

P525/2

CHEMISTRY

Paper 2

August 2023

2½ hours.



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS AUGUST, 2023

CHEMISTRY

(Principal Subject)

Paper 2

2 hours 30 minutes.

INSTRUCTION TO CANDIDATES:

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

Write answers in the answer booklet provided

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers

Where necessary use (Cu = 64, S = 32, O = 16, Br = 79.9, H = 1)

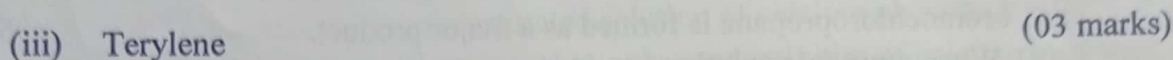
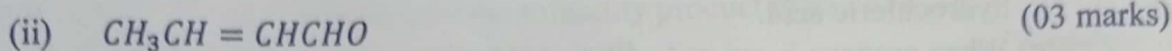
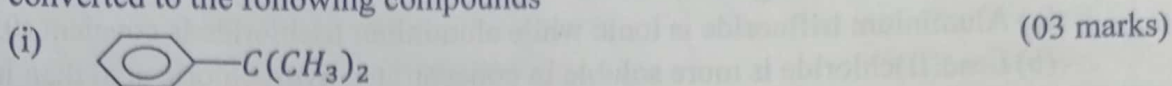
Faraday's constant is 96500c

SECTION A

(Answer three questions from this section)

- 1(a) A dark purple crystalline solid Z dissolves in water to give a violet solution. When aqueous sodium hydroxide solution was added to the solution of Z drop wise until in excess, a green solution was formed (01 mark)
- Name the cation in Z
 - Write the formulae of the species responsible for the formation of the; violet solution and the green solution (02 marks)
- (b) When hydrogen peroxide was added to the green solution in (a) above, a yellow solution was formed which on treatment with lead (II) ethanoate solution forms a yellow precipitate. Write the equation(s) for the formation of;
- Green solution ($1\frac{1}{2}$ marks)
 - Yellow solution ($1\frac{1}{2}$ marks)
 - Yellow precipitate ($1\frac{1}{2}$ marks)
- (c) When ammonium dichromate was heated, a green solid R was formed which when heated with sodium hydroxide in presence of air forms a solid S that dissolves in water and forms a yellow solution.
- Write the equation for the formation of solid R ($1\frac{1}{2}$ marks)
 - State what is observed and write equation for the reaction leading to formation of solid S ($2\frac{1}{2}$ marks)
- (d) State what is observed and write the ionic equation between;
- Solution of S and dilute sulphuric acid ($2\frac{1}{2}$ marks)
 - Resultant solution in d(i) and sodium hydroxide ($2\frac{1}{2}$ marks)
- (e) 3.8g of solder containing tin was dissolved in excess hydrochloric acid. The solution made up to the 250cm^3 . 25cm^3 of the solution required 23.5cm^3 of a 0.01M potassium dichromate solution for complete reaction.
- Write the equation for the reaction between tin and acidified potassium dichromate solution. ($1\frac{1}{2}$ marks)
 - Determine the percentage of tin in solder (05 marks)
- 2(a) When an organic compound Y was completely burnt in air, 4.41g of water were formed and the residual gas occupied 16.76dm^3 at room temperature. When the residual gas was passed through concentrated sodium hydroxide solution, the volume decreased to 5dm^3 . All volumes being measured at room temperature and pressure. Determine
- the empirical formula of Y ($3\frac{1}{2}$ marks)
 - the molecular formula of Y if it has a vapour density of $1.161 \times 10^{-3} \text{g cm}^{-3} \text{ s.t.p}$ ($2\frac{1}{2}$ marks)

- (b) Using equations while indicating reagents and conditions show how Y can be converted to the following compounds



- (c) When 400cm^3 of a mixture Y and ethene measured at room temperature was bubbled in excess ammoniacal silver nitrate solution, a white precipitate was formed.

- (i) Write the equation for the reaction which took place and name the white precipitate. (02 marks)
- (ii) Calculate the percentage by volume of ethene in the mixture if 2.4g of the precipitate was formed. (03 marks)

- 3(a) When 1.8g of Naphthalene was dissolved in 3.0g of camphor, the vapour pressure of camphor decreased by 5.0pa and the melting point by 18.75°C . The freezing point constant of camphor is 40°C per mol per 100g.

Explain;

- (i) The meaning of freezing point constant. (01 marks)
- (ii) Why vapour pressure of camphor decreased. (03 marks)
- (b) (i) Calculate the relative molecular mass of Naphthalene. (03 marks)
- (ii) State any assumptions made in your calculation. (02 marks)
- (c) When Naphthalene is dissolved in biphenyl, they form a eutectic mixture at 41°C containing 47% naphthalene. The melting point of various compositions of naphthalene -biphenyl mixture system is shown in the table below;

%composition of Naphthalene	12.5	27.5	70	80.0
Freezing point ($^\circ\text{C}$)	63.0	53.0	54.0	69.0

- (i) Explain the term eutectic mixture. (01 mark)
- (ii) Draw an accurate diagram for the naphthalene- biphenyl system and label all the regions of the diagram (the melting point of naphthalene and biphenyl are 86°C and 71°C respectively). (03 marks)
- (iii) Explain the phase changes that would take place if the liquid mixture containing 80% naphthalene at 60°C was gradually cooled. (02 marks)
- (iv) 100g of a liquid mixture of composition 5% naphthalene was cooled from 80°C to 40°C . Calculate the composition of the remaining liquid mixture. (03 marks)
- (v) State any three tests carried out to show that a eutectic mixture is not a pure

compound.

(02 marks)

- 4 Explain the following observations
- (a) Aluminium trifluoride is ionic while aluminium trichloride is covalent (05 marks)
 - (b) Lead(II)chloride is more soluble in concentrated hydrochloric acid than in dilute hydrochloric acid. (05 marks)
 - (c) When propene is reacted with bromine in presence of sodium chloride solution, bromochloropropane is formed as a major product. (05 marks)
 - (d) When ammonia solution is added to a solution of magnesium sulphate a white precipitate is formed, however no precipitate is formed when ammonia solution is added to same solution in presence of ammonium chloride solution. (05 marks)

SECTION B. (40 marks)

Attempt two (2) questions from this section

- 5 Using relevant examples and mechanisms where possible, explain each of the following reactions

- (a) Free radical substitution reaction. (04 marks)
- (b) Nucleophilic addition reaction. (04 marks)
- (c) Coupling reactions. (03 marks)
- (d) Cumene process. (05 marks)
- (e) Vulcanization of natural rubber. (04 marks)

- 6 (a) The boiling points of hydrides of group(vii) are given in the table below;

Hydride	H - F	H - Cl	H - Br	H - I
Boiling point (°C)	+19	-85.0	66.7	-35.4

- (i) State and explain the trend in boiling points. (04 marks)
- (ii) suggest and explain the trend in acidic strength. (04 marks)
- (b) With the aid of equations describe how the hydrides of fluorine and bromine can be prepared. (05 marks)
- (c) Hydrogen bromide fumes were bubbled through a mixture of nitric acid and silver nitrate solution.
 - (i) State what was observed. (0½ marks)
 - (ii) Write the equation for the reaction that took place. (1½ marks)
- (d) Concentrated hydrochloric acid was added to the following solutions dropwise until in excess. State what was observed and write the equation for the reaction in each case
 - (i) Lead (II) nitrate solution. (2½ marks)
 - (ii) Copper (II) sulphate solution. (2½ marks)

- 7(a) Explains the following terms;
- molar conductivity. (02 marks)
 - solubility product constant. (02 marks)
- (b) (i) Briefly describe how the solubility product of calcium phosphate can be determined (diagram not required). (06 marks)
- (ii) The conductivity of a saturated solution of calcium phosphate at 25°C is $3.12 \times 10^{-4} \Omega^{-1} \text{cm}^{-1}$. The molar ionic conductivities of calcium ions and phosphate ions in an infinite dilute solution at 25°C are 119.0 $\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ and 24.0 $\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$. Calculate the solubility product of calcium phosphate at 25°C and state its units given that the conductivity of water at 25°C is $1.16 \times 10^{-4} \Omega^{-1} \text{cm}^{-1}$. (04 marks)
- (c) On the same axes, draw sketch graphs to show how the molar conductivity of hydrofluoric acid and hydrochloric acid vary with concentration. (02 marks)
- (d) Explain the shape of the graphs drawn in (c) above. (04 marks)
- 8(a) Explains what is meant by the terms;
- Thermosets
 - Addition polymers
- (b) Polyacrylonitrile (PAN) $\text{---} \left[\text{CH}_2 - \underset{\text{C} \equiv \text{N}}{\text{CH}} \right]_n \text{---}$ is an addition polymer.
- State one structure requirement for addition polymerization in monomers. (01 mark)
 - Write the structure and IUPAC name of the monomer of PAN. (02 marks)
 - Write equations while stating reagents clearly in each step to show how PAN can be obtained from 1,2-dibromoethane. (03 marks)
 - State two applications of PAN. (02 marks)
- (c) A solution containing 20g l⁻¹ of PAN exerts an osmotic pressure of 740mmHg at 25°C
- Explain what is meant by the term osmotic pressure. (01 marks)
 - Calculate the molecular mass of PAN. (03 marks)
 - Determine the number of monomers in PAN. (02 marks)
 - Explain why the osmotic pressure of PAN cannot be effectively determined by cryoscopy. (03 marks)