

P525/2

CHEMISTRY

(Theory)

Paper 2

AUGUST-SEPT. 2023

$2\frac{1}{2}$ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

(THEORY)

Paper 2

SENIOR FIVE

END OF TERM 2

2hours:30minutes

INSTRUCTION TO CANDIDATES

*Attempt **five** questions including **three** questions in section A and **two** questions in section B.*

Answers must be written on the answer sheets (booklets) provided.

Begin each question on a fresh page.

Mathematical tables and squared paper are provided.

Silent non-programmable scientific electronic calculators may be used.

Write equations where necessary to illustrate your answers

Where necessary, use the following

*1 mole of gas occupies 22.4dm^3 at STP; molar gas constant (**R**) is $0.0821\text{ atm dm}^3\text{K}^{-1}$.*

C=12, O=16, H=1,

SECTION A (60MARKS)

Answer **three** questions from this section.

1. (a) Explain what is meant by the following terms:

(i) *Molar conductivity* (02marks)

(ii) *Electrolytic conductivity* (02marks)

(b) State the relationship between the two conductivities in (a) (01mark)

(c) Draw sketch graphs to show how molar conductivities of the following vary with concentration:

(i) A weak electrolyte (01½marks)

(ii) A strong electrolyte (01½marks)

(d) Explain the shapes of the graphs in (c). (04marks)

(e) The table below shows the variations of conductivity with volume of ammonia when two inert electrodes connected to a conductivity metre were immersed in 50cm³ of 0.025M zinc nitrate solution and 2cm³ portions of 0.5M ammonia, added at intervals.

Volume of ammonia solution (cm ³)	0	2	4	6	8	10	12	14
Conductivity of resultant solution ($\Omega^{-1}\text{cm}^{-1}$)	1.2	1.16	1.12	1.08	1.05	1.045	1.06	1.10

(i) Plot a graph of conductivity of solution against volume of ammonia. (03marks)

(ii) Determine the volume of ammonia solution that gave the lowest conductivity. (01mark)

(iii) Determine the formula of the species present in the solution in (e) (i). (04marks)

2. (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 drop wise until in excess. **(02 marks)**
3. On complete combustion of 7.5g of an organic compound W, it gave 17.8g of carbon dioxide and 9.27g of water.
- (a) Calculate the empirical formula of W. **(03marks).**
- (b) (i) Deduce the molecular formula of W if its vapour density is 37. **(02marks)**
- (ii) Write all the possible isomers of compound W and give their IUPAC names. **(1.5marks)**
- (b) Compound W when heated with concentrated phosphoric acid and compound M was formed, which when treated with hydrogen chloride forms a tertiary alkyl chloride, which was treated with metallic sodium in dry ether forming compound O.
- (i) Identify compound W, M, and O. **(1.5marks)**

(ii) Giving a reason, state the homologous series to which compound W, M, and O belong. **(02marks)**

(c) Write an equation and mechanism for the reaction that led to formation of the following compounds.

(i) Compound W from any compound. **(03marks)**

(ii) Tertiary alkyl chloride. **(02marks)**

(iii) Compound M. **(03marks)**

(d) Write equations for the reaction by which W can be converted to compound O. **(02marks)**

4. (a) (i) Explain what is meant by the term steam distillation?. **(02marks)**

(ii) Draw a diagram of set-up of the apparatus that can be used to purify a substance by steam distillation. **(03marks)**

(b) (i) State three properties of a substance that enable it to be purified by steam distillation. **(03marks)**

(ii) Explain how the properties you have stated in (b) (i) above enable the substance to be purified by steam distillation. **(04marks)**

(iii) State the advantage of isolating substances by steam distillation. **(02marks)**

(c) Compound **Q** contains 62.1% carbon, 10.3% hydrogen, the rest being oxygen.

(a) Calculate the empirical formula of **Q**. **(02marks)**

(b) **Q** distills in steam at 98°C and $1.1 \times 10^5 \text{ Nm}^{-2}$. If the vapour pressure of water at 98°C is $9.5 \times 10^4 \text{ Nm}^{-2}$.

(i) Calculate the molecular mass of **Q** if the distillate contained 16.67% by mass of **Q**. **(03marks)**

(ii) Write the structural formulae of any two isomers of **Q**. **(01mark)**

SECTION B. (40 MARKS)

Attempt any two questions from this section.

5. The elements; carbon, silicon, tin and lead belong to group IV of the Periodic Table.

(a) State the oxidation states of the elements. (01 mark)

(b) Explain the trend in stability of the oxidation states. (03 marks)

(c) (i) State the type of bonding that is in the chlorides of lead. (01 mark)

(ii) State two physical properties of each chloride that show the type of bonding you have mentioned above. (04 marks)

(d) Describe the reactions of the chlorides of these elements with water. Write equations for the reactions that take place. (04 marks)

(e) Describe the reactions of the oxides of the elements with sodium hydroxide. Write equations for the reactions that take place. (07 marks)

6. (a) Distinguish between **nuclear fission** and **nuclear fusion**. (02marks)

(ii) Name three types of radiations emitted during radioactivity and state how they affect the nucleus of a radioisotope. (04marks)

(b) The table below shows how the mass of radioactive protactinium, $^{234}_{91}\text{Pa}$ varies with time.

Mass of protactinium (g)	60.0	38.5	26.0	17.2	11.1
Time (s)	0	40	80	120	160

(i) Plot a graph of mass of protactinium against time. (03marks)

(ii) Use your graph to determine the half-life of protactinium. (01mark)

(iii) Determine the time taken for 8g of protactinium to decay to 1g. (02marks)

(c) (i) Briefly describe how carbon-14 can be used to determine the age of archeological objects. (03marks)

(ii) State and describe two factors that affect stability of nucleus. (03marks)

7. (a) Write equations to show how the following compounds can be synthesized

(i) Phenyl ethene from Benzene. (03marks)

(ii) Propanoic acid to 1-bromopropan-2-ol. (03marks)

(ii) But-1-yne to 3, 4-Di methyl hexane. (04marks)

(ii) 2-Chloro-3-methylbutane from 2-methylbutan-2-ol. (03marks)

(b) Write an equation and a mechanism for the reaction that leads to formation of the following compounds.

(i) 2-Methylbut-1-ene. (03marks)

(ii) Nitrobenzene. (04marks)

8. (a) State what is meant by the term **boiling point constant** of a liquid. (02marks)

(b) (i) Describe an experiment that can be used to determine the relative molecular mass of compound using the method of ebullioscopy. Diagram required and treatment of results. (07marks)

(ii) Explain why the method you have described above in (b) (i) is **not** suitable for determination of relative molecular mass of ethanoic acid in aqueous solution. . (03marks)

(c) The boiling point of pure water is 100°C but when 1.97g of potassium chloride is dissolved in 125g of water, the solution boiled at 100.11°C at a pressure of 760mmHg.

(i) Explain this observation. (04marks)

(ii) Calculate the boiling point constant of water. (**K=39.1, Cl=35.4**) (04marks)

END

WISH YOU NICE HOLIDAYS