Kits

28th-07-2022

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545/2
CHEMISTRY
Paper 2
Jul / Aug. 2022
2 hours

UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Certificate of Education

CHEMISTRY

Paper 2

2 hours

INSTRUCTIONS TO CANDIDATES:

*Section A consists of **10** structured questions. Answer **ALL** questions in this section. Answers to the questions **must** be written in the spaces provided.*

*Section **B** consists of **4** semi – structured questions. Answer only **two** questions from this section. Answers to the questions **must** be written in the answer booklets provided.*

In both sections all working must be shown clearly.

Where necessary

[Zn = 65, O = 16, H = 1, Pb = 207]

1 mole of a gas occupies 22.4 dm^3 at s.t.p

1 mole of a gas occupies 24dm^3 at room temperature

For Examiner's use only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL

SECTION A: (50 MARKS)

Answer **ALL** *questions in this section*

1. In an experiment, cooking oil was added into a beaker containing a large volume of water and the mixture was shaken then allowed to stand.

(a) State what was observed. (½ mark)

Cooking oil floats on water ✓ 0½

(b) (i) Name the piece of apparatus that can be used to separate the mixture. (½ mark)

Separating funnel. ✓ 0½

(ii) Give a reason for your answer in (b) (i) above. (½ mark)

Cooking oil is less dense than water ✓ 0½

Accept; Difference in densities.

(c) In another experiment, ammonium chloride was heated as a mixture with sodium chloride.

State:

(i) What was observed during the process of heating? (01 mark)

Dense white fumes ✓ 01

(ii) The practical application of heating the mixture. (½ mark)

Separation of mixtures of which one ✓ component sublimes 0½

(d) Mention one example of a mixture which can be separated by fractional distillation. (01 mark)

Liquid air. ✓ 01 - Ethanol and water

Petroleum (crude oil) any one

2. The atomic numbers of elements, **X, Y** and **Z** are 6, 12 and 17. Respectively:-

(a) Write the electronic configuration for:-

(i) X: 2,4 ✓ 0½ 2:4 2)4 (½ mark)

(ii) Y: 2,8,2 ✓ Accept; 2:8:2 OR 2)8)2 (½ mark)

(iii) Z: 2,8,7 ✓ 2:8:7 2)8)7 (½ mark)

(b) Write the formula for the product when:

(i) X, burns in the excess oxygen. (01 mark)

XO_2 ✓ 01

Reject { $X^4 + O^2 \rightarrow XO_2$; $X^4 O^2 = XO_2$

(ii) Atoms of Y are burnt in the molecules of Z. (01 mark)

YZ_2 ✓ 01

$Y^2 Z^1 = YZ_2$ Reject

$Y^2 Z^1 = YZ_2$ Accept

$Y^2 + Z^1 \rightarrow YZ_2$ Reject

(c) Water was added to the compound in (b) (i) and the product tested with litmus paper(s). State:

(i) What was observed? (01 mark)

Blue litmus turns ✓ red, Red ✓ remains red. (01)

(ii) Any one conclusion that can be drawn following your observation in (c)(i). (½ mark)

Compound XO_2 is acidic ✓ in nature. 0½

3. (a) Sodium peroxide reacts with water to produce oxygen according to the following equation.

$2Na_2O_2(s) + 2H_2O(l) \longrightarrow 4NaOH(aq) + O_2(g)$

(i) State what is observed during the reaction. (01 mark)

Yellow ✓ solid dissolves in water producing ✓ bubbles of a colourless gas and a colourless solution. (01)

(ii) Calculate the volume of oxygen gas produced at room temperature when 3.12g of sodium peroxide were completer reacted with water.
($Na = 23, O = 16$, 1 mole of a gas occupies $24dm^3$ at room temperature.
1 mole of a gas occupies $24dm^3$ at room temperature. (02 marks)

Molar mass of $Na_2O_2 = (23 \times 2) + (16 \times 2) = 78g$ ✓

From equation;

2 moles of Na_2O_2 produce 1 mole of oxygen

$(2 \times 78)g$ of Na_2O_2 produce $24dm^3$ of oxygen ✓ (02)

3.12g of Na_2O_2 produce $\left(\frac{3.12 \times 24}{2 \times 78}\right)$ ✓ dm^3 of oxygen.

$= 0.48dm^3$ of oxygen

Volume of oxygen produced is $0.48dm^3$ ✓

(b) A small sample of burning sulphur was plunged into a gas jar containing oxygen gas. State:

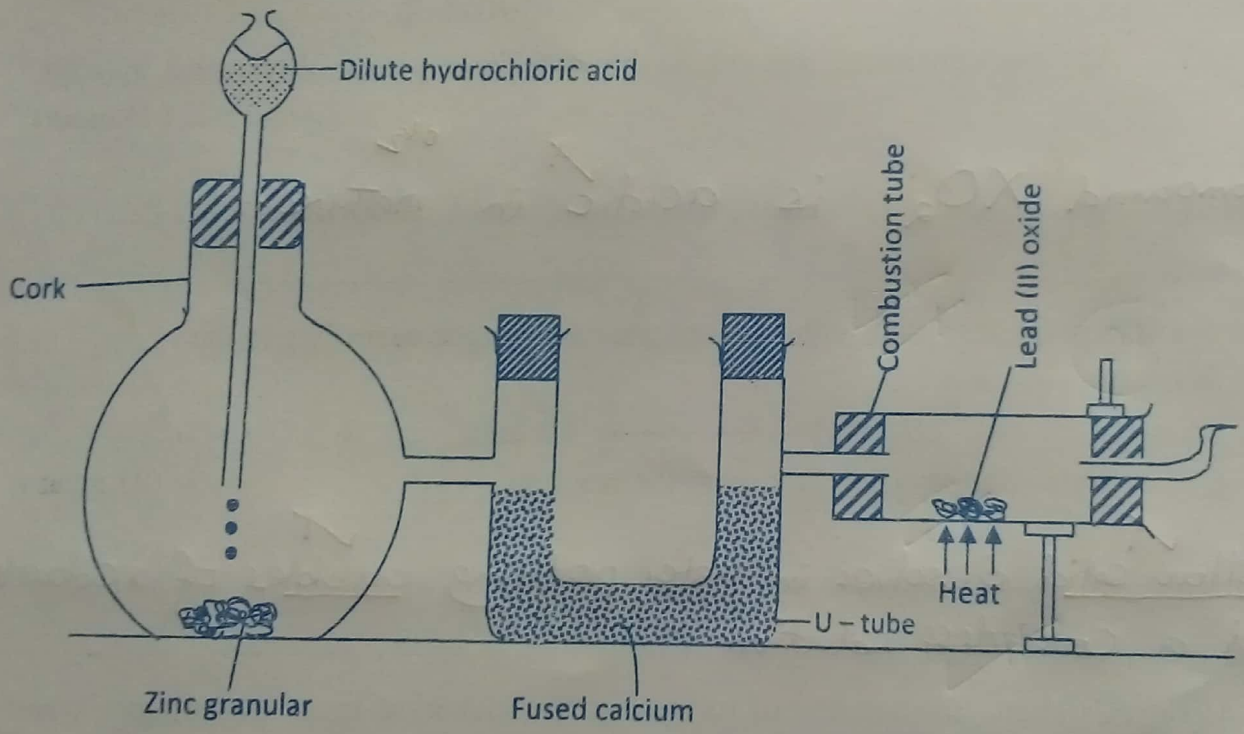
(i) What was observed? (01 mark)

The yellow powder burns with a blue flame forming a colourless gas. 01

(ii) The effect of the product(s) in (c) (i) on litmus paper(s). (01 mark)

Blue litmus turns red; Red remains red. 01

4. Dilute hydrochloric acid was added until in excess to zinc granules and the gas evolved was passed over heated lead (II) oxide as shown in the **figure 1**. Below.



(a) State;

(i) What was observed in the combustion tube? (01 mark)

Reddish brown solid turns to a grey residue 01
A colourless liquid.

(ii) The role of fused calcium chloride in the U-tube. (½ mark)

To dry the gas. 01/2

(b) Write equation for the reaction.

(i) between zinc and dilute hydrochloric acid. (1 ½ mark)

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$ ✓✗ 0½

Accept ionic equation (ii) $Zn_{(s)} + 2H^+_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + H_{2(g)}$

(ii) that takes place in the combustion tube. (1 ½ marks)

$PbO_{(s)} + H_{2(g)} \longrightarrow Pb_{(s)} + H_2O_{(g)}$ ✓✗ 0½

(c) Give **one** other oxide besides Lead (II) oxide that could have been used in the combustion tube. (½ mark)

Copper(II) oxide ✓ 0½

accept: Zinc oxide.

5. A solid compound, Q, reacts with dilute sulphuric acid to produce a colourless gas that has the following properties.

(i) Turns acidified potassium dichromate solution from orange to green.

(ii) Bleaches moist blue flowers to white.

(a) Name:

(i) Compound Q. (½ mark)

Sodium sulphite crystals. ✓ 0½

(ii) The colourless gas. (½ mark)

Sulphur dioxide ✓ 0½ Reject: Sulphurdioxide

(b) Write an equation for the reaction between Q and dilute sulphuric acid. 0½ (1 ½ marks)

$Na_2SO_{3(s)} + H_2SO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + SO_{2(g)} + H_2O_{(l)}$ ✓✓

Accept ionic equation $SO_3^{2-}{}_{(s)} + 2H^+_{(aq)} \longrightarrow SO_{2(g)} + H_2O_{(l)}$

(c) State;

(i) the practical application of the reaction when the gas was bubbled through acidified potassium dichromate solution. (½ mark)

Confirmatory test for Sulphur dioxide gas. ✓ 0½

(ii) what would be observed if the colourless gas was passed through a solution of Iron (III) sulphate. (01 mark)

The green ✓ solution turns to brown ✓ solution 01

(d) The bleaching action of the colourless gas is by reduction. Write equation for the reaction to show how the gas reduces moist blue flowers. (01 mark)

$SO_{2(g)} + H_2O_{(l)} + dye \longrightarrow H_2SO_{4(aq)} + [dye-O]$

Accept; $SO_{2(g)} + 2H_2O_{(l)} + dye \longrightarrow [Dye + 2H] + H_2SO_{4(aq)}$ 01

6. When magnesium powder was added into 25cm^3 of 0.2M solution of copper (II) chloride in a plastic beaker, some heat was evolved.

(a) State;

(i) What else was observed apart from the evolution of heat? (01 mark)

The grey powder dissolves in the blue solution forming a colourless solution and brown residue. 01

(ii) Why the reaction liberates heat. (01 mark)

It is exothermic.

(b) Write an ionic equation for the reaction that took place. (01 mark)

$Mg_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Cu_{(s)} + Mg^{2+}_{(aq)}$ 01

(c) Calculate the;

(i) Number of moles of copper (II) ions contained in the 25.0cm^3 of the solution. (01 mark)

1000cm^3 of solution contain 0.2 moles of Cu^{2+}

25.0cm^3 of solution contain $\left(\frac{25.0 \times 0.2}{1000}\right)$ moles

$= 5 \times 10^{-3}$ moles. 01

(ii) The mass of copper that was displaced by one mole of magnesium if 1.92g of Magnesium were used in the reaction. *(Cu=64, Mg = 24).* (02 marks)

From equation; 1 mole of Cu^{2+} react with 1 mole of Mg

5×10^{-3} moles of Cu^{2+} react with $\left(\frac{5 \times 10^{-3} \times 1}{1}\right)$ mole of Mg

$= 5 \times 10^{-3}$ moles of Mg

1 mole of Mg produce 1 mole of Cu

24g of Mg produce 64g of Cu

1.92g of Mg produce $\left(\frac{1.92 \times 64}{24}\right)$ g of Cu

$= 5.12$g of Cu 02

7. The diagram in the Figure 2 below shows the set up of apparatus that was used to carry out electrolysis of different electrolytes in the laboratory. Carbon electrodes were used in the experiment.

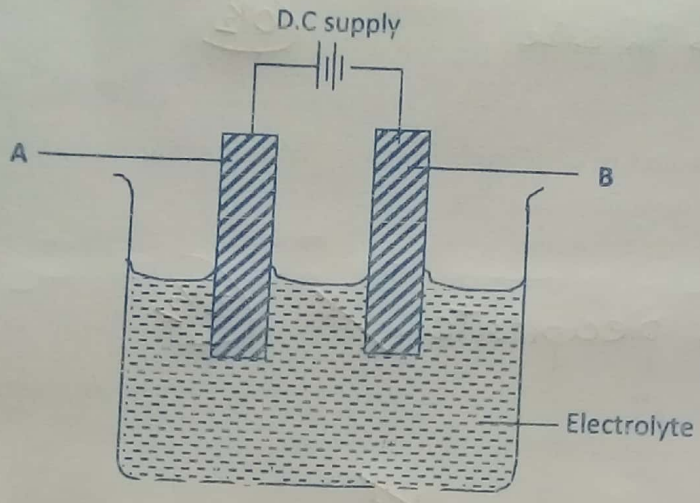


Fig. 2

(a) Name the substance that was formed at electrode, A, if the following electrolytes were used.

(i) Aqueous silver nitrate solution. (½ mark)

Oxygen gas and water. ✓+ (01)

(ii) Copper (II) chloride solution in dilute form. (½ mark)

Oxygen gas ✓+ and water (01)

(b) Write an equation for the electrode reaction in (a) (i). (01 mark)

$4\bar{O}H_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$ ✓ (01)

Accept; $4\bar{O}H_{(aq)} - 4e \longrightarrow 2H_2O_{(l)} + O_{2(g)}$

(c) If the electrolyte used was concentrated sodium chloride solution, name the product(s) that was formed at electrode:

(i) A: Chlorine gas ✓+ (½ mark)

(ii) B: Hydrogen gas ✓+ (01) (½ mark)

(d) State how the product you have given in (c) (ii) can be identified in the laboratory. (01 mark)

By inserting a glowing ✓+ splint in a gas jar of hydrogen (01)

Observations; The glowing splint is extinguished with ✓+ a "pop" sound

(e) If the electrodes were replaced with Copper electrodes and the electrolysis in (a) (ii) done for some time, state what was observed at A. (½ mark)

Electrode A reduces in size ✓ ✗ 0½

8. (a) State what would be observed if each of the following reagents was added to a solution of aluminium chloride.

(i) Lead (II) nitrate solution. (½ mark)

white precipitate ✓ ✗ 0½

(ii) Ammonia solution dropwise until in excess. (01 mark)

white ✓ precipitate ✗ insoluble ✗ in excess. 01

(b) Write an equation for the reaction that took place in (a) (i) above. (01 mark)

$3Pb(NO_3)_{2(aq)} + 2AlCl_{3(aq)} \longrightarrow 3PbCl_{2(s)} + 2Al(NO_3)_{3(aq)}$

Accept ionic equation: $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \longrightarrow PbCl_{2(s)}$

(c) To the resulting mixture in (a) (ii) was added sodium hydroxide solution dropwise until in excess.

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

The white precipitate ✓ ✗ is soluble in excess forming a colourless solution ✗ 01

(ii) Give a reason to support your answer in (c) (i). (01 mark)

Aluminium hydroxide, seen as a white precipitate, is amphoteric ✓ ✗ hence dissolves in excess sodium hydroxide forming soluble (aluminate ions) A complex ✓ ✗ 01

9. (a) In the presence of a catalyst, glucose can be converted to ethanol.

(i) Name the catalyst used. (½ mark)

Zymase ✓ ✗ 0½

(ii) Write equation for the reaction in which glucose is converted to ethanol. (01 mark)

$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH_{(l)} + 2CO_{2(g)} + \text{heat}$

Accept if not balanced ✓ 01

(iii) State how the purity of ethanol can be determined. (½ mark)

By testing its boiling point. (0½)

Pure Ethanol has a boiling point of 78°C hence below or above 78°C, ethanol has impurities.

(b) The ethanol obtained can be converted to carbon dioxide gas according to the following equation:

$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l) + Heat$

Calculate the mass of ethanol that was burnt in oxygen to produce 544.0KJ of heat.
(C = 12, O = 16, H = 1; 1 mole of ethanol burns to produce 1360KJ of heat) (02 marks)

Molar mass of $C_2H_5OH = (12\times2) + (1\times5) + 16 + 1$
$= 46g$

1mole of C_2H_5OH produce 1360KJ of heat. (02)

∴ 1360KJ of heat is evolved by 46g of C_2H_5OH.

544.0KJ of heat is evolved by $\frac{544.0\times46}{1360}$ g of C_2H_5OH

18.4g of C_2H_5OH.

∴ Mass of ethanol burnt is 18.4g

(c) State what:

(i) is formed when ethanol is heated with concentrated sulphuric acid. (½ mark)

A ~~Colourless gas~~ A colourless sweet smelling gas. (0½)

(ii) is observed when the product in (c) (i) is treated with bromine. (01 mark)

Reddish ~~brown~~ solution turns to a colourless solution. (01)

10. When concentrated hydrochloric acid was added to manganese (IV) oxide and the mixture heated, a gas was evolved.

(a) (i) Name the gas that was evolved. (½ mark)

Chlorine gas. (0½)

(ii) Write equation for the reaction that took place. (1 ½ marks)

$MnO_{2(s)} + 4HCl_{(aq)} \longrightarrow MnCl_{2(aq)} + Cl_{2(g)} + 3H_2O_{(l)}$ (01½)

(b) State what is observed when the gas is bubbled through:

(i) Cold dilute potassium hydroxide solution. (01 mark)

~~Pale yellow solution~~ (01)

Greenish yellow gas dissolves in a colourless solution forming a pale yellow solution.

(e) Ammonia gas can react with concentrated sulphuric acid to produce ammonium sulphate according to the following equation:

$2NH_3(g) + H_2SO_4(l) \longrightarrow (NH_4)_2SO_4(S)$

(i) Calculate the mass of ammonium sulphate that would be produced by 0.96 dm^3 of ammonia gas at room temperature.
(N = 14, S = 32, O = 16, one mole of a gas occupies $24dm^3$ at room temperature. (02 marks)

(ii) Explain why an aqueous solution of ammonium sulphate turns blue litmus paper red. (02 marks)

(f) When aqueous ammonia solution was added to a solution containing zinc ions, a white precipitate **Y** which dissolved in excess ammonia to give a colourless solution was formed.

(i) Identify **Y**. (½ mark)

(ii) Write the formula for the cation in the colourless solution. (½ mark)

14. (a) State the difference between an acid and a salt. (02 marks)

(b) Describe;

(i) how a pure dry sample of lead (II) carbonate can be prepared in the laboratory. (no diagram is required) (04 marks)

(ii) the effect of heat on lead carbonate . (02 marks)

(c) Lead (II) carbonate reacts with dilute nitric acid according to the following equation.

$PbCO_3(s) + 2HNO_3(aq) \longrightarrow Pb(NO_3)_2(aq) + CO_2(g) + H_2O(l)$

Calculate the mass of lead (II) carbonate that is required to react completed with $200cm^3$ of 0.2M dilute nitric acid. (Pb = 207, C = 12, O = 16). (2 ½ marks)

(e) State what would be observed if into a solution of lead (II) ions was added;

(i) Drops of potassium iodide. (½ mark)

(ii) Ammonia solution drop wise until in excess. (01 mark)

(iii) Dilute hydrochloric acid and the mixture heated then allowed to cool. (1 ½ marks)

(f) Write an equation to illustrate your answer in (d) (ii) above. (1 ½ marks)

END

(ii) A beaker containing moist red flowers. (½ mark)

Red flowers turn to white ✓ 0½

(c) The gas in (a) (i) was bubbled through a solution of sodium iodide until no further change.

(i) Write equation for the reaction. (1 ½ marks)

$2NaI_{(aq)} + Cl_{2(g)} \longrightarrow 2NaCl_{(aq)} + I_{2(s)}$ ✓ 0½

(ii) Suggest any conclusion that can be drawn from the equation you have written in (c) (i). (1 mark)

Chlorine is a higher oxidising agent than iodine. ✓ 01

Reject; { Chlorine is more reactive than Iodine hence it displaces it from its solution

SECTION B (30 MARKS)

Answer any TWO questions from this section

11. Calcium oxide is regarded as a hygroscopic substance.

(a) (i) Define the term a hygroscopic substance. (01 mark)

(ii) Give one other example of a hygroscopic substance. (½ mark)

(iii) State one laboratory use of hygroscopic substance. (01 mark)

(b) A gas A, is mainly dried in the laboratory using calcium oxide.

(i) Identify gas A. (½ mark)

(ii) Write an equation for the reaction that leads to the formation of gas A, in the laboratory. (1 ½ marks)

(c) Excess water was added on to calcium oxide until there was no further change.

(i) Write equation for the reaction that took place. (1 ½ marks)

(ii) Using equations, explain the changes that would result if carbon dioxide gas was bubbled through the product(s) in (c) (i) until in excess. (4 ½ marks)

(d) State;

(i) The conditions for the reaction of calcium oxide with nitric acid. Write equation for the reaction that takes place. (2 ½ marks)

(ii) Why the reaction in (d) (i) is not possible with sulphuric acid. (Equation not require). (02 marks)

12. Hydrogen chloride gas can be prepared in the laboratory by reacting sodium chloride crystal and an acid.

(a) (i) Name the acid commonly used for this preparation. (½ mark)

(ii) State the conditions for the reaction. (1 mark)

(iii) Write equations for the reaction. (1 ½ marks)

(b) Iron fillings when heated in dry hydrogen chloride react according to the following equation:

$$Fe(s) + 2HCl(g) \longrightarrow FeCl_2(s) + H_2(g)$$

(i) Calculate the volume of hydrogen chloride gas that would be required to react with iron at s.t.p to produce 5.0g of Iron (II) chloride.
(Fe = 56, Cl = 35.5; 1 mole of a gas occupies 22.4 dm^3 at s.t.p).
(2 ½ marks)

(ii) The anhydrous Iron (II) chloride formed in (b) was dissolved in water. State what was observed and write an ionic equation for the reaction.
(2 ½ marks)

(c) Dilute sodium hydroxide solution was added to the solution (product) in (b) (ii) drop wise until in excess.

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

(ii) Write an ionic equation for the reaction. (1 ½ marks)

(d) Explain;

(i) The effect of bubbling hydrogen chloride gas through a solution of silver nitrate. (2 ½ marks)

(ii) Why aqueous hydrogen chloride liberates hydrogen with zinc metal whereas hydrogen chloride in methyl benzene does not. (2 ½ marks)

13. Nitrogen can react with hydrogen in the Haber process to produce ammonia gas.

(a) State the;

(i) Source of nitrogen and hydrogen (01 mark)

(ii) Factors that can affect the yield of ammonia in the Haber process.
(1 ½ marks)

(b) Write an equation for the reaction leading to the formation of ammonia in the Haber process. (01 mark)

(c) Write an equation for the reaction to show oxidation of ammonia gas;

(i) by Copper (II) oxide (1 ½ marks)

(ii) in the presence of hot platinum. (1 ½ marks)

(d) Using equations, outline how the product(s) in (c) (ii) can be converted to nitric acid. (3 ½ marks)