

P525/2
CHEMISTRY
Paper 2
July/August 2018
2¹/₂ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

(Principal Subject)

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES;

- Answer **five** questions including **three** questions from section **A** and any **two** questions from section **B**.
- Write the answers in the answer booklet/sheets provided.
- **Begin each question on a fresh page.**
- Mathematical tables and graph papers are provided.
- Non programmable, silent scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.
- Where necessary use (C = 12, O = 16, H = 1, N = 14, IF = 96500C)

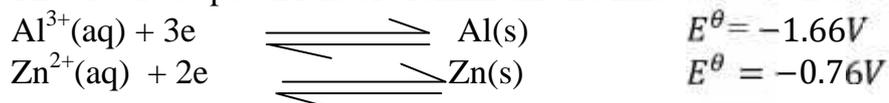
SECTION A

Answer **three** questions from this section.

1. (a) Phenolphthalein can be used as an acid- base indicator.
- (i) What is meant by the term **acid- base indicator**? (01mark)
 - (ii) Describe briefly how phenolphthalein works as an acid- base indicator. (06marks)
 - (iii) The indicator constant, K_i for phenolphthalein is $5.012 \times 10^{-10} \text{ mol dm}^{-3}$. Determine the approximate pH working range for phenolphthalein. (02marks)
- (b) 25 cm^3 of 0.12M ethanoic acid was pipetted into a clean conical flask and 2-3 drops of phenolphthalein indicator added and the mixture titrated with 0.2M sodium hydroxide solution until the equivalence point had reached, when 15 cm^3 of sodium hydroxide had been used.
- (i) What is meant by the term equivalence point? (01mark)
 - (ii) State the colour change at equivalence point. (01mark)
 - (iii) Calculate the pH of the mixture at equivalence point. (05marks)
(K_a for ethanoic acid = $1.75 \times 10^{-5} \text{ mol dm}^{-3}$ and K_w for water = $1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$)
- (c) Sketch a graph of pH against volume of sodium hydroxide for the titration in (b) and explain the shape of the graph. (04marks)
2. Carbon, silicon, germanium, tin and lead are elements of Group(IV) of the Periodic Table.
- (a) (i) Write the outer most electronic configuration of Group(IV) elements. (01mark)
- (ii) State the oxidation states of Group(IV) elements. (01mark)
 - (iii) State how the stability of the oxidation states vary down the group. (02marks)
- (b) Describe the reactions of the elements with
- (i) water (06marks)
 - (ii) concentrated sulphuric acid. (06marks)
- (c) Write equations for the reactions between
- (i) silicon (IV)oxide and hot concentrated hydrofluoric acid. (1½marks)
 - (ii) trileadtetraoxide and warm dilute nitric acid. (1½marks)
 - (iii) tin(II) chloride solution and iron(III) sulphate solution. (1½marks)
3. (a) A gaseous alkene **Y** diffuses 0.57735 times faster than nitrogen gas. Determine the molecular formula of **Y**. (03marks)
- (b) On ozonolysis followed by hydrolysis, **Y** produced propanal and propanone as the major organic products. Identify **Y**. (01mark)
- (c) Write the equation and suggest a mechanism for the reaction between
- (i) **Y** and benzene in the presence of an acid. (04marks)
 - (ii) **Y** and bromine water. (04marks)
 - (iii) propanal and phenyl hydrazine in acidic medium. (04marks)
- (d) Using equations only show how **Y** can be synthesized from propyne. (04marks)

4. (a) (i) Define the term lattice energy. (01mark)
- (ii) State two factors that affect lattice energy. (01mark)
- (b) Thermo dynamic data for aluminium, fluorine and aluminium fluoride are given below.
- | | |
|--|----------------------------|
| The standard enthalpy of formation of aluminium fluoride | = -1301kJmol ⁻¹ |
| The standard enthalpy atomization of aluminium | = + 314kJmol ⁻¹ |
| The standard enthalpy bond dissociation of fluorine | = +158kJmol ⁻¹ |
| First ionization energy of aluminium | = +577kJmol ⁻¹ |
| Second ionization energy of aluminium | = +1820kJmol ⁻¹ |
| Third ionization energy of aluminium | = +2740kJmol ⁻¹ |
| First electron affinity of fluorine | = - 348kJmol ⁻¹ |
- (i) Draw an energy level diagram for formation of aluminium fluoride. (4½marks)
- (ii) Use the diagram you have drawn to determine the lattice energy of aluminium fluoride. (03marks)
- (iii) Given that the hydration energies of aluminium ions and fluoride ions are -4690 and -364kJmol⁻¹ respectively. Calculate the enthalpy of solution of aluminium fluoride and comment on the solubility of aluminium fluoride in water. (4½marks)

- (c) The electrode potentials of aluminium and zinc are shown below.

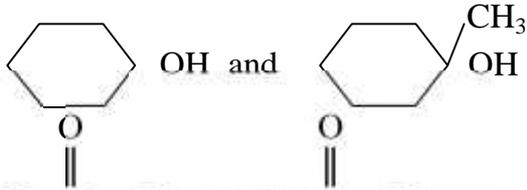
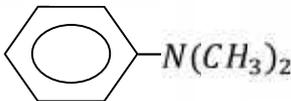


The two half cells are combined to form a cell

- (i) Write the overall cell reaction (1½marks)
- (ii) Calculate the emf of the cell (1½marks)
- (iii) Calculate the standard free energy for the cell. (02marks)
- (iv) State whether the cell is feasible or not. Give a reason for your answer. (01marks)

SECTION B

Answer two questions from this section.

5. (a) Name a reagent that can be used to distinguish between the following pairs of organic compounds and in each case state what would be observed and write equation for the reaction if any when the reagent is treated with each compound in the pair.
- (i) CH₃CHO and CH₃CH₂CHO (04marks)
- (ii)  (04marks)
- (iii) $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ and $\text{CH}_3\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ (04marks)
- (iv)  and  (04marks)
- (b) Using equations only show how phenylethanoate can be synthesized from benzene. (04marks)

Turn Over

6. (a) 2-nitrophenol and 4-nitrophenol can be prepared by reacting phenol with dilute nitric acid.
- (i) write equation for the reaction. (01mark)
- (ii) Which of the two products has a higher melting point. Explain your answer. (06marks)
- (b) 2-nitrophenol and 4-nitrophenol can be separated by steam distillation.
- (i) What is meant by steam distillation? (01marks)
- (ii) With aid of a labeled diagram, describe how a mixture of 2-nitrophenol and 4-nitrophenol can be separated by steam distillation. (06marks)
- (c) When 50g of a mixture of 2-nitrophenol and 4-nitrophenol was steam distilled at 97°C and 750mmHg, a distillate was found to have a mass of 35g. The vapour pressure of water at 97°C is 654mmHg. Determine the percentage by mass of 4-nitrophenol in the mixture. (04marks)
- (d) State two advantages of steam distillation over fractional distillation. (02mark)
7. Explain each of the following observations
- (a) Ethene reacts with bromine to form 1,2-dibromoethane. But when the reaction is carried out in the presence of sodium chloride solution, 1-bromo-2-chloroethane is formed. (05marks)
- (b) The solution of 0.1M hydrochloric acid has a pH of 1 whereas that of 0.1M hydrofluoric acid is 3.8. (04marks)
- (c) When cold concentrated hydrochloric acid was added to lead (IV) oxide, brown solid dissolves to form a pale yellow liquid. However on slight warming, there was effervescence of a gas. (04marks)
- (d) Hydrogen fluoride can be prepared by reacting calcium fluoride with concentrated sulphuric acid. However hydrogen bromide cannot be prepared from calcium bromide and concentrated sulphuric acid. (04marks)
- (e) When ammonium thiocyanate solution was added to iron (III) chloride solution, a red blood solution was formed. (03marks)
8. (a) What is meant by the term **ore**? (01mark)
- (b) Briefly describe how the following ores can be purified.
- (i) zinc blende (04marks)
- (ii) bauxite (06marks)
- (c) Write equation(s) to show how aluminium metal can be extracted from the purified ore in (b) (ii) above. (1½marks)
- (d) Describe how
- (i) aluminium reacts with sulphuric acid (05marks)
- (ii) zinc reacts with sodium hydroxide. (2½marks)

END