



ACEITEKA JOINT MOCK EXAMINATIONS 2023  
UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

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

Answers to the question must on the answer sheets provided

Begin each question on a fresh page.

Extra questions attempt will not be marked.

Mathematical tables and graph papers are provided.

Non- programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers.

[H = 1, C = 12, O = 16, Al = 27, Cl = 35.5, I = 127, 1 mole of a gas occupies  $22.4 \text{ dm}^3$  at s.t.p.]

## SECTION A

Answer **three** questions from this section.

1. (a) State Le chatelier's principle (01mark)  
(b) Describe an experiment that can be used to determine the equilibrium constant,  $K_c$  for decomposition of hydrogen iodide. (8½marks)  
(c) Explain what would happen to the position of equilibrium reaction in (b) if  
(i) a catalyst is added. (02marks)  
(ii) a little potassium iodide solution is added. (2½marks)  
(iii) some hydrogen iodide is withdrawn from the reaction mixture. (02marks)  
(d) 1 mole of hydrogen and  $\frac{1}{3}$  mole of iodine were heated together at 450°C until equilibrium is attained. Calculate the number of moles of hydrogen iodide present in the equilibrium mixture at 450°C. ( $K_c$  for the reaction between hydrogen and iodine is 50) (04marks)
2. (a) What is meant by the term ore? (01mark)  
(b) Write the name and formula of the main ore from which aluminium is extracted. (02marks)  
(b) Describe how  
(i) the ore in (b) above can be concentrated. (06marks)  
(ii) pure aluminium can be extracted from the concentrated ore. (03marks)  
(c) Describe the reactions of aluminium with  
(i) sodium hydroxide (02marks)  
(ii) hydrochloric acid (02marks)  
(d) A chloride **R** of aluminium contains 20% by mass of aluminium and 80% by mass of chlorine. Determine the molecular formula and hence the structural formula of **R**. (04marks)  
(Vapour density of **R** is 0.01192gcm<sup>-3</sup> at s.t.p)  
(e) Sodium carbonate solution was added to an aqueous solution of aluminium chloride .  
(i) State what would be observed. (01mark)  
(ii) Write equation for the reaction. (1½marks)
3. When 0.0175g an organic compound **Q** was burnt in excess oxygen, 22.4cm<sup>3</sup> of carbon dioxide and 0.0135g of water were formed at s.t.p. 0.105g of **Q** when vaporized at 298°C and 725mmHg occupied a volume 73.67cm<sup>3</sup>  
(a) (i) Calculate the empirical formula of **Q** (3½marks)  
(ii) Determine the molecular formula of **Q**. (03marks)

- (b) Q burns with a sooty flame and forms yellow precipitate with Brady's reagent. Write the structural formulae and names of the possible isomers of Q. (03marks)
- (c) Q forms a yellow precipitate with iodine solution in the presence of sodium hydroxide solution. Identify Q. (0½mark)
- (d) Write equation and suggest a mechanism for the reaction between Q and  
 (i) Brady's reagent. (4½marks)  
 (ii) acidified solution of sodium sulphite. (3½marks)
- (e) Q was treated with alkaline potassium manganate (VII)  
 (i) State what would be observed. (0½mark)  
 (ii) Write equation and name the main organic product. (1½marks)
4. (a) Draw separate diagrams to show the changes in pH when 0.1M sodium hydroxide is added in portions until in excess to  
 (i) 25cm<sup>3</sup> of 0.1M hydrochloric acid (02marks)  
 (ii) 25cm<sup>3</sup> of 0.1M ethanoic acid. (02marks)
- (b) Explain the shapes of the graphs in (a) above. (10marks)
- (c) (i) 55cm<sup>3</sup> of 0.2M ethanoic acid solution were mixed with 45cm<sup>3</sup> of 0.2M sodium ethanoate solution. Calculate the pH of the resultant solution. ( $K_a$  for ethanoic acid =  $1.75 \times 10^{-5} \text{ mol dm}^{-3}$ ) (3½marks)  
 (ii) 0.5cm<sup>3</sup> of 0.1M sodium hydroxide solution were added to the solution in c(i). Calculate the change in pH of the resultant mixture. (2½marks)

### SECTION B

*Attempt any two questions from this section.*

5. Using equations only show how the following conversions can be effected.  
 (a) Butane-1,4- dioic acid from ethyne (05marks)  
 (b) Methyl propanoate from propene (05marks)  
 (c) 1-methylcyclohex-1-ene from cyclohexanol (05marks)  
 (d) Iodobenzene from nitrobenzene (05marks)
6. (a) State  
 (i) Partition law (01mark)  
 (ii) the conditions under which the law is valid (02marks)
- (b) 50g of iodine was dissolved in water to make 1000cm<sup>3</sup> of the aqueous solution. Calculate the mass of iodine extracted by shaking the aqueous solution with  
 (i) 500cm<sup>3</sup> of carbon disulphide (02marks)  
 (ii) two successive 250cm<sup>3</sup> portions of carbon disulphide  
 ( $K_D$  of iodine between carbon disulphide and water = 84.0 at 25°C) (04marks)



- (c) The table below shows the results of partition of ammonia between 0.1M nickel(II) sulphate and trichloromethane. Excess ammonia reacts with nickel(II) sulphate to form a complex ion,  $[\text{Ni}(\text{NH}_3)_n]^{2+}$ .

$[\text{NH}_3](0.1\text{M NiSO}_4)$	0.72	0.94	1.19	1.43	1.70	1.92
$[\text{NH}_3]\text{CHCl}_3$	0.01	0.03	0.05	0.07	0.09	0.11

- (i) Plot a graph of  $[\text{NH}_3](0.1\text{M NiSO}_4)$  against  $[\text{NH}_3]\text{CHCl}_3$  (03marks)
  - (ii) Use the graph to determine the value of  $n$ . (01mark)
  - (iii) Excess ammonia was added to 0.1M nickel(II) sulphate and the resultant mixture shaken with trichloromethane and left to stand until equilibrium was established.  $25\text{cm}^3$  of the organic layer required  $20\text{cm}^3$  of 0.04M hydrochloric acid while  $25\text{cm}^3$  of the aqueous layer required  $35\text{cm}^3$  of 1.0M hydrochloric acid for complete neutralization. Calculate the partition coefficient,  $K_D$  of ammonia between water and trichloromethane. (06marks)
7. Explain the following observations. Illustrate your answer with equations where applicable.
- (a) A 0.2M aqueous solution of urea and 0.1M aqueous solution of potassium chloride have the same boiling point at 1 atmosphere (04marks)
  - (b) When few drops of concentrated sodium carbonate solution were added to an aqueous solution of iron (III) sulphate, there was effervescence of a colourless gas and brown precipitate formed. (04marks)
  - (c) When chlorine was passed through an aqueous solution of sodium thiosulphate, a yellow precipitate was formed which dissolved in excess chlorine to form a colourless solution. (04marks)
  - (e) Lithium has a negative electron affinity whereas beryllium has a positive electron affinity although both elements are in the same period of the Periodic Table. (04marks)
  - (f) Aluminium chloride forms dimers on heating while aluminium fluoride **does not**. (04marks)
8. (a) Write the outer most electronic configuration of group (II) elements. (01mark)
- (b) Describe the reaction of group (II) elements with
- (i) water (06marks)
  - (ii) dry air (3½marks)
  - (iii) concentrated sodium hydroxide solution. (3½marks)
- (c) Write equation for the reaction between
- (i) strontium hydride and water (1½marks)
  - (ii) barium peroxide and ice cold dilute sulphuric acid (1½marks)
  - (iii) beryllium carbide and warm water. (1½marks)
  - (iii) calcium carbide and warm dilute hydrochloric acid. (1½marks)

END