

545/2
CHEMISTRY
Paper 2
April./May.2022
2 hours.

S.4

CHEMISTRY

Paper 2

2 hours 30 minutes

Section A consists of 10 structured questions. Answer all questions in this section.

Answers to these questions **must** be written in the spaces provided.

*Section B consists of 4 semi-structured questions. Answer any **two** questions from this section. Answers to these questions **must** be written in the answer booklet(s) provided.*

In both sections all working must be clearly shown.

Where necessary use;

[H=1; C=12; N=14; O=16; Na=23; S=32; Cl=35.5]

1 mole of gas occupies 24l at room temperature

1 mole of gas occupies 22.4 l at s.t.p.

[illegible]

SECTION A (50 MARKS)

Answer all questions in this section.

1. A sample of water obtained from Lake Katwe contains a high concentration of dissolved sodium chloride and less potassium chloride.

(a) State a practical method how,

- (i) pure water can be obtained from the sample of water obtained from the lake. ($\frac{1}{2}$ mark)

.....
.....

- (ii) sodium chloride can be obtained from it's mixture with potassium chloride in water obtained from lake. ($\frac{1}{2}$ mark)

.....
.....

- (iii) a sample of chlorine gas can be obtained from the sample of water from the lake. ($\frac{1}{2}$ mark)

.....
.....

- (b) Give a reason for the method used in (a)(ii) above. ($\frac{1}{2}$ mark)

.....
.....

- (c) (i) State what would be observed if a small sample of the water obtained from the lake is mixed with aqueous silver nitrate solution. ($\frac{1}{2}$ mark)

.....
.....
(ii) Write the ionic equation of reaction that took place in (c)(i).
(1 $\frac{1}{2}$ marks)

.....
2. Element **X** belongs to Period 3 of the periodic table. The ion formed by element **X** is X^{3+} .

(a) State the:

(i) atomic number of element **X** (01 mark)

.....
(ii) electronic configuration of element **X**. (01 mark)

.....
(iii) group of the period table to which **X** belongs. ($\frac{1}{2}$ mark)

.....
(b) Element **X** was strongly heated in excess air.

(i) Write the formula of the resultant product formed. (01 mark)

.....
(ii) State the type of the bond that exists in the compound formed in b(i)
($\frac{1}{2}$ mark)

.....
3. During commercial separation of oxygen and nitrogen from air, atmospheric air is first passed through sodium hydroxide solution, and then through silicon(IV) oxide. The resultant air is subjected to repeated compression at pressures of about 200 atmospheres, and cooling until air liquefies to a liquid mixture of oxygen and nitrogen.

(a) State why air is passed through:

(i) sodium hydroxide solution. ($\frac{1}{2}$ mark)

.....

.....

(ii) silicon(IV) oxide. ($\frac{1}{2}$ mark)

.....

.....

(b) Write equation of reaction to show the role of sodium hydroxide solution. (1 $\frac{1}{2}$ marks)

.....

.....

(c) (i) Name the method used to obtain oxygen from it's liquid mixture with nitrogen. ($\frac{1}{2}$ mark)

.....

(ii) Give a reason for method used named in (c)(i). ($\frac{1}{2}$ mark)

.....

.....

(d) (i) State which of oxygen and nitrogen is collected off first from the liquid method, using the method named in (c)(i). ($\frac{1}{2}$ mark)

.....

(ii) Give **one** industrial use of the gaseous component stated in (d)(i) ($\frac{1}{2}$ mark)

.....

4. (a) Carbon dioxide gas can be prepared in the laboratory from calcium carbonate and hydrochloric acid.

(i) State the conditions of reaction. (01 mark)

.....
.....
(ii) Write the ionic equation of the reaction that takes place leading to the formation of carbon dioxide gas. (1 $\frac{1}{2}$ marks)
.....
.....

(b) (i) Name the reagent used to dry carbon dioxide gas in the laboratory. ($\frac{1}{2}$ mark)
.....
.....

(i) Give a reason why the reagent named in (b)(i) is suitable for drying carbon dioxide gas. (01 mark)
.....
.....

(c) Write equation of reaction between carbon dioxide and hot coke. (1 $\frac{1}{2}$ mark)
.....
.....

5. A gaseous organic compound **W** consists of 85.7% carbon, and the rest being hydrogen. 50 g of organic compound **W** occupies 40dm³ at s.t.p

(a) Name the group of organic compound to which **W** belongs. ($\frac{1}{2}$ mark)
.....
.....

(b) Calculate the simplest formula of compound **W**. (02 marks)
.....
.....

.....

.....

.....

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.....

(b) Determine the molecular formula of **W**. (1 $\frac{1}{2}$ marks)

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.....

.....

.....

6. Water gas is a mixture of two gases, carbon monoxide gas and hydrogen gas in the ratio of 1:1

(a) State how water gas is produced? (01 mark)

.....

.....

(b) Write equation of reaction leading to the formation of water gas. (1 $\frac{1}{2}$ marks)

.....

.....

(c) State **one** industrial use of water gas. ($\frac{1}{2}$ mark)

.....
(d) Excess carbon monoxide gas obtained from water gas was dried, then passed over strongly heated lead(II) oxide.

(i) State what was observed? (01 mark)

.....

.....

(ii) Write equation for the reaction that took place. (1 $\frac{1}{2}$ marks)

.....

.....

7. (a) State the conducting particles of current in:

(i) lead(II) bromide. ($\frac{1}{2}$ mark)

.....

(ii) graphite rod. ($\frac{1}{2}$ mark)

.....

(b) Solid lead(II) bromide was electrolyzed between graphite electrodes.

(i) State what was observed at both electrodes? ($\frac{1}{2}$ mark)

.....

.....

(ii) Give a reason for your observation above. (01 mark)

.....

.....

(c) The experiment in (b) was repeated using molten lead(II) bromide.

(i) State what was observed at the cathode. ($\frac{1}{2}$ mark)

.....

.....

(ii) Write the equation of reaction that took place at the anode.

(01 mark)

.....

.....

8. Name the reagent that can be suitably used to distinguish between the following given pairs of ions in solution and state the observation made in each case.

(a) sulphate ion and chloride ion.

(i) Reagent

(01 mark)

.....

.....

(ii) Observations

(01 mark)

.....

.....

(b) Magnesium ion and Calcium ion.

(i) Reagent

(01 mark)

.....

.....

(ii) Observations

(01 mark)

.....

.....

9. During the laboratory preparation of hydrogen chloride gas, sulphuric acid is reacted with potassium chloride , then gas passed through a wash bottle containing liquid **X**, and finally collected in the gas jar by upward displacement of air.

(a)(i) State the conditions of reaction leading to the formation of hydrogen chloride gas. (01 mark)

.....
.....

(ii) Write the equation of the reaction that took place. (1 $\frac{1}{2}$ marks)

.....
.....

(b) (i) Name liquid **X**. ($\frac{1}{2}$ mark)

.....

(ii) State purpose served by liquid **X** named in b(i) in the preparation of hydrogen chloride. (01 mark)

.....
.....

(iii) Give a reason for the method used in the preparation of hydrogen chloride gas. ($\frac{1}{2}$ mark)

.....
.....

(c) Name the reagent that is used to identify hydrogen chloride gas , and state what would be observed when the named reagent is treated with the gas.

(i) Reagent (01 mark)

.....
(ii) Observation

($\frac{1}{2}$ mark)

.....
(d) Write the ionic equation of reaction between aqueous hydrogen chloride and silver nitrate solution. (1 $\frac{1}{2}$ marks)

.....
10. Sodium is extracted from sodium chloride in a diaphragm cell by electrolysis.

(a) (i) Name the substance used as the:

(01 mark)

•Anode.....

•Cathode.....,

(ii) Write equation of reaction that took place at the cathode.

(01 mark)

.....
(b) State:

(i) why calcium chloride is added to molten sodium chloride during extraction of sodium? (01 mark)

.....
(ii) purpose served by iron gauze diagram in the cell above.

($\frac{1}{2}$ mark)

.....

.....

(iii) sodium is collected under dry nitrogen gas. ($\frac{1}{2}$ mark)

.....

.....

(c) (i) Write the equation of reaction leading to formation of substance **R**, which is let out of the cell. (01 mark)

.....

.....

(ii) State **one** use of substance **R** on an industrial scale. ($\frac{1}{2}$ mark)

.....

.....

(d) Give a reason why sodium is extensively used to cool the fuel in nuclear energy reactors. ($\frac{1}{2}$ mark)

.....

.....

SECTION B

Answer two questions from this Section.

11.(a) (i) Draw a well labelled diagram of the set-up of apparatus that can be used to prepare a dry sample of hydrogen gas from zinc granules. (3 $\frac{1}{2}$ marks)

(ii) Write equation for the reaction leading to the formation of hydrogen gas. (1 $\frac{1}{2}$ marks)

(iii) Name the substance that can be used to speed up the rate of formation hydrogen gas in the reaction above. ($\frac{1}{2}$ mark)

(iv) State how hydrogen gas can be identified in the laboratory. (01 mark)

(b) (i) State the conditions of the reaction between hydrogen gas and lead(II) oxide. (01 mark)

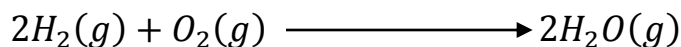
(ii) State what would be observed when hydrogen gas is reacted with lead(II) oxide. (1 $\frac{1}{2}$ marks)

(iii) Write equation for the reaction that would take place. (1 $\frac{1}{2}$ marks)

(iv) Explain your observation in (ii) above. (1 $\frac{1}{2}$ marks)

(v) Name any other metal whose oxide can react with hydrogen gas in a similar way like lead(II) oxide. ($\frac{1}{2}$ mark)

(c) Hydrogen gas burns in excess air producing water vapour as equation below.



Calculate the volume of hydrogen gas that must completely burn in 0.68dm³ of oxygen gas at s.t.p. (02 marks)

(d) State **one** large scale use of hydrogen gas. ($\frac{1}{2}$ mark)

12. During electrolysis, electrons are known to flow into and out of electrolytes through electrodes.

(a) Define the terms **electrolyte** and **electrolysis**. (02 marks)

(b) Name the electrode through which;

(i) electrons enter the electrolyte ($\frac{1}{2}$ mark)

(ii) leave the electrolyte ($\frac{1}{2}$ mark)

(c)(i) Outline the reactions that occur during electrolysis of dilute sulphuric acid. (**Your outline should include equations**) (7 $\frac{1}{2}$ marks)

(ii) Justify the formation of products at the anode. (02 marks)

(iii) Explain why the electrolysis of dilute sulphuric acid is regarded as electrolysis of water. (2 $\frac{1}{2}$ marks)

13 (a) Copper (II) carbonate was heated strongly. State what was observed and write the equation for the reaction that took place. (02 marks)

(b) Describe how a pure dry sample of copper (II) sulphate - 5 - water can be prepared in the laboratory, starting from copper (II) oxide. (8 $\frac{1}{2}$ marks)

(c) Some copper (II) sulphate - 5 - water was dropped into concentrated sulphuric acid. State what was observed and give a reason for your observation. (02 marks)

(d) Write ionic equation to show the reaction that would take place if, to a solution containing copper (II) ions was added:

(i) a few drops of ammonia solution. (1 $\frac{1}{2}$ marks)

(ii) a clean piece of magnesium ribbon. (01 mark)

14. (a) A crystalline carbonate of sodium of formula $Na_2CO_3 \cdot xH_2O$ decomposed into a white powdery residue **W**, when it was heated at constant mass. Write the name and formula of **W**. (01 mark)

(b) When 7.29g of a sample of the crystalline sodium carbonate in (a) was heated to constant mass 2.7g of **W** was collected.

(i) Calculate the value of X in the formula $Na_2CO_3 \cdot xH_2O$.

(03 marks)

(ii) Write the correct name of the crystalline sodium carbonate.

(01 mark)

(c) (i) Name **two** substances which when reacted together would be most suitable for preparing zinc carbonate. (01 mark)

(ii) Write the equation for the reaction that would lead to formation of zinc carbonate in (c)(i). (1½ marks)

(d) State what would be observed and write the equation for the reaction that would take place, if zinc carbonate was heated strongly and then allowed to cool. (03 marks)

(e) (i) Name one reagent that can be used to differentiate between zinc ions and lead (II) ions in solution. (½ mark)

(ii) State what would be observed in each case if zinc ions and lead(II) ions were treated separately with the reagent you have named in e) (i). (02 marks)

END.