PROPOSED.

MARKING GUIDE

UNNASE 2022

X/80

Candidate's Name: .....

Signature: .....

| Random No. | | | | | | Personal No. | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

CHEMISTRY MOCKS

PAPER 2, 2022

2 hours

INSTRUCTIONS TO CANDIDATES:

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

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

c) 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 a gas occupies 24.0 litres at room temperature.

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

| For Examiners' Use Only | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
| | | | | | | | | | | | | | | |

SECTION A (ATTEMPT ALL QUESTIONS)

(1) Candle wax is a mixture of hydrocarbon molecules that belong to the same homologous series.

(a) Explain what is meant by the term homologous series. (1mks)

Is a group of compounds which conform to the same general molecular formula; have similar chemical properties and usually prepared by similar methods ✓

(b) An example of one hydrocarbon contained in candle wax is $C_{25}H_{52}$.

i) Name the homologous series to which this hydrocarbon belongs.

Alkanes ✓ Reject Alkane (1mk)

ii) Write the molecular formula for the molecule, containing 72 hydrogen atoms, that belongs to the same homologous series.

$C_{35}H_{72}$ ✓ (1mk)

(c) State the suitable method that can be used to separate the different hydrocarbons in candle wax and give a reason.

(i) Method Fractional distillation ✓ (1mk)

(ii) Reason

Hydrocarbons in candle wax have relatively close but different boiling points ✓ (1mk)

Reject if relatively close is missing

(2). A student carried out the following experiment.

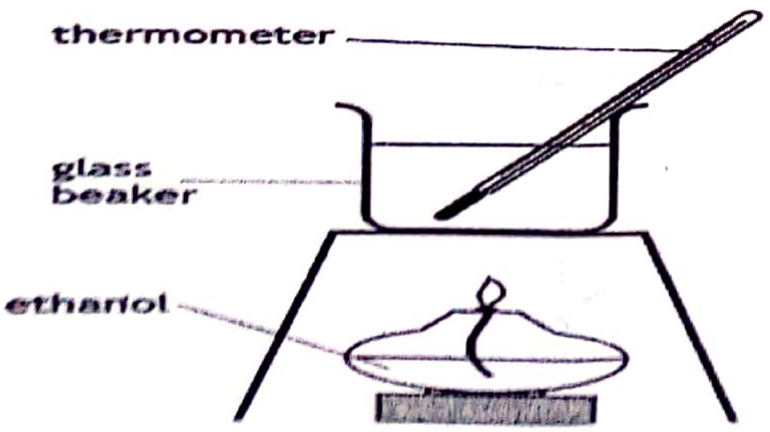



figure1

Accept *$C_2H_6O$ *$CH_3CH_2OH$

(a) Write equation for complete combustion of ethanol (1.5mks)

$C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ ✓✓

(b) When 0·8 g of ethanol was burned, 8·36 kJ of energy was absorbed by the water. If the temperature of the water increased by 40 °C, calculate the mass, in grammes, of water used by the student in this experiment. (specific heat capacity of water is 4.2 J/g °C) (1.5 mks)

Heat produced by burning ethanol = Heat absorbed by water ✓

$8.36 = \frac{mc\Delta T}{1000}$

$\therefore m = \frac{8.36 \times 1000}{4.2 \times 40}$ ✓

$= 49.76$ g of water ✓✓

(c) The experiment was repeated, replacing the glass beaker with a copper can and using a draught shield. Explain why these changes resulted in more heat energy being absorbed by the water.

(i) Use of copper can (1mk)

Copper is a better conductor of heat than glass ✓

(ii) Use of draught shield (1mk)

Draught shield minimises heat loss to the immediate surroundings ✓

Reject "prevents"

(3) A researcher investigated the conditions for producing ammonia at industrial scale

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

(a) Name the catalyst used in the industrial production of ammonia (1mk)

Finely divided iron ✓

(b) In her first experiment she measured how the percentage yield of ammonia varied with pressure at a constant temperature of 500 °C

| Pressure(atmospheres) | 100 | 200 | 300 | 400 | 500 |
|---|---|---|---|---|---|
| Percentage yield of ammonia (%) | 10 | 18 | 26 | 34 | 42 |

Predict the percentage yield of ammonia at 700 atmospheres (1mk)

Percentage yield will be 58 ✓

Accept 58%

(c) In a second experiment the researcher kept the pressure constant, at 200 atmospheres, and changed the temperature as shown.

| Temperature(° C) | 200 | 300 | 400 | 500 |
|---|---|---|---|---|
| Percentage yield of ammonia (%) | 89 | 67 | 39 | 18 |

Describe how the percentage yield of ammonia varies with temperature. (1mk)

The percentage yield of ammonia decreases with increase in temperature ✓

(d) Using the information in both tables, state the conditions that would produce the highest percentage yield of ammonia. (2mk)

High pressure of about 500 atmospheres ✓

Relatively low temperature of about 200°C ✓

4) Vitamin C is found in fruits and vegetables. In an experiment, 16.00 $cm^3$ of 0.005M of iodine solution reacted with exactly 25 $cm^3$ of orange juice according to the equation below

$C_6H_8O_{6\,(aq)} + I_{2(aq)} \longrightarrow C_6H_6O_{6\,(aq)} + 2HI_{\,(aq)}$

(vitamin C)

(a) Calculate the concentration, in grammes per litre of vitamin C in the orange juice (C=12, H=1 and O=16) (5mks)

$1000\,cm^3$ of solution contain 0.005 moles of iodine ✓

$16.00\,cm^3$ of solution contain $\frac{(0.005 \times 16)}{1000}$ moles of iodine ✓

$= 0.00008$ moles of iodine ✓

From the equation above

1 mole of iodine reacts with 1 mole of Vitamin C

0.00008 moles of iodine react with $\frac{1}{1} \times 0.00008$ moles of Vitamin C ✓

$= 0.00008$ moles of Vitamin C

25 cm³ of orange juice contain 0.00008 moles of vitamin C

1000 cm³ of orange juice contain $\left(\frac{0.00008 \times 1000}{25}\right)$ moles

= 0.0032 moles per litre

RFM of Vitamin C; $C_6H_8O_6$ = 12×6 + 1×8 + 16×6

= 176

1 mole of vitamin C weighs 176 g

0.0032 moles of vitamin C weigh $\left(\frac{176}{1} \times 0.0032\right)$ g

= 0.5632 g l⁻¹

Repeat if rounded off

Reject if units are wrong

5. Oxygen is obtained on large scale by the fractional distillation of air as shown on the flow chart bellow

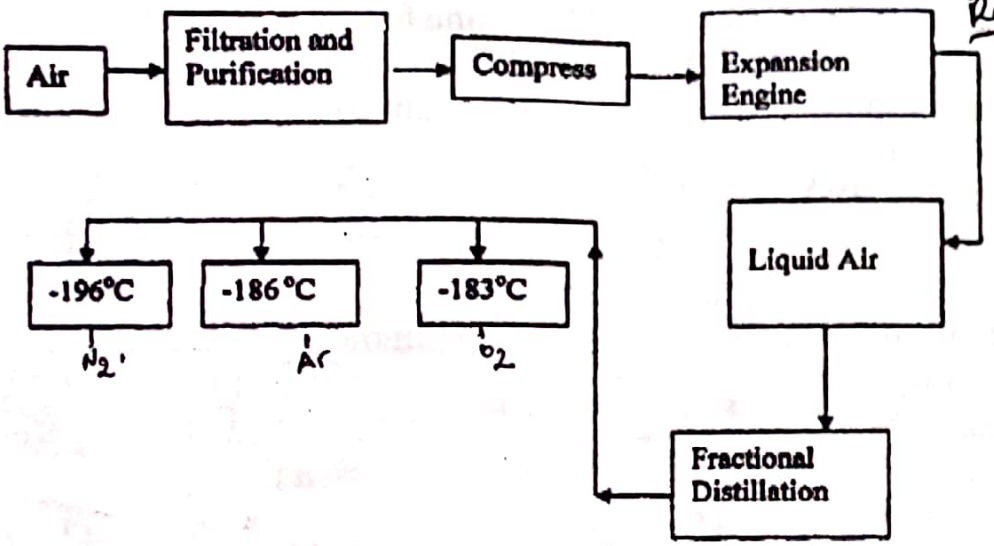



figure 2

(a) Name four components of air in the atmosphere (2mks)

Carbon dioxide, Repeat carbondioxide, Oxygen, Nitrogen and noble gases or Inert gases

Accept ~~Reject~~ Rare gases

(b) Identify the substance that is removed at the filtration stage (1mk)

Dust Particles

(c) Explain why Carbon(IV) oxide and water are removed before liquefaction of air (1mk)

Carbon dioxide and water solidify at low temperatures and this would block the flow of liquid air through the pumps and pipes

(d) Identify the component that is collected at -186°C (1 mk)

Argon Repeat Noble gas

(6) The set-up below is used to investigate the properties of hydrogen.

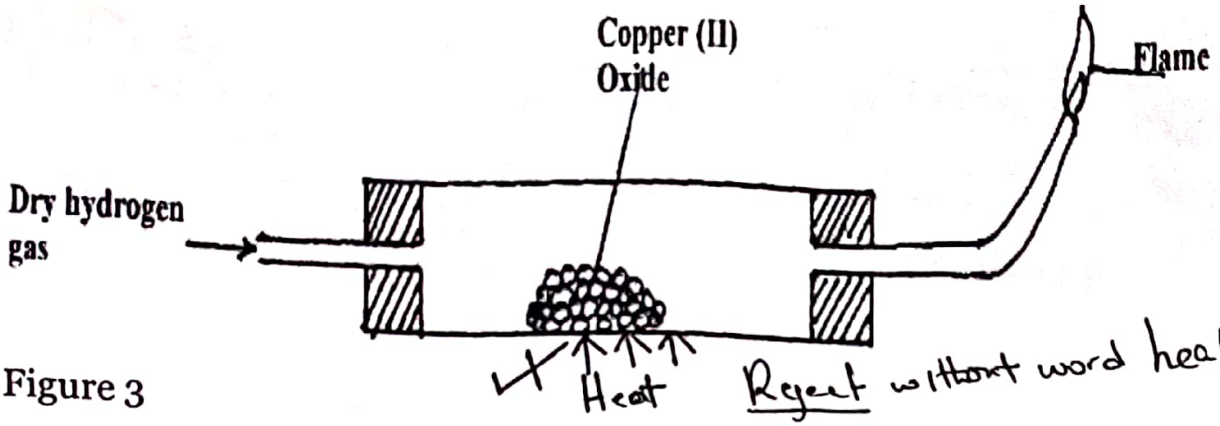



Figure 3

Reject without word heat

(a) On the diagram, indicate what should be done for the reaction to occur (0.5mks) see the diagram on

(b) Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain why (1mk)

To drive out air because a mixture of air containing oxygen and hydrogen explodes when lit

(c) Write an equation for the reaction that occurs in the combustion tube (1.5 mks)

$CuO_{(s)} + H_{2(g)} \rightarrow Cu_{(s)} + H_2O_{(l)}$

Reject wrong symbols of copper, eg Cu

(d) When the reaction is complete, hydrogen gas is passed through the apparatus until they cool down. Explain why (1mk)

To prevent re-oxidation of hot copper by the atmospheric oxygen in air

(e) What property of hydrogen is being investigated? (0.5mks)

Reducing property

(f) What observation confirms the property stated in (e) above? (0.5mks)

Black solid turns to a brown solid confirming that copper(II) oxide was reduced to copper metal

Colourless liquid condensate

(7) The table below gives information about the ions $T^+$ and $X^{2-}$

| Ions | $T^+$ | $X^{2-}$ |
|---|---|---|
| Electronic configuration | 2:8:8 | 2:8:8 |
| Number of neutrons | 20 | 16 |

(a) How many protons are there in the nucleus of?

(i) Element T? (1mk)

19 protons ✓

(ii) Element X? (1mk)

16 protons ✓

(b) Determine the molar mass of the compound formed between T and X (2mks)

Formula of the Compound formed between T and X is $T_2X$ ✓

Mass number of T = 19 + 20 ✓ = 39 ✓

Mass number of X = 16 + 16 = 32 ✓

Molar mass of $T_2X$ = 39 × 2 + 32 ✓ = 110g ✓

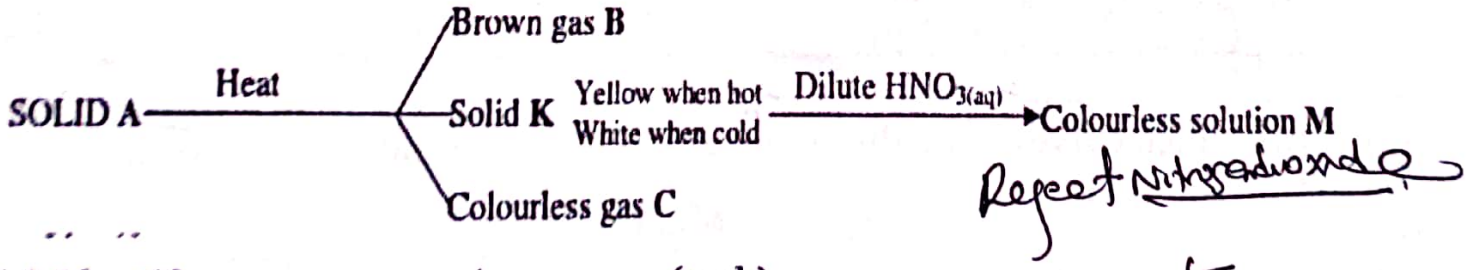
Reject the final answer with if gram is not indicated

(c) State two conditions under which the compound would conduct electricity (1mk)

When the compound is in molten state ✓

When the compound is in aqueous state ✓

(8) Study the flow chart below and answer the questions that follow




Reject Nitrogen dioxide

(a) Identify; (1mk)

i) gases C Oxygen gas ✓ Accept $O_2$ and B Nitrogen dioxide gas ✓ Accept $NO_2$.

ii) Ions likely to be presented in solid A (1mk)

Zinc ion ✓ or $Zn^{2+}$ ✓ ; nitrate ion ✓ or $NO_3^-$

(b) Write chemical equation for reaction that

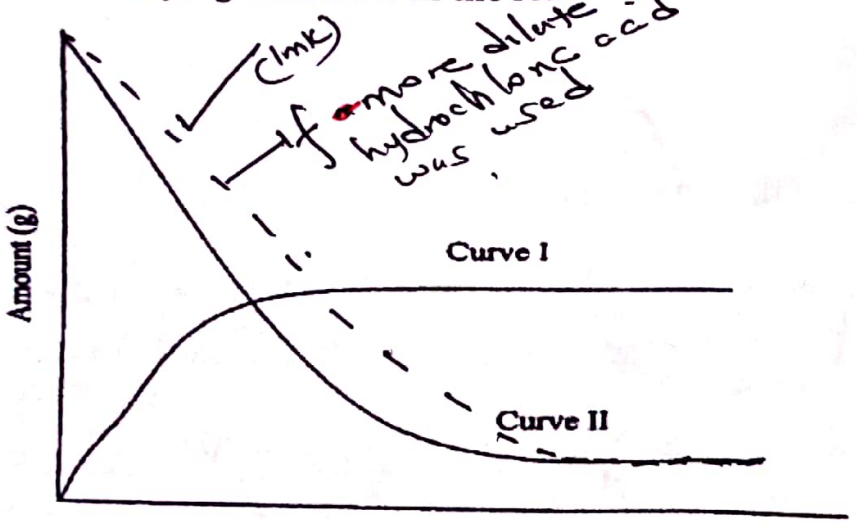
(i) led to formation of solid K (1.5 mks)

$2Zn(NO_3)_{2(s)} \xrightarrow{heat} 2ZnO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(ii) occurred between solid K and dilute nitric acid (1.5mks)

$ZnO_{(s)} + 2HNO_{3(aq)} \longrightarrow Zn(NO_3)_{2(aq)} + H_2O_{(l)}$

(9) The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reactions:




(1mk)

If more dilute hydrochloric acid was used.

(a) What is meant by the term 'rate of reaction' (1mk)

Is the measure of change in amount of reactants used per unit time

Accept other correct responses.

R/J if rate appears in the definition

(b) Write an equation for reaction between calcium carbonate and dilute hydrochloric acid (1.5 mks)

$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

Accept ionic equation.

(c) (a) Which curve shows the amount of calcium chloride varying with time? (0.5 mks)

Curve I

(d) (b) Explain why the two curves become horizontal after a given period of time. (1mk)

For curve I: no more calcium chloride is being formed

For curve II: no more calcium carbonate is being used or all the calcium carbonate has reacted.

OR: The reaction between calcium carbonate and dilute hydrochloric acid to form calcium chloride stops after some time when one or both reactants are used up thus curves become horizontal

(e) (c) Sketch on the graph how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution (1mk)
See the graph.

(10) The setup below was used in the electrolysis of dilute copper (II) nitrate solution

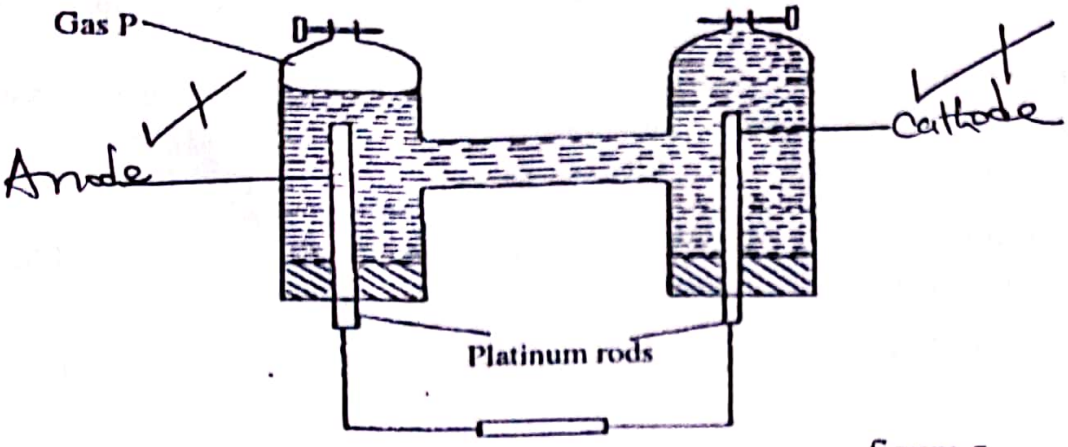



figure 5

(a) What is meant by the term electrolysis? (1mk)
Is the decomposition of an electrolyte in aqueous or molten state by passing direct electric current through it OR Equivalent

Accept compound
Reject substance

(b) Show the anode and cathode on the diagram above (1mk) See the diagram

(c) Explain how you would confirm gas P (1mk)
By lowering a glowing splint into a gas jar containing gas P; the glowing splint relights confirming that gas P is oxygen

(d) Write the equation for the reaction occurring at

i) Anode (1mk)
$4\bar{O}H_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$

ii) Cathode (1mk)
$Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$

Award ½ if states are wrong or missing for (a) equation

Deny all if symbols & charges are wrong.

of Cu not Cu

SECTION B (ATTEMPT ANY TWO QUESTIONS)

11. (a) Sodium metal is extracted by the electrolysis of molten sodium chloride to which calcium chloride has been added before heating is done.

i) Give a reason for the addition of calcium chloride. (1mk)
ii) Name a material that can be used as the cathode and another that can be used as the anode (1mk)
iii) Write equations for the reactions that take place at each electrode. (2mks)
iv) Describe how the product at the cathode is collected (1mk)
v) Name one other metal that can be extracted by a similar method (1mk)

(b) Name a place in Uganda where a plant for the extraction of sodium could be constructed. Give a reason for your answer. (2mks)

(c) State what would be observed and write equation(s) for reaction(s), if a small piece of sodium metal

i) was heated and quickly plunged into a gas jar of oxygen. (3mks)
ii) was dropped in trough which is half filled with water (4mks)

12. (a) Chlorine can be prepared in the laboratory from an acid and an oxide.

i) Name the acid and the oxide used in the preparation of chlorine. (1mk)
ii) State the conditions for the reaction. (1mk)
iii) Write an equation for the reaction which takes place between the acid and the oxide you have named in (i). (1.5mks)

(b) (i) Draw a labelled diagram to show the preparation of anhydrous iron(III) chloride using chlorine. (4 mks)

(ii) State what would be observed during the preparation. (1.5mks)

(iii) Write an equation for reaction leading to the formation of iron(III) chloride. (1.5mks)

(c) (i) State what would be observed if aqueous ammonia was added to a solution of iron(III) chloride. (1mk)

(ii) Write an ionic equation for the reaction in (c)(i). (1.5mks)

(d) State two industrial uses of chlorine gas (2mks)

(13) (a) Describe the structure of graphite (diagram required). (5.5mks)

(b) State two properties in which graphite differs from diamond. (02 mks)

(c) Graphite was heated in excess air and the gas given off passed through aqueous calcium hydroxide for a long time.

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

(ii) Write equation(s) for the reaction(s) (03 mks)

(iii) Carbon monoxide reacts with iron(III) oxide according the following equation: $Fe_2O_3(s) + 3CO\ (g) \rightarrow 2\ Fe(s) + 3CO2\ (g)$

If excess carbon monoxide was passed over 3.5 g of hot iron(III) oxide, calculate the volume of carbon dioxide evolved at s.t.p. (3.5 mks)

14(a) Explain how sulphuric acid is manufactured at industrial scale (7mks)

(b). Describe the reaction of sulphuric acid with;

i) Carbon (3mks)
ii) Magnesium oxide (3mks)

(c). Describe the confirmatory test for the anion in dilute sulphuric acid (2mks)

END

-1

# QUESTION 11

(a) i) To lower the melting point of sodium chloride from about 800°C to 600°C

Ignore

ii) Cathode: steel OR Iron

Anode: Graphite OR Carbon

iii) Anode: $2Cl^-_{(l)} \longrightarrow Cl_{2(g)} + 2e$

cathode: $Na^+_{(l)} + e \longrightarrow Na_{(l) \text{ or } (s)}$

iv) Molten sodium collects in the inverted trough placed over the cathode, rises up the pipe and tapped off and collected in a tank filled with nitrogen

v) Potassium OR

- Aluminium
- Calcium
- Magnesium

Equivalent

(b) Shores of lake Katwe in Kasese

Reason: There is abundant rocksalt in the area.

(c) i) Silvery white solid burns with a bright yellow flame forming a pale yellow solid

$2Na_{(s)} + O_{2(g)} \longrightarrow Na_2O_{2(s)}$

ii) A silvery white solid floats, melts to a silvery ball and darts about the water. hissing sound is produced; silvery ball becomes smaller in size and colourless solution is finally formed

$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$

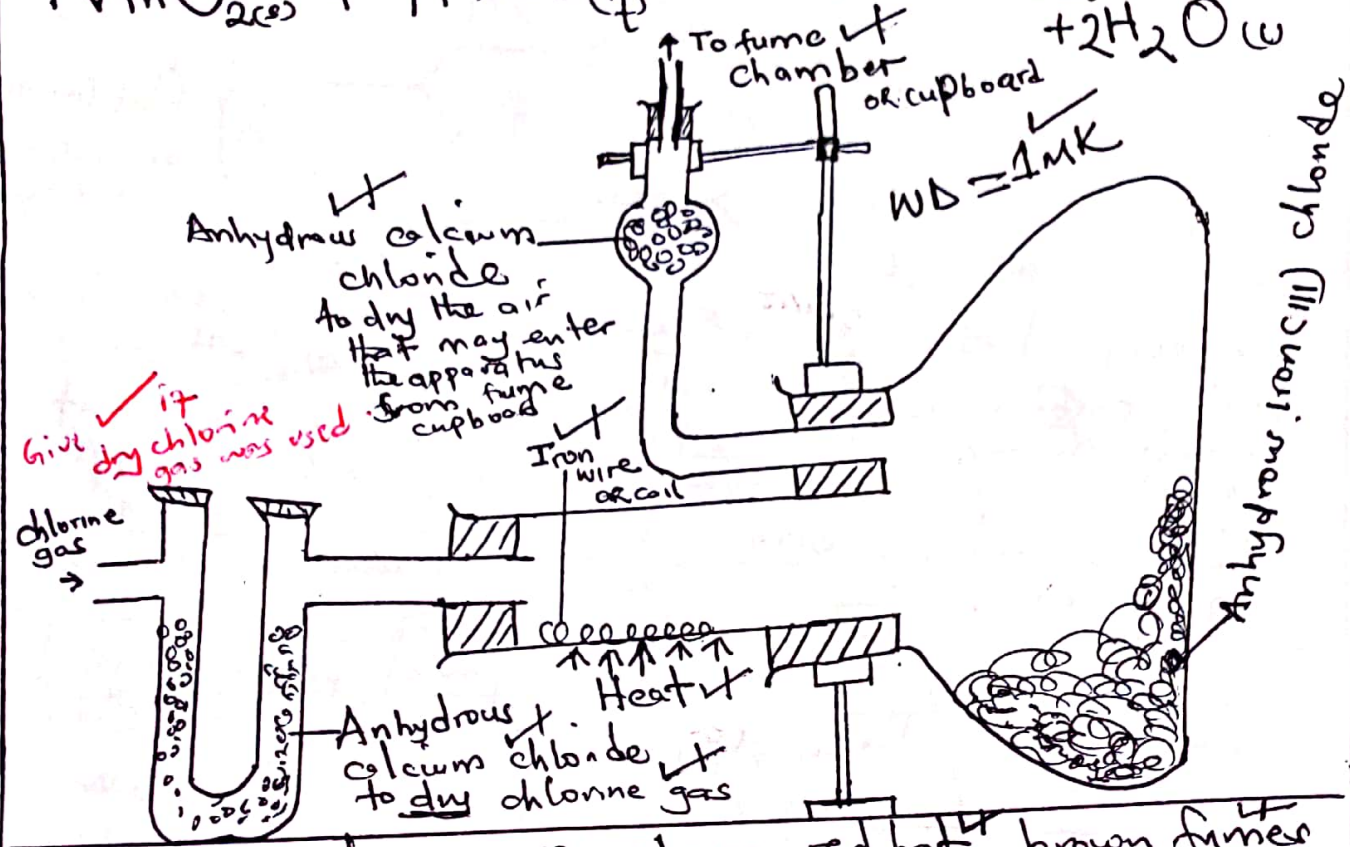
# Question 12.

a) i) Concentrated hydrochloric acid and manganese(IV) oxide
Ignore conc
Reject manganese (IV) oxide
Accept lead (IV) oxide OR Trilead tetraoxide

ii) Hydrochloric acid should be concentrated
Mixture of manganese(IV) oxide and concentrated hydrochloric acid should be heated

iii) $MnO_{2(s)} + 4HCl_{(aq)} \rightarrow MnCl_{2(aq)} + Cl_{2(g)} + 2H_2O_{(l)}$

b) (i)




ii) Grey iron wire | grey wire glows red hot, brown fumes are produced which are deposited as black crystals in the flask

iii) $2Fe_{(s)} + 3Cl_{2(g)} \rightarrow 2FeCl_{3(s)}$

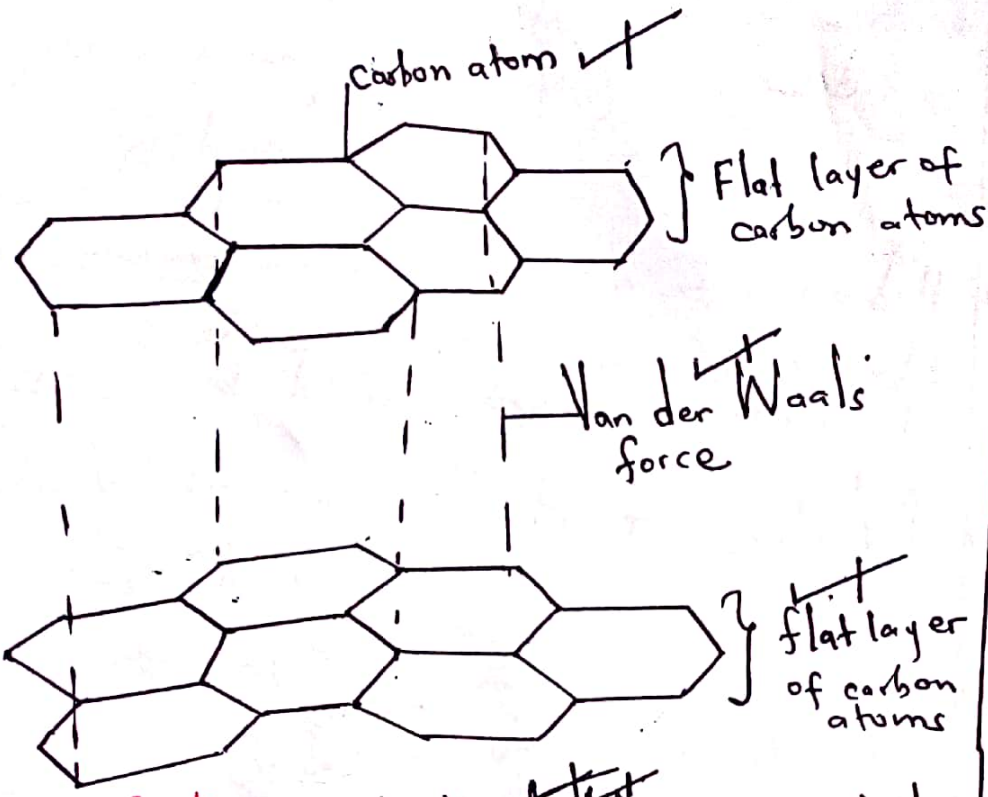
c) i) Reddish brown precipitate; Accept Brown precipitate

ii) $Fe^{3+}_{(aq)} + 3\bar{O}H_{(aq)} \rightarrow Fe(OH)_{3(s)}$

d) Manufacture of hydrochloric acid
manufacture of antiseptics such as sodium hypochlorite
bleaching agents
Accept other correct alternatives
Reject if words like prepare are used.

# QUESTION 13

13 (a)




Graphite has a giant covalent structure in which each carbon atom is joined to three other carbon atoms by covalent bonds, each at equal distance from the first carbon atom. The remaining one electron is delocalised in the whole structure making graphite electrically conductive. The carbon atoms form layers with a hexagonal arrangement of atoms. The layers are held together by weak Van der Waals force of attraction allowing layers of graphite to slide past each other (5½)

(b)

| Graphite | Diamond |
|---|---|
| • Has average density of $2.3 g cm^{-3}$ | • Has average density of $3.5 g cm^{-3}$ |
| • Black and opaque | • Colourless and transparent |
| • Very soft | • Extremely hard |
| • Conduct electricity | • Doesnot conduct electricity |

(02) (Any two)

13 c) i) White precipitate which dissolves in excess carbon dioxide forming a colourless solution

ii) $Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$

$CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)} \rightarrow Ca(HCO_3)_{2(aq)}$

iii) RFM of $Fe_2O_3 = 56\times2 + 16\times3$

$= 160$

160g of iron(III) oxide contain 1 mole

3.5g of iron(III) oxide contain $\left(\frac{1}{160} \times 3.5\right)$ moles

0.021875 moles

From the equation

1 mole of iron(III) oxide produced 3 moles of carbon dioxide

0.021875 moles of iron(III) oxide produced $\left(\frac{3}{1} \times 0.021875\right)$ moles of carbon dioxide

$= 0.065625$ moles of carbon dioxide

1 mole of carbon dioxide at stp occupies 22.4 litres

0.065625 moles of carbon dioxide at stp occupy $\left(\frac{22.4 \times 0.065625}{1}\right)$ litres

$= 1.47$ litres

# QUESTION 14

a) Sulphur is burnt in excess oxygen to produce sulphur dioxide

$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$

MAX 7

- Sulphur dioxide is purified (or cleaned) to remove impurities which may poison the catalyst making it ineffective
- Sulphur dioxide is then dried; and mixed with dry oxygen and passed a long heated pipes containing pellets of Vanadium(V) oxide (catalyst) at a temperature of 450°C - 500°C (low temperature) under a pressure of 2-3 atmospheres (high pressure) and sulphur trioxide is formed

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

(Accept full arrow)

- Sulphur trioxide is dissolved in concentrated sulphuric acid to form Oleum

$$SO_{3(g)} + H_2SO_{4(l)} \longrightarrow H_2S_2O_{7(l)}$$

Oleum is carefully diluted with correct amount of water forming ordinary concentrated sulphuric acid

$$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(aq)}$$

b) i) Hot concentrated sulphuric acid oxidises carbon to carbon dioxide and itself is reduced to sulphur dioxide and water

$$C_{(s)} + 2H_2SO_{4(l)} \longrightarrow CO_{2(g)} + 2SO_{2(g)} + 2H_2O_{(l)}$$

ii) Dilute sulphuric acid reacts magnesium oxide at room temperature forming magnesium sulphate and water.

$$MgO_{(s)} + H_2SO_{4(aq)} \rightarrow MgSO_{4(aq)} + H_2O_{(l)}$$

c) To 2cm³ (ignore) of dilute sulphuric acid is added 2cm³ of barium nitrate solution; White precipitate forms that confirms the presence of sulphate ion in dilute sulphuric acid

(Accept $BaCl_2$ soln + $Pb(NO_3)_2$ soln)

Ag Ans