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific calculators may be used.

Use equations where necessary to illustrate your answers.

Where necessary, use the following;

$$[\ O = 16, \qquad Cr = 52, \qquad Ag = 108]$$

SECTION A : (60 MARKS)

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

1. (a) Write the formula and name of the main ore of aluminium. *(01 mark)*

(b) Describe how:

(i) the ore is purified *(07 marks)*

(ii) pure aluminium is obtained from the purified ore. *(03 marks)*

(c) Describe the reaction of aluminium with:

(i) sulphuric acid *(03 marks)*

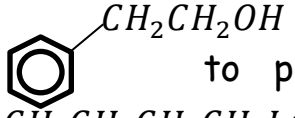
(ii) sodium hydroxide *(02 marks)*

(d) State what you will observe and write equations for the reactions that take place when;

(i) sodium carbonate solution is added to an aqueous solution of aluminium sulphate. *(02 marks)*

(ii) sodium hydroxide solution is added to aqueous aluminium sulphate dropwise until in excess. *(02 marks)*

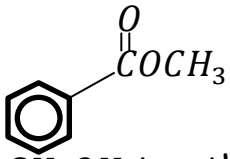
2. Write equations to show how you would effect the following conversions indicating the reagents and conditions for the reactions.

(a)  to phenylethyne *(3 ½ marks)*

(b) $CH_3CH_2CH_2CH_2I$ to propane *(03 marks)*

(c) CH_3CHO to ethylamine *(03 marks)*

(d) $CH_3CH_2CH_2CH_2OH$ to 2,2-dichlorobutane *(4 ½ marks)*

(e)  to benzene *(2 ½ marks)*

(f) CH_3OH to ethanol *(3 ½ marks)*

3. (a) (i) Define solubility. *(01 mark)*

(ii) solubility product. *(01 mark)*

(b) Describe an experiment that you would carry out to determine the solubility of silver phosphate. *(06 marks)*

(c) The solubility of silver chromate at $25℃$ is $3.21 \times 10^{-2} gdm^{-3}$.

(i) Calculate its solubility product at this temperature. *(02 marks)*

(ii) Calculate the solubility of silver chromate in 0.05M silver nitrate solution. *(02 marks)*

(d) A solution of silver nitrate was added to a solution containing 0.02M potassium chloride and 0.02M potassium chromate. Calculate the concentration of silver ions required to precipitate.

(i) silver chloride *(1 ½ marks)*

(ii) silver chromate *(1 ½ marks)*

(e)State which of the compounds in (d) will be precipitated first. Give a reason for your answer. *(02 marks)*

(Solubility product of silver chloride $= 1.0 \times 10^{-10} mol^2 dm^{-6}$ at $25℃$)

(f)Explain what happens to the solubility of silver chromate when ammonia solution is added to a saturated solution of silver chromate. *(03 marks)*

4. (a) Water boils at $100℃$ and $101.3\ kPa$. Aminobenzene boils at $112℃$. A mixture of water and aminobenzene boils at $96℃$. Explain this observation. *(04 marks)*

(b) (i) What is steam distillation? *(01 mark)*

(ii) Explain the principle of separation by steam distillation. *(4 ½ marks)*

(iii) State the requirements for a substance to be isolated by steam distillation. *(1 ½ marks)*

(iv) Name one other substance apart from aminobenzene that can be isolated by steam distillation. *(01 mark)*

(v) State two advantages of steam distillation. *(01 mark)*

(c) With the aid of a diagram, describe how aminobenzene can be purified by steam distillation. *(04 marks)*

(d) When a substance Z was distilled at $93°C$ and $750mmHg$, the distillate contained 55% of Z by mass. The vapour pressure of water at this temperature is $654mmHg$. Calculate the relative molecular mass of Z. *(03 marks)*

SECTION B : (40 MARKS)

Answer any **two** *questions from this section*

5. (a) Describe how iron is extracted from spathic iron ore. *(05 marks)*

(b) Describe the reaction of iron with:

(i) water *(03 marks)*

(ii) sulphuric acid *(05 marks)*

(c) Explain briefly why iron(II) salts are easily oxidised to iron(III) salts but manganese(II) salts cannot easily be oxidised to manganese(III) salts. *(03 marks)*

(Atomic numbers of Manganese and iron are 25 and 26 respectively)

(d) Describe briefly how you would determine the percentage of iron in an impure iron ore. *(04 marks)*

6. Explain the following observations

(a) Aluminium has a lower first ionisation energy that that of sulphur. *(03 marks)*

(b) The boiling points of the hydrides of group IV elements in the Periodic Table are in the order $CH_4 < SiH_4 < GeH_4 < SnH_4 < PbH_4$ whereas the boiling points of the hydrides of group VII elements are in the order $HCl < HBr < HI < HF$. *(05 marks)*

(c) Potassium chloride is more soluble in water than in concentrated hydrochloric acid whereas lead(II) chloride is more soluble in concentrated hydrochloric acid than in water. *(05 marks)*

(d) Lead does not form lead tetraiodide. *(02 marks)*

(e) When iodohexane was treated with hot aqueous sodium hydroxide and the resultant solution neutralised dilute nitric acid and then treated with silver nitrate solution, a yellow precipitate is formed. Iodobenzene on a similar treatment gives no precipitate. *(05 marks)*

7. (a) (i) What is the chemical nature of soap? *(01 mark)*

(ii) Give the chemical name of an example of soap. *(01 mark)*

(iii) What do you understand by the term synthetic detergents? *(01 mark)*

(iv) Explain clearly how soaps remove grease particles from fabric during washing. *(04 marks)*

(v) State one advantage and one disadvantage of soapless detergents over soap. *(02 marks)*

(b) Describe how:

(i) a soapless detergent can be prepared from benzene. Include equation(s) in your answer. *(04 marks)*

(ii) a solid soap can be prepared from simsim oil *(04 marks)*

(c) (i) Write equation for formation of soap from 9.5g of oil containing hexadecanoic acid, $C_{15}H_{31}COOH$. *(01 mark)*

(ii) Calculate the mass of soap. *(02 marks)*

8. (a) The table below shows the pH of the solution when measured volumes of hydrochloric acid is added to $25cm^3$ of 0.1M ammonia solution.

Volume of hydrochloric acid(cm^3)	0	10.0	15.0	16.5	17.0	20.0	25.0
pH of solution	10.25	9.08	8.30	6.70	2.97	1.96	1.60

(i) Plot a graph of pH against volume of hydrochloric acid. *(03 marks)*

(ii) Explain the shape of the graph. *(04 marks)*

(b) Using the graph in (a) above, calculate the:

(i) molarity of hydrochloric acid. *(1 ½ marks)*

(ii) ionisation constant, K_b of ammonia. *(2 ½ marks)*

(iii) Concentration of ammonium chloride formed. *(02 marks)*

(iv) hydrolysis constant of ammonium chloride. *(03 marks)*

(c)Calculate the pH of the solution formed when $5\ cm^3$ of 0.1M hydrochloric acid is added to $25cm^3$ of 0.1M ammonia solution.

$(K_b = 1.8 \times 10^{-5}\ and\ K_w = 1 \times 10^{-14}\ at\ 25℃)$. *(04 marks)*

END