P525/2
CHEMISTRY
(THEORY)
Paper 2
July/August 2023
2½ hours

MASAKA DIOCESAN EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
Joint Mock Examinations 2023
CHEMISTRY
(THEORY)
Paper 2
2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **five** questions including **three** questions from section **A** and any **two** from section **B**.*
Write the answers on the answer sheets provided.
*Begin **each** question on a **fresh** page.*
Mathematical tables and graph papers are provided.
Silent-non programmable scientific electronic calculators may be used.
Use equations where necessary to illustrate your answers.
Where necessary use the following:

(H = 1, C = 12, O = 16), S = 32)

Universal molar gas constant is 8.31Jmol^{-1}k^{-1} molar gas volume at s.t.p is 22.4dm^3

SECTION A: *(60 marks)*

Answer **three** questions from this section.
Any additional question answered will **not** be marked.

1. (a) State what is meant by the term;

   i) Eutectic mixture (01 mark)
   ii) Eutectic temperature (01 mark)
   iii) Phase (01 mark)

   (b) The table below shows the melting points and composition of various mixtures of cadmium and bismuth

Composition of bismuth (%)	5	20	35	50	65	80
Melting point (°C)	300	242	184	156	189	265

   Draw a labeled phase diagram of the bismuth cadmium system. (05 marks)

   (c) Using the diagram in (b) above;

   i) Determine melting points of bismuth and cadmium. (01 mark)
   ii) State the melting point and composition of the eutectic mixture. (01 mark)
   iii) Describe what happens when a liquid mixture containing 10% cadmium is cooled from 350°C to 100°C. (04 marks)
   iv) Work out the mass of cadmium crystallized when 200g of a mixture containing 15% bismuth was cooled from 300°C to 200°C.

   (d) Write down two differences and two similarities between eutectic mixtures and compounds. (02 marks)

2. Complete the equation and outline a mechanism for the reaction.

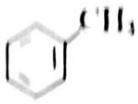
   (c) $CH_3COCl \xrightarrow{CH_3CH_2NH_2}$ (03 marks)

   (d)  $+ H_2NOH \xrightarrow{H^+}$ (05 marks)

   (e)  $+ CH_3COBr \xrightarrow{FeBr_3}$ (3½ marks)

(f) CH_3 [illegible] $\xrightarrow[\text{Heat}]{}$

(g) $(CH_3)_2CHCH_2CH_3$ $\xrightarrow[\text{Heat}]{}$

(h) 

$\xrightarrow[\text{Heat}]{Conc\ H_2SO_4}$

3. (a) The elements fluorine, chlorine, bromine and iodine are group [illegible] in the periodic table.
State the trend in the acid strength of their hydrides and explain your answer

(b) Describe the reactions of fluorine and bromine with;
i) water
ii) sodium hydroxide

(c) Explain the following observations;
i) The elctronegativities of fluorine and chlorine are -333 and -349 KJmol^{-1}, respectively.
ii) Hydrogen fluoride is a gas at 19°C but hydrogen iodide is a gas.

4. (a) i) What is an alkaline buffer? (01 mark)
ii) Briefly describe the action of an alkaline buffer. (04 marks)

(b) Methylamine is a weak alkali
i) Write equation for the dissociation of methylamine in water. (1½ marks)
ii) Calculate the PH of a 0.02M methylamine. (03 marks)

(c) 50cm^3 of a 0.05M methylamine was added to 30cm^3 of a 0.05M hydrochloric acid. Calculate the pH of the resultant solution.
(kb of methylamine is 1.8 x 10^{-3} moldm^{-3} at 25°C Kw = 1.0 x 10^{-14} mol^2 dm^{-6}) (3½ marks)

(d) 50cm^3 of a 0.02M methylamine was added to an equal volume of a 0.02M nitric acid.
i) Calculate the pH of the solution formed. (05 marks)
ii) Explain your answer in d(i) above. (02 marks)

SECTION B: *(40 marks)*

Answer **two** questions from this section.
Any additional question answered will **not** be marked.

5. (a) Write the electronic configuration of manganese. (atomic number = 25) (½ mark)

   (b) Explain why manganese;

   i) is a transition metal. (1½ marks)
   ii) has variable oxidation states. (02 marks)
   iii) forms complex ions. (02 marks)
   iv) is a d-block element. 902 marks)

   (c) Describe the reactions of manganese with;

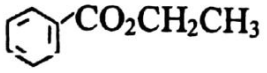
   i) water. (02 marks)
   ii) sulphuric acid (04 marks)

   (d) State the observations made and explain the reactions of manganese (II) chloride with;

   i) sodium hydroxide (3½ marks)
   ii) a mixture of nitric acid and sodium bismuthate. (2½ marks)

6. Write equations to show how the following conversions can be effected. Indicate reagents and conditions.

   (a) Calcium carbide to benzoylchloride. (03 marks)

   (b)  from benzene (3½ marks)

   (c) Propyne to CH_3CHCH_3 (03 marks)
   NH_2

   (d) Propan-l-ol from bromo ethane (3½ marks)

   (e) Ethanol to CH_3Br (3½ marks)

   (f) Ethylamine from propan-2-ol (3½ marks)

7. Explain the following observations. Write equations for the reactions that take place where necessary.

(a) When a saturated solution of potassium carbonate is added to a solution of potassium chromium (III) sulphate ($K_2SO_4.Cr_2(SO_4)_3.18H_2O$), a green precipitate is formed with effervescence of a colourless gas. (4½ marks)

(b) Sodium methanoate reacts with ammoniacal silver nitrate solution to form a silver mirror but sodium ethanoate does not. (04 marks)

(c) The first ionization energy of period 3 elements in the periodic table increases with increasing atomic number but the first ionization energy of phosphorus is higher than that of sulphur. (P = 15, Cl = 17) (05 marks)

(d) The acid dissociation constant of methanoic acid, Ka is 1.75×10^{-4} moldm^3 but ka for ethanoic acid is 1.8×10^{-5} moldm^{-3}. (03 marks)

(e) When chlorocyclohexane is reacted with hot sodium hydroxide solution and dilute nitric acid added followed by aqeous silver nitrate a white precipitate forms but when chlorobenzene is treated in the same way, there is no observable change. (3½ marks)

8. (a) i) Starting with iron pyrites, describe the manufacture of sulphuric acid by the contact process. (7½ marks)

ii) State two uses of sulphuric acid other than the manufacture of fertilizers. (01 mark)

(b) Concentrated sulphuric acid is 98% acid with a density of 1.84g/cm^3

i) Work out the molar concentration of the acid. (2½ marks)

ii) Calculate the volume of the acid needed to prepare a 0.2M solution of this acid using a 250cm^3 volumetric flask. (2½ marks)

iii) Write equation to show how sulphuric acid is used to prepare superphosphate fertilizer. (01 mark)

(c) Describe the reaction of sulphuric acid with;

i) Copper (1½ marks)

ii) Iron (04 marks)

END.