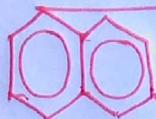


KIBUGO DENNIS

545/2
Chemistry
Paper 2
July - August 2022
2 Hours

~~Kib~~



0750-732031
0760-954033

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS-2022

NAME.....

INDEX NO..... SIGN.....

UGANDA CERTIFICATE OF EDUCATION
Chemistry paper 2

Time 2hours

INSTRUCTIONS TO CANDIDATES:

- Section A consists of 10 structured questions. Answer all questions in this Section.
- Answers to these questions must be written in the spaces provided only.
- 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 sheets provided only.
- In both sections all working must be clearly shown.

Where necessary use;

(H = 1; C = 12; S = 32; Cu = 64; Fe = 56; Pb = 207)

1 mole of gas occupies 24L at room temperature

1 mole of a gas occupies 22.4L at s.t.p

For Examiner's use only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total

(c) Describe how you can prove that the above forms of Carbon are allotropes of carbon. *Accept: Equal masses of Coke and graphite are burnt in excess oxygen.* (2 marks)

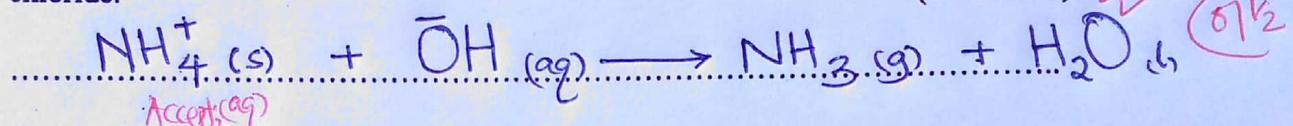
1g of graphite is burnt in excess oxygen and the volume of Carbon dioxide evolved at standard conditions is measured and recorded. *OZ*

1g of Coke is burnt in excess oxygen and the volume of Carbon dioxide evolved at standard conditions is measured and recorded.

Since same volume of Carbon dioxide is produced by graphite and Coke, this proves the two are allotropes of Carbon.

3. A mixture of sodium hydroxide solution and solid ammonium chloride was heated and 180cm³ of ammonia gas were evolved at s.t.p.

(a) Write an ionic equation for the reaction of Sodium hydroxide with ammonium chloride. (1 1/2 marks)



Accept: (aq)

(b) Explain why ammonia cannot be collected by:

(i) Downward displacement of water. (1 mark)

It is less dense than water

It is highly soluble in water *✓ 0.1*

(ii) Upward displacement of air. (1 mark)

It is less dense than air. *✓ 0.1*

(c) Calculate the mass of ammonia gas that was produced at s.t.p.

(1 mole of gas occupies 22400cm³ at s.t.p; H=1, N=14) (1 1/2 marks)

Molar mass of NH₃ = 14 + (1 × 3) = 17 g mol⁻¹ *✓*

22400 cm³ is occupied by 1 mole of NH₃.

22400 cm³ is occupied by 17 g of NH₃.

180 cm³ is occupied by $\frac{180}{22400} \times 17$ g of NH₃

$$= 0.137 \text{ g of NH}_3$$

Accept:
$$\left\{ \begin{array}{l} 22400 \text{ cm}^3 \longrightarrow 17 \text{ g of NH}_3 \\ 180 \text{ cm}^3 \longrightarrow \left(\frac{180}{22400} \times 17 \right) \text{ g} \\ = 0.137 \text{ g} \end{array} \right.$$

4. Dilute nitric acid was added to a mixture of copper (II) oxide and lead (II) oxide until no further change. To the resultant solution, dilute sodium hydroxide solution was added drop wise until in excess and the mixture was then filtered.

(a) Write the formula of cation present in the

(i) Filtrate.



Reject, Pb^{2+} (½ mark)

(ii) Residue.



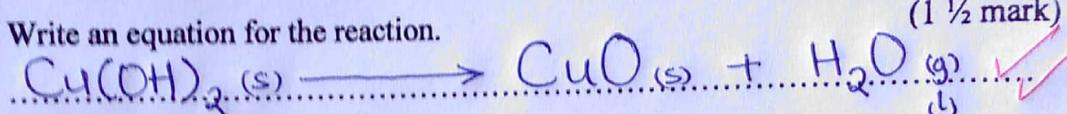
Reject, Cu^{2+} (½ mark)

(b). The residue was heated strongly until no further change.

(i) State what was observed.

Pale blue residue turns to a black residue. (01)
Accept; Blue (solid)

(ii) Write an equation for the reaction.



(0½)

(c) In another experiment students had solutions of lead (II) nitrate, magnesium sulphate and zinc chloride.

Which one of the above solution formed a precipitate with:

(i) Barium nitrate solution.

Magnesium sulphate solution (½ mark)
Reject, MgSO_4

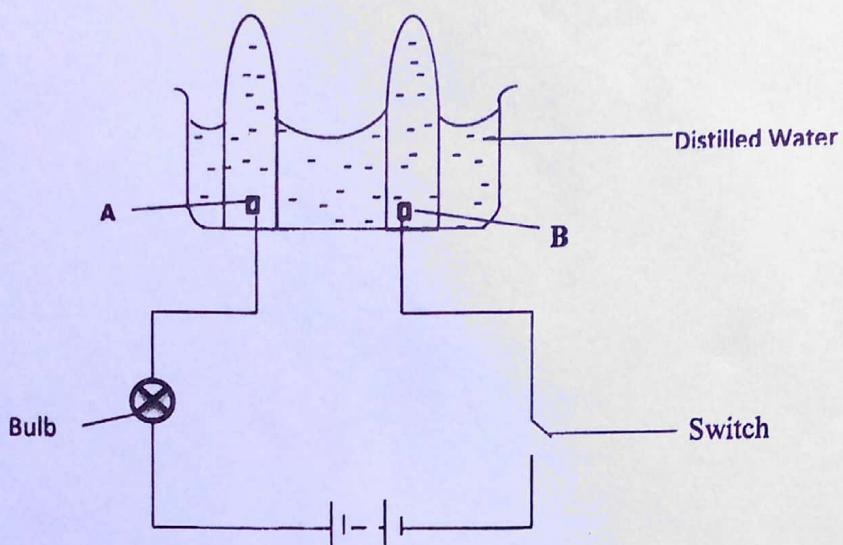
(ii) Silver nitrate solution.

Zinc chloride solution (½ mark)
Reject, ZnCl_2

(iii) Potassium iodide solution.

Lead(II) nitrate solution (½ mark)
Reject, $\text{Pb}(\text{NO}_3)_2$

5. Study the diagram below and answer the questions that follow.

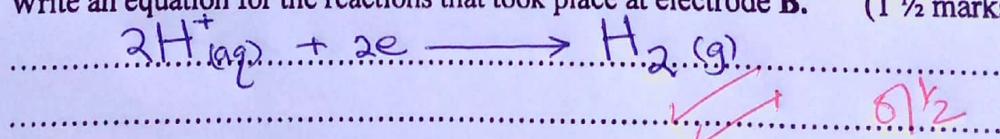


- (a) Explain why there was no observation made the switch was closed. (1 mark)
Distilled water contains molecules which do not conduct electricity.

(b) A small amount of concentrated sulphuric acid was added to distilled water and the switch was then closed.

- (i) Explain the observation made. (1 ½ marks) (81/2)
The bulb lit. This is because addition of concentrated sulphuric acid quickens/enhances the ionisation of water molecules into ions which conduct electricity.

(ii) Write an equation for the reactions that took place at electrode B. (1 ½ marks)



- (c) State one application of electrolysis process. (1 mark)

- In extraction of metals eg. sodium, Aluminium.
 - In manufacture of Sodium hydroxide
 - In electroplating of metals.
 - Anodisation of aluminium.
 - Purification of metals

6. (a) State the conditions under which sulphuric acid can react with:

(i) Copper.

Hot concentrated sulphuric acid.

(01)

(1 mark)

(ii) Ethanol.

Excess hot concentrated sulphuric acid at 180°C.

(01)

(1 mark)

(b). State the property of sulphuric acid which is shown by its reaction with,

(i) Copper.

As an oxidising agent

(01)

(1 mark)

Reject; Oxidising agent

(ii) Ethanol.

As a dehydrating agent

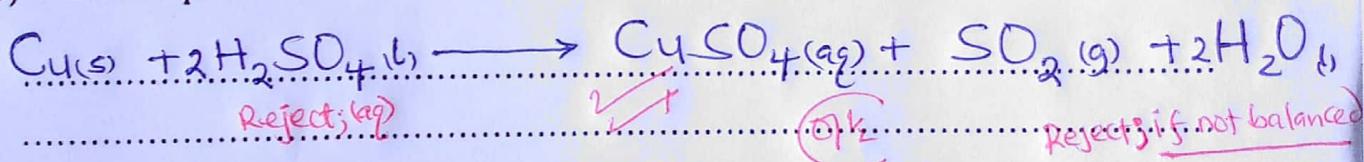
(01)

(1 mark)

Reject; Dehydrating agent

Reject; Dehydration

(c) Write an equation for the reaction between sulphuric acid and copper. (1 1/2 marks)



7. A hydrated salt contains 20.2% Iron, 23.0% oxygen, 11.5% sulphur and 45.3% water of crystallization. Its relative molecular mass is 278.

(a) Determine the molecular formula of the hydrated salt.

(Fe = 56; S = 32; O = 16; H = 1)

(3 marks)

Elements/compound	Fe	S	O	H ₂ O
% Composition	20.2	11.5	23.0	45.3

Moles	20.2	11.5	23.0	45.3
	56	32	16	18

0.3607 0.3594 1.4375 2.5167

(0.3)

0.3607 0.3594 1.4375 2.5167
0.3594 0.3594 0.3594 0.3594

Simplest ratio 1 : 1 : 4 : 7

Empirical formula is FeSO₄·7H₂O ✓

(FeSO₄·7H₂O)_n = 278 ✓

(FeSO₄·7H₂O)_n = FeSO₄·7H₂O

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$$56n + 32n + (6 \times 4)n + (8 \times 7)n = 278$$

$$n = 1$$

Page 6 of 13

∴ Molecular formula of salt
is FeSO₄·7H₂O ✓

(b) 6.95g of the hydrated salt were dissolved in distilled water to make 250cm³ of solution.

Molar mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ = 278.9 mol⁻¹

(2 marks)

250cm³ of solution contain 6.95g

$$1000\text{cm}^3 \text{ of solution contain } \frac{(1000 \times 6.95)}{250} \text{ g} \\ = 27.8 \text{ g/l}$$

278g of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ contain 1 mole

$$27.8 \text{ g of } \text{FeSO}_4 \cdot 7\text{H}_2\text{O} \text{ contain } \frac{27.8}{278} \text{ mol} \\ = 0.1 \text{ mol l}^{-1}$$

∴ Concentration of solution is 0.1 mol l⁻¹

8(a) In one experiment, metals A, B and C each were added separately to 50cm³ of 1M

copper (II) Sulphate solution. The initial temperature of copper (II) Sulphate solution was noted and recorded before the start of each experiment.

The highest temperature reached of the mixture after stirring was recorded as below.

Metal added to copper(II) sulphate solution	A	B	C
Highest temperature (°C) of the mixture	28.3	24.0	33.7
Initial temperature of copper (II)sulphate solution	24.0	24.0	24.0

- (i) Arrange the metals A, B and C in order of reactivity starting with the most reactive and in each case give a reason for your answer. (2 marks)

$C > A > B$ ✓ 01 Accept; C, A, B

Order of Reactivity depends on temperature change value.

C is the most reactive because it yields the highest heat temperature change during the reaction.

Accept { 1. C
2. A
3. B

B is the least reactive since it yields no temperature change thus it can not displace Copper from its solution.

- (i) Which metal did not show any visible reaction with copper (II) sulphate? (½ mark)

B ✓ 0½

- (ii) State any other observation made inside the reaction vessels in which there was a reaction that occurred. (1 mark)

Blue solution turns to a brown residue.

01

- (c) In the reaction vessels in which there was a reaction

- (i) State whether the reaction was exothermic or endothermic. Give a reason for your answer. (1 mark)

Exothermic.

01

Heat evolved caused a temperature rise.

- (ii) State the type of enthalpy change of reaction in the above experiment (½ mark)

Enthalpy of displacement.

0½

- 9 (a) What is meant by the term rate of reaction? (1 mark)

Amount of products formed per unit time in a reaction.

OR Amount of reactants used up per unit time in a reaction.

- (b) State any two factors that can affect the rate of a reaction (2 marks)

Reject { Surface Area, Concentration.

{ - Surface area of reactants | Particle size

{ - Concentration of reactants

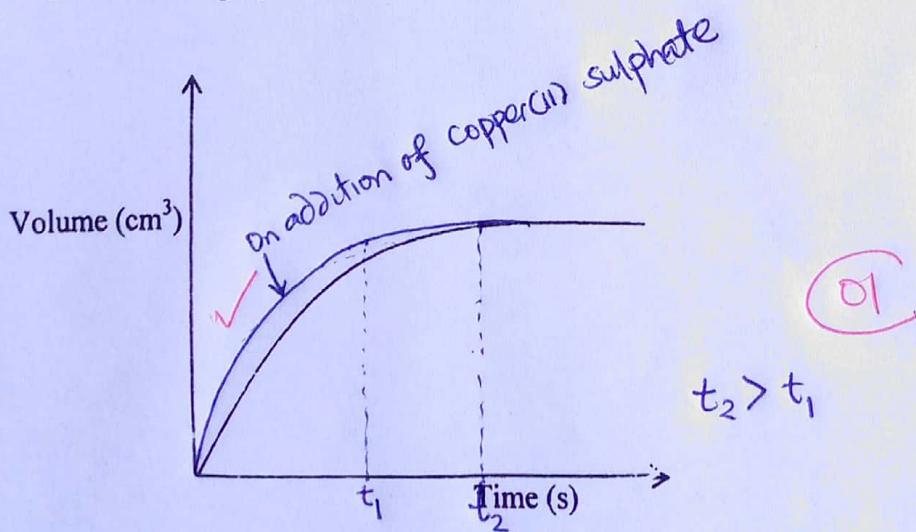
{ - Temperature

{ - catalyst

Reject { Pressure, Light

any 2

- (c) In an experiment, hydrogen gas was prepared by reacting magnesium ribbon with dilute hydrochloric acid, and the volume of hydrogen gas evolved varied with time, as shown in the graph in the figure below:



- (i) On the same axes in (c) above, sketch the curve that would be obtained if a few crystals of copper (II) sulphate were added into the reactants. (1 mark)

- (ii) Explain your answer in (i) above. (1 mark)

Copper(II) sulphate added speeded up the rate of reaction hence acts as a catalyst by providing an alternative route of a lower activation energy, hence same volume of hydrogen evolved in a quicker time interval. (01)

- 10 (a). An element W has mass number 27 and 14 neutrons.

- (i) Write down the electronic configuration of W. (½ mark)

~~2:8:3~~ ✓ Accept: 2,8,3 (OR) 2)8)3 Rej 2.8.3

- (ii) W combines with Oxygen to form compound R. Write down the formula of R and state the type of bonding in R..

Formula..... W_2O_3 ✓ (01) (1 mark)

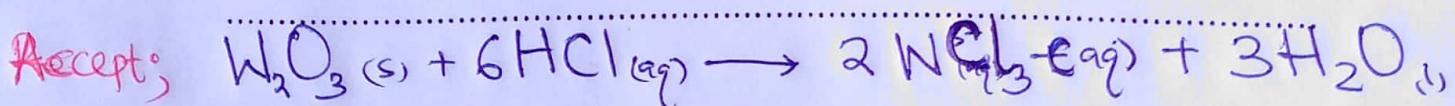
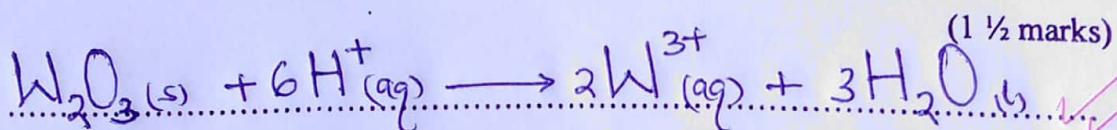
Type of bonding..... Ionic ✓ Accept: Electrovalent

- (iii) State any two properties of compound R. (02) (2 marks)

Conducts electricity in molten state or aqueous state
Soluble in water and insoluble in non-polar organic solvents.
Has a giant ionic structure
It is a solid at room temperature.
High density and boiling points.

any 2
Correct
points.

- (b). Write an equation for the reaction between R and dilute hydrochloric acid.



SECTION B. (30 marks)

Attempt any two questions from this section.

11. Glucose can be converted into ethanol by a catalytic reaction caused by the enzymes produced by yeast.

(a). Name:

(1 mark)

(i) the reaction in which yeast converts glucose to ethanol.

(1 mark)

(ii) the enzyme produced by yeast during the above reaction.

(b) Write the equation for the reaction leading to the formation of ethanol by the process named in a (i) above.

(1½ marks)

(c) When ethanol was strongly heated together with concentrated sulphuric acid, gas W was formed.

(i) Identify gas W.

(1 mark)

(ii) Write equation for the reaction leading to the formation of gas W. (1 ½ mark)

(d) (i) Name one reagent that can be used to identify W in the Laboratory. (1 mark)

(ii) State what is observed when the reagent named in d(i) is treated with gas W.

(1 mark)

(e) When treated at high pressure and temperature in the presence of a suitable catalyst, molecules of W react together to form a compound P of high molecular mass.

(i) Identify P.

(½ mark)

(ii) Name the process leading to formation of compound P

(1 mark)

(iii) State any three disadvantages of using P

(3 marks)

(f) Differentiate between thermosetting and the thermo- softening plastics. (2 marks)

12(a) Describe the laboratory method for preparation of dry samples of sulphur dioxide from sodium sulphite. (Diagram not required) (5 marks)

(b) State what is observed when:

(i) Burning magnesium ribbon is lowered into a gas jar of sulphur dioxide. (1 ½ marks)

(ii) Sulphur dioxide gas is bubbled through a solution of iron (III) chloride. (1 ½ mark)

(iii) Write an equation for the reaction that took place in b (i) above. (1 ½ marks)

(c) When sulphur dioxide is reacted with more oxygen in presence of a catalyst, substance X is formed, X dissolves in water forming a solution Z.

(i) Name the catalyst used. (1 mark)

(ii) Identify substance X. (1 mark)

(iii) Write an equation for the formation of X. (1 marks)

(iv) Name solution Z. (1 mark)

(d) Solution Z was reacted with impure zinc to produce hydrogen gas.

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

(ii) If 6.5g of impure zinc sample reacted completely with 20cm³ of a 0.1M solution Z, calculate the percentage of zinc in impure sample s.t.p.

(Zn = 65) (1 ½ marks)

13(a) Differentiate between strong acid and concentrated acid. (2 marks)

(b) The table below shows the pH values for some unknown solutions formed.

Solution	pH value
A	6.2
B	12.0
C	7.0
D	2.0
E	9.8

Which of the above solutions is most likely to be formed by each of the following substances are dissolved in water? and give a reason for your answer.

- (i) Carbon dioxide.
- (ii) Ammonia gas.
- (iii) Sodium oxide.
- (iv) Hydrogen chloride gas. (5 marks)
- (v) Sodium chloride. (1 Mark)

(c)(i). Calcium oxide is a basic oxide. Define the term basic oxide.

(ii). Describe the laboratory preparation of dry crystals of calcium nitrate from calcium oxide. (5 marks)

(d). Calcium nitrate crystals were strongly heated until no further change.

- (i) State what was observed. (1 ½ marks)
- (ii) Write the equation of reaction that took place. (1 ½ marks)

14 (a) Name the main ore from which the following metals are extracted?

- (i) Sodium metal. (1 mark)
- (ii) Iron metal. (1 mark)

(b) Iron is extracted from its ores in blast furnace using a reducing agent.

- (i) Give the main reducing agent in the blast furnace and write equations for its formation. (2 marks)
- (ii) Using equations, describe the use of calcium carbonate in the extraction of iron metal from its ore. (3 marks)

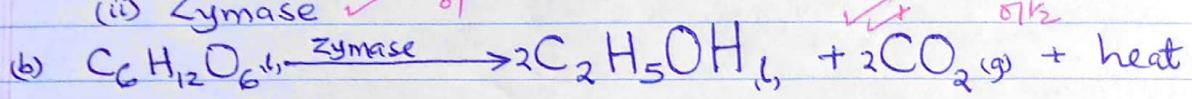
- (c) State what is observed when iron metal is heated in dry sample of chlorine. (2 marks)
- (d) Explain why common reducing agents are not used in the extraction of sodium metal from its ore. (2 marks)
- (e) During extraction of sodium, calcium chloride is added to the ore.
- (i). State the purpose of adding calcium chloride to the ore. (1 mark)
- (ii). Write equations for the reactions at electrode during extraction of sodium metal. (3 marks)

END

Question 11.

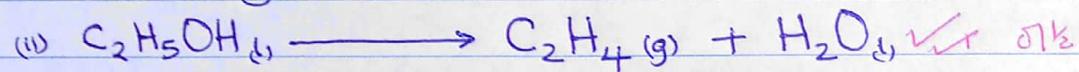
(a) (i) Fermentation ✓ 01

(ii) Zymase ✓ 01



✓ 01

(c) (i) Ethene gas. ✓ 01



(d) (i) Bromine water ✓ 01

(ii) Reddish brown solution turns colourless 01

Bromine liquid

- Red liquid turns to colourless solution

{ Acidified potassium manganate(VII) solution
- Purple solution turns colourless

(e) (i) Polyethene ✓ 01

Accept: Polythene

(ii) Polymerisation ✓ 01

(iii) → Non-biodegradable, hence ends up polluting soil and water bodies 03

When burnt, it produces toxic fumes to animals.

Cut off oxygen supply when eroded on water surface, hence suffocating aquatics.

(f) Thermosetting plastics are one which when heated can decompose and can not be remoulded into any other shape Example-Bakelite 01
- Melamine

Thermosoftening plastics are one which when heated, can be remoulded into another shape and on cooling they harden in that new shape. Example Polythene plastics. 01

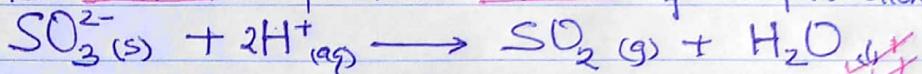
15 MARKS.

Question 12.

(a) Sodium sulphite crystals are put in a flask corked with a delivery tube and a funnel.

Dilute Sulphuric acid is added into the funnel onto sodium sulphite crystals in the flask. (05)

The mixture is heated to produce bubbles of sulphur dioxide gas.

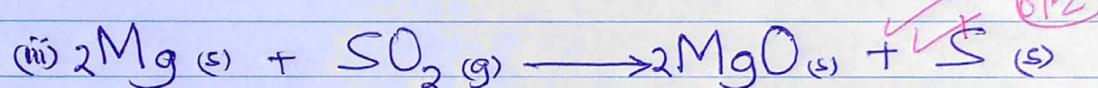


The gas is passed through concentrated sulphuric acid to be dried since it does not react with the gas.

The gas is finally collected by downward delivery since it is denser than air.

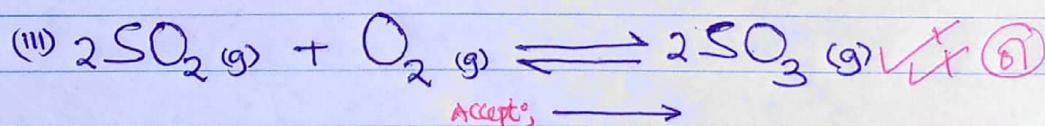
(b) The grey ribbon continues to burn with brilliant white flame forming white ash and yellow particles. (01 1/2)

(ii) Brown solution turns to green solution. (01)

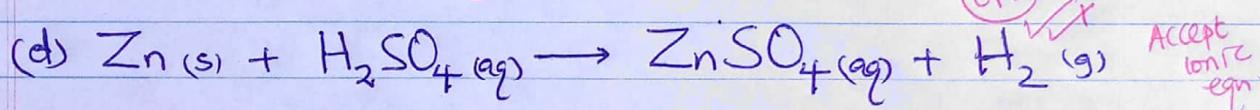


(c) (i) Vanadium(V) oxide ✓ (61) Accept; Vanadium pentoxide
Rej; Vanadium pentoxide

(ii) Sulphur trioxide gas. ✓ (61)



(v) Sulphuric acid ✓ (61)



$$(ii) \text{Moles of Z} = \left(\frac{0.1}{1000} \times 20 \right) = 0.004 \text{ moles.}$$

Mole ratio of Zn : Z is 1:1 ∴ Moles of Zn = 0.004 moles reacted

65 1 mole of Zn weighs 65 g

0.004 moles of Zn weigh $\left(\frac{0.004 \times 65}{1} \right) \text{g} = 0.26 \text{g}$ (81/2)

$$\% \text{ of Zinc} = \frac{0.26}{6.5} \times 100 \text{ } \cancel{\%} = 4\%$$

15 MARKS.

Example of Strong acid $\text{H}_2\text{SO}_4 \rightarrow 2\text{H}^+ + \text{SO}_4^{2-}$
Example of Concentrated acid $5\text{M H}_2\text{SO}_4 \quad \text{H}_2\text{SO}_4(l) \rightleftharpoons \text{H}^+(\text{aq}) + \text{HSO}_4^-(\text{aq})$

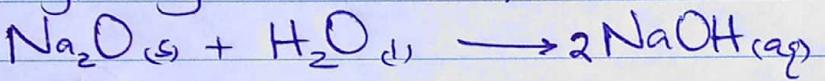
Question 13.

(a) Strong acid is one that completely ionises while
Concentrated acids partially ionise and contain excess hydrogen ions
or the least amount of water in their stock solutions. ✓ (02)

(b) (i) For Carbon dioxide ; Solution A. ✓ (01)
Carbon dioxide dissolves in water forming a weak acid
of carbonic acid. $\text{H}_2\text{O}(l) + \text{CO}_2(\text{g}) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq})$

(ii) For ammonia ^{gas}; Solution E ✓ (01)
Ammonia gas dissolves in water forming a weak alkalis of
ammonium hydroxide. $\text{H}_2\text{O}(l) + \text{NH}_3(\text{g}) \rightleftharpoons \text{NH}_4\text{OH}(\text{aq})$

(iii) For Sodium oxide; Solution B ✓ (01)
Sodium oxide dissolves in water forming a strong alkalis of
sodium hydroxide making the resultant solution to have a higher
pH ~~far~~ greater than 7.



(iv) Hydrogen chloride gas; Solution D ✓
Hydrogen chloride gas dissolves in water forming hydrochloric
acid, a strong acid, thus resultant pH will be very low ~~far~~ below 7.
$$\text{HCl}(\text{g}) + \text{aq} \rightarrow \text{HCl}(\text{aq})$$

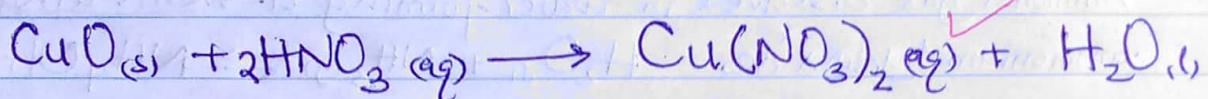
(v) Sodium chloride; Solution C ✓ (01)
Sodium chloride undergoes salt hydrolysis in water forming
a strong acid of hydrochloric acid and strong alkalis of
sodium hydroxide. Since the concentration of hydrogen ions
are equal to concentration of hydroxide ions, there is
neutralisation making the resultant pH neutral (exactly 7.0)

(c) An oxide of a metal which when dissolved in water produces
an alkaline solution. ✓ (01)

(d)

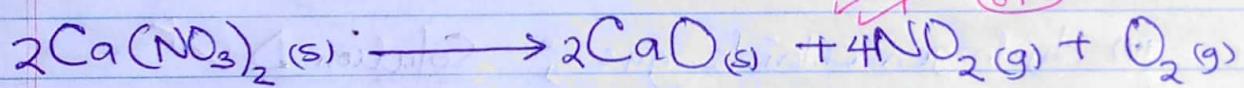
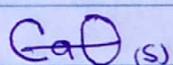
(c) (ii) Warm dilute nitric acid is put in a plastic beaker. Calcium oxide is added to the acid little at a time while stirring until no excess. The excess calcium oxide is filtered off. The filtrate is evaporated to saturation and then cooled for crystals to form and filtered off. The crystals are washed with little cold distilled water. The crystals are dried in an oven.

(OS)



(d) White crystals melt with a crackling sound forming white powder (residue), brown fumes.

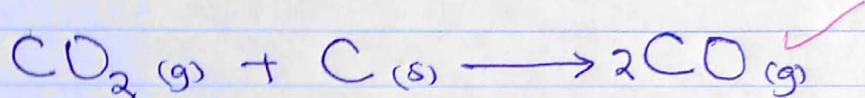
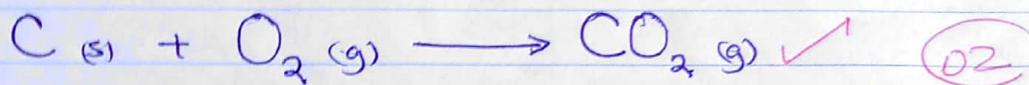
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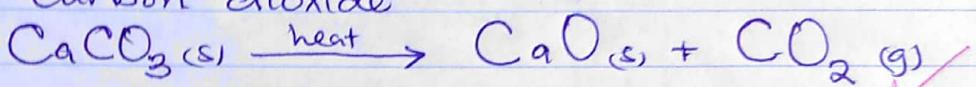
15 MARKS.

Qn 14

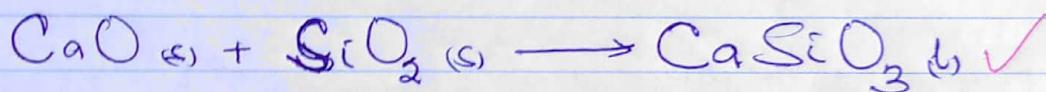
- (a) (i) Rock salt ✓ ① Accepted; Sodium chloride.
(ii) Haematite ✓ ② Spathic / Magnetite / siderite
(b) (i) Carbon monoxide ✓



- (ii) Calcium carbonate decomposes on heating to Calcium oxide and Carbon dioxide



The Calcium oxide formed removes the impurities of Silicon dioxide forming molten slag of calcium silicate that is later taphed off. ③

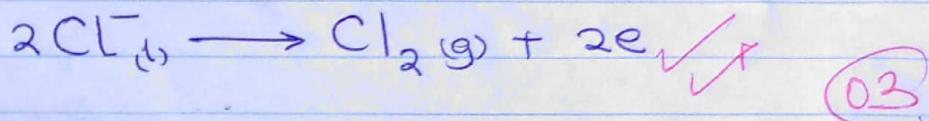


- (c) The grey metal glows red hot forming brown vapour that later condenses as a black sublimate. ②

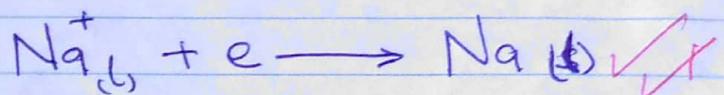
- (d) Sodium is highly reactive, hence can not be ① reduced by common reducing agents such as Carbon monoxide.

- (e) (i) To lower the melting point of sodium chloride from $800^\circ C$ to $600^\circ C$. ①

(ii) Anode



Cathode



15 MARKS -

"THE DEAD ARE NOT DEAD", DISCUSS.