Name: .....

Index No. .....Signature: ....

545/2
Chemistry
Paper 2
2 hours

Nov/Dec 2020

KAMSSA JOINT MOCK EXAMINATIONS

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 these questions MUST be written in the spaces provided.

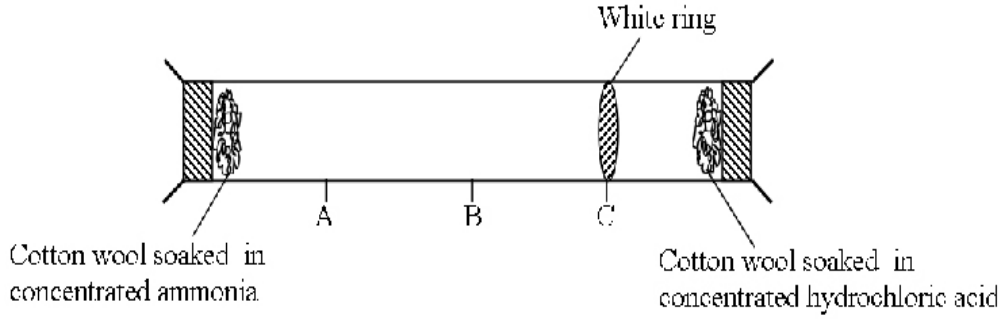
SECTION B - Consists of 4 semi-structured questions. Attempt any two questions from this section. Answers to the question must be written in the answer booklets provided.

(1 mole of gas occupies 24litres at room temperature) (1 mole of gas occupies 22.4l at s.t.p)

SECTION A

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

1. (a) The diagram below shows an experiment used to investigate diffusion process.



(i) Write an equation for the reaction leading to the formation of white ring.

$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$.

.....

(ii) Why is the white ring formed at position C but not hat A or B.

This is because ammonia gas diffuse faster than hydrogen chloride gas hence moved longer distance thus forming a white ring at position C .

.....

(b) A sample of the white ring was dissolved in water and to the resultant solution, Lead (II) nitrate solution was added.

(i) State what was observed.

.A white precipitate dissolved on boing and re-appeared on cooling

.....

.....

(ii) Write an equation for the reaction that took place between Lead (II) nitrate and the solution.

. $Pb^{2+}(aq) + 2Cl^{-}(aq) \longrightarrow PbCl_2(s)$

.....

.....

2. (a) What is meant by the following:

(i) a conductor,

This is a substance which allows passage of electricity.

.....

.....

(ii) an electrolyte.

..This is a compound in solution of molten form which conduct electric current

.....

(b) Name the particles which conduct electricity in;

(i) Liquids

. Ions.....

(ii) Solids

.....electrons.....

(c) Dilute copper (II) chloride solution was electrolysed using graphite electrodes; Identify the substances formed at the;

(i) Anode

.....Oxygen gas.....

(ii) Cathode

.....Copper solid deposited.....

(d) Write an equation for the reaction at the cathode.

$Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$

(e) State any one application of electrolysis process.

- Production of sodium hydroxide from electrolysis of brone.
- Refining of copper
- Electroplating
- Anodising of Aluminium
- Production of chlorine
- Production of energy

3. (a) When an hydrous Iron (II) sulphate was heated strongly, a gas X which turned acidified Potassium dichromate solution green was formed.

(i) Identify gas X.

.....Sulphur dioxide gas.....

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

$2FeSO_4(s) \xrightarrow{heat} Fe_2O_3(s) + SO_3(g) + SO_2(g)$

(b) The residue formed in (a) was dissolved in dilute hydrochloric acid.

(i) State what was observed.

A yellow solution was observed.....

(ii) Write an equation for the reaction that took place.

$Fe_2O_3(s) + 6HCl(aq) \longrightarrow 2FeCl_3(aq) + 3H_2O(l)$

(c) The resultant solution in (b) was added ammonia solution dropwise until in excess.

(i) State what was observed.

. Green precipitate insoluble in excess ammonia and turns brown on standing.....

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

$Fe^{2+}(aq) + 2OH(aq) \longrightarrow Fe(OH)_2(aq)$

4. A hydro carbon Q with vapour density 14, contains 4.8g of carbon and 0.8g of hydrogen.

(a) What is a hydrocarbon?

This is a substance that contain carbon and hydrogen only.....

(b) Determine the;

(i) empirical formula of Q.

Elements	C	H
mass composition	4.8	0.8
No. of moles	$\frac{4.8}{12}$	$\frac{0.8}{1}$
	0.4	0.8

mole ratio $\frac{0.4}{0.4} = \frac{0.8}{0.4}$

1 = 2

The empirical formular is CH2

(ii) molecular formula of Q.

Using (empirical formula)n = molecular mass

But molecular mass = 2 x vapour density

$(CH_2)n = 2 \times 14$

$(12 + 1 \times 2)n = 28$

$14n = 28$

$n = \frac{28}{14}$

$n = 2$

molecular formular is C_2H_4

(c) (i) Name the reagent used to test for substance Q.

Bromine water

Acidified or alkaline potassium manganate(vii)

(ii) State what would be observed.

The reddish brown colour of bromine water is turned colourless.

or The purple colour of acidified potassium manganate(vii) turns colourless.....

.....

(iii) Write equation for the reaction that took place.

. Br_2/H_20

. $H_2C=CH_2$ ..... $BrCH_2CH_20H$

OR $Mn04/0H$

$H_2C=CH_2 \xrightarrow[Heat]{} H0CH_2CH_20H$

5. (a) In each case, state what would be observed if aqueous Lead (II) nitrate added to;

(i) dilute sulphuric acid

...White precipitate is formed which does not dissolve on boiling.....

.....

(ii) sodium iodide solution

.....Bright yellow precipitate would be observed.....

.....

(iii) Sodium chloride solution

...A white precipitate formed which dissolves on boiling and recystallises on cooling.

.....

(b) Write ionic equation for the reaction in

(i) (a)(i) above

.....

$.....Pb^{2+}(aq) + SO_4^{2-}(aq)$ ..... $PbSO_4(s)$

.....

(ii) (a)(ii) above

.....

$.....Pb^{2+}(aq) + I^{-}(aq)$ ..... $PbI_2(s)$.....

6. When aqueous ammonia was added dropwise to a solution containing Zinc Sulphate, until in excess.

(a) (i) State what would be observed.

.White precipitate soluble in excess ammonia forming a colourless solution.....

.....

(ii) Write equation(s) for the reactions that took place.

. $Zn^{2+}(aq) + 0^{-}H$ ..... $Zn(0H)_2(s)$.....

.....

$Zn(0H)_2(s) + 4NH3(aq) \longrightarrow Zn(NH_3)_4^{2-}(aq) + 20\bar{H}(aq)$

.....

(b) (i) Name a reagent that can be used to identify the sulphate ions in solution.

Nitric acid followed by Barium nitrate solution.....

(ii) State what would be observed when the reagent you have named in (b)(i) is used.

.....A dense white precipitate is formed..... .....

(iii) Write ionic equation for the reaction that took place.

.....

..... $Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$ .....

.....

7. (a) (i) Name one process by which ethanol can be produced from sugar.

.....fermentation.....

(ii) Write equation for the production of ethanol by the process you have named in (a)(i).

..... Zymase.....

.....$C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(l) + 2CO_2(g) + Heat$

.....

(b) Ethanol can be converted to ethene by dehydration.

(i) State the conditions under which the reaction takes place.

concentrated sulphuric acid.....

.....High temperature of 170°c - 180 °c .....

.....

(ii) Write equation for the reaction leading to the formation of ethene from ethanol.

.....concetrated H_2SO_4.....

$C_2H_5OH(l) \longrightarrow C2H_4(g) + H_2O(l)$ .....

..... 170°c - 180 °c.....

(c) Write equation for the reaction between ethene and bromine.

.....Br2.....

.....$H_2C=CH_2 \longrightarrow BrCH_2CH_2Br$ .....

.....

8. (a) Define the term enthalpy of neutralization.

This is the heat change that occurs when an acid reacts with a base to produce one mole of water.....

(b) $25cm^3$ of 2.0M sodium hydroxide was added to $25cm^3$of 2.0M hydrochloric acid in a plastic beaker and the temperature of the resultant solution rose from 24.9^0C to 37.4^0C.

(i) State whether the reaction is endothermic or exothermic and give a reason for your answer.

. It is exothermic because it gives off heat to the surrounding (there is a rise in temperature)

(ii) Calculate the molar heat of neutralisation of sodium hydroxide by hydrochloric acid (density of solution is $1g/cm^3$, shc of solution is $4.2kJg^{-1}\,^oC$)

Temperature change = $(37.4 - 24.9)\,^oC$

$= 12.5\,^oC$

Heat change = mass of solution x specific heat capacity x temperature change

$= [(25 + 25) \times 1\ 4.2 \times 12.5]J$

$= (50 \times 4.2 \times 12.5)J$

$= 2625J$

moles of sodium hydroxide

$1000cm^3$ of solution contain 2 moles of sodium hydroxide

$25cm^3$ of solution contain $\frac{2.0 \times 25}{100}$ moles of Na0+1 = 0.05moles

0.5 moles of sodium hydroxide produce 2625J

1 mole of sodium hydroxide produce $\frac{2625}{0.05}J$ = 52500J

OR $\frac{52500}{1000}$ = 52.5KJ

9. A hydrated salt T, consists of 20.2% Iron, 11.5% sulphur, 23% oxygen and 45.3% water crystallisation.

(a) Calculate the empirical formula of T.
(Fe = 56, S = 32, O = 16, H = 1)

Elements	Fe	S	0	H20
percentage composition	20.2	11.5	13	45.3
No. of moles	$\frac{20.2}{56}$	$\frac{11.5}{32}$	23 / 16	$\frac{45.3}{18}$
	0.36	0.359	1.437	2.517

Mole ratio
$\frac{0.361}{0.359} : \frac{0.359}{0.359} : \frac{1.437}{0.359} : \frac{2.517}{0.359}$
1 : 1 : 4 : 7
The empirical formular of T is
FeS04. 7H20

(b) Determine the moleclar formula of T. (rfm of T = 278)

(Empirical formular)n = molecular mass
(FeS04.7H20)n = 278
(56 + 32 + (16 x 4) + 7(1x2+16) n = 278
278n = 278

n = $\frac{278}{278}$ = n =1
The molecular formular is
FeS04.7H20

(c) Write equation for the reaction between a solution of T and chlorine.

$2Fe^{2+}(aq) + CL2(g) \longrightarrow 2Fe^{3+}(aq) + 2CL^{-}(aq)$

10. (a) Complete the following equations.
(Your equations should be balanced)

(i) $2NaNO_3 \xrightarrow{heat}$ 2NaN0_2(s) + 02(g).....
....

(ii) $2Pb(NO_3)_2 \xrightarrow{heat}$ 2Pb0(s) + 4N0_2(g) + 0_2(g).....

(iii) $2AgNO_3 \xrightarrow{heat}$ .2Ag(g) + 2N0_2(g) + 0_2(g) .....

(b) Concentrated nitric acid was added copper metal and the mixture heated.

(i) State what hwas observed.
The mixture decomposed producing brown fumes of a gas colourless gas that relights aglowing splint and leaving black powder.....

(ii) Write an equation for the reaction.
Cu(s) + 4H$N0_3$(aq) $\longrightarrow$ Cu($N0_3$)$_2$ (aq) + 2N0_2(g) + 2H$_2$0(l)

2Cu($N0_3$)$_2$ (s) $\longrightarrow$ 2Cu0(s) + 4N0_2(g) + 0_2(g)

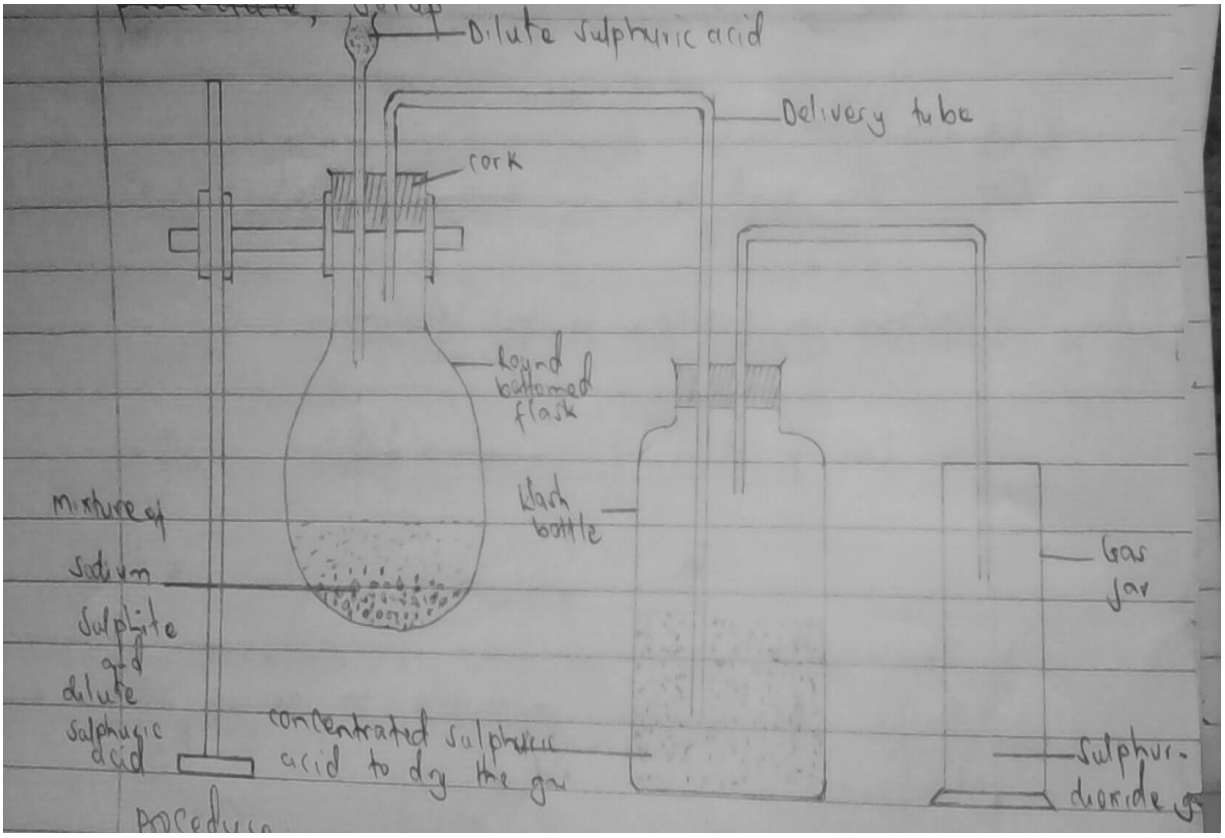
11 (a) (i)

Preparation of a dry sample of sulphurdioxide gas in alaboratory using sodium sulphite and sulphuric acid.

Apparatus and materials

- round bottomed flask
- Concentrated sulphuric acid
- Thistle funnel
- retort stand
- delivery tube
- cork
- Sodium sulphite
- Dilute sulphuric acid/ Dilute hydrochrolic acid
- Gas jar.

Set up.



Procedures:

- sodium sulphite is put in the round bottomed flask and the apparatus is arranged as shown above.
- Dilute sulphuric acid or dilute hydrochrolic acid is added to it through thistle funnel.
- The gas is then passed through a wash bottle containing concentrated suphuric acid to dry it and it is collected by downward delivery since it is denser than air.

(ii)

Equation.

$Na_2S0_4(s) + H_2s0_4(aq) \longrightarrow Na_2S04(aq) + S0_2(g) + H_20(l)$

OR

$Na_2S0_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + S0_2(g) + H_20(l)$

(b) Reagent used to confirm presence of sulphurdioxide

Acidified potassium dichromate (vi) solution.

Observation:

The solution changes colour from orange to green.

(c) (i) With water

$S0_2(g) + H_20(l) \longrightarrow H_2S0_3(aq)$

(ii) oxgyen in presence of hot platinum:

$2S0_2(g) + 0_2(g) \longrightarrow 2S0_3(g)$

Observation

A white precipitate insoluble in excess solution was observed

(ii)

At first, sulphurtrioxide gas reacted with water forming sulphuric acid as indicated by the equation below.

$S0_3(g) + H_20(l) \longrightarrow H_2S0_4(aq)$

the sulphate ions from sulphuric acid reacted with the barium sulphate observed as on a white precipitate insoluble in excess.

Equation:

$Ba^{2-}(aq) + S0_4^{-2}(aq) \longrightarrow BaS0_4(s)$

12 (a)

Ore of iron.

Haematile, Fe_20_3

Magnetile $Fe30_4$

Iron pyrite FeS_2

Sederite/ Spathic iron $FeC03$

Limonite $Fe_20_3.XH_20$

(b) (i) Role of coke.

it reacts with very hot air introduced into the blast furnace forming carbondioxide gas.

$C(s) + 0_2(g) \longrightarrow C0_2(g)$

The carbondioxide gas produced is reduced by the excess coke to produce carbonmonoxide

$C0_2(g) + C \longrightarrow 2C0(g)$

Carbon monoxide formed reduces the iron ore at a high temperature (about 1000

c) to form

iron metal.

$4C0(g) + Fe30_4(s) \longrightarrow 3Fe(s) + 4C0_2(g)$

The malten iron formed sinks to the bottom of the blast furnace where it is tapped and solidified into blocks of p.g iron.

(ii) The role of limestone

limestone removes silicon (iv) oxide which is the main impurity in the iron ore. Limestone at high temperature decomposes to form calcium oxide and with silicon (iv) oxide to form malten calcium silicate (slag)

Equations:

$CaC0_3(s) \xrightarrow{\text{Heat}} CaC0(s) + C02(g)$

$Ca0(s) + Si0_2(s) \longrightarrow CaSi0_3(s)$

the slag being less dense than iron forms a separate layer above iron thus are tapped seperately.

(c) Cast iron which is hard, brittle and with low melting point is used to make water pipes, burner bases, cookers, wrought iron which is tough, malleable and ductile is used to make iron nails, sheetings, ornamental work, horse shoes and agricultural implements. Steel is used in properties depend on the amount of carbon present is used in construction of buildings, bridges, car bodies cutting and boring fools, crushing machines and stainless cutlery such as knives, forks e.t.c

(d) $H_2S0_2(aq) + Fe(s) \longrightarrow FeS0_4(aq) + H_2(g)$

(e) It gave off a clourless gas that turned potassium dichromate solution from yelow to green, white fumes and a brown residue was left.

Equation:

$2FeS0_4(s) \xrightarrow{\text{Heat}} Fe_20_3(s) + S0_3(g) + S0_2(g)$

13 (a)

Preparation of a dry sample of hydrogen gas

Zinc granules are placed in the flat bottomed flask.

A little copper (ii) suphate solution is added to the granules in the flask to ack as a catalyst.

Dilute suphuric acid or hydrochloric acid is added to the granules through the thistle funnel.

Effervescence occurs as hydrogen gas is produced.

The gas is then passed through a wash bottle containing concentrated sulphuric acid to dry it and collected by upward delivery method.

OR:

it can be passed through a u-tube containing fused calcium chloride to dry the gas.

Equation:

$Zn(s) + H2S0_4(aq) \longrightarrow ZnS0_4(aq) + H2(g)$

OR:

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H2(g)$

(b) (i) L Is water

(ii) Reagent: Anhydrous copper (ii) sulphate

Observation: when L is added to anhydrous copper

(iii) sulphate, It changes colour from white to blue.

OR

Reagent: Cobalt chloride paper

Observation: When L is added to cobalt chloride

Paper, It changes colour from blue to pink.

(c) Equation; sunlight

$H_2(g) + Cl_2(g) \longrightarrow 2HCl\ (g)$

(d)

Conditions under which hydrogen can react with copper(ii) oxide

Dry hydrogen gas should be used.

The copper (ii) oxide should be heated in a combustion tube.

Equation:

$Cu0(s) + H_2(g) \longrightarrow Cu(s) + H_20(l)$

(e)

From the equation;

3 moles of iron are produced by 4 moles of hydrogen gas.

(3 x 56)g of iron are produced by (4 x 24)dm^3 of hydrogen.

1g of iron would be produced by $\frac{(4 \times 24)}{(3 \times 56)} dm^3$ of hydrogen

3.36g of iron would be produced by $\frac{(4 \times 24 \times 3.36)}{(3 \times 56)} dm^3$ of hydrogen

$= \frac{(96 \times 3.36)}{168} dm^3$

$= 1.92\ dm^3$ of hydrogen.

The volume of hydrogen measured at room temperature that would be required to produce 3.3g of iron is 1.92dm^3 or 1920cm^3

(f) Industrial use of hydrogen.

- used in the manufacture of ammonia by harber process.
- it is used in hydrogenation of vegetable oil making it hard and used for making margarine and cooking fats like blue band and kimbo.
- Used in the manufacture of hydrogen bombs.

14

(a) The rate of reaction can be determined by change in mass as outlined below.

Procedurs:

A flask containing a known volume of hydrochloric acid is weighed using a direct reading balance.

A known mass of calcium carbonate in powder form is added carefully and a rubber bung carrying glass tubing with cotton wool is immediately inserted to close the flask.

A stop clock is started at the same time.

- In another set up (Control set up), calcium carbonate inform of marble chips is used.
- The mass of the flask and its contents is recorded at a regular interval of time.
- the results are then plotted on the graph.

Observation:

rate of reaction is higher when calcium carbonate inform of powder is used and even stops within a short time, due to its large surface area compared to when marble chips are used.

OR:

Alternatively the rate of reaction can be determined by change in gas volume.

Procedure:

- A known volume of dilute hydrochloric acid is put in the flask and a know mass of calcium carbonate powder is added. In another set up, marble chips are used to act as a control experiment.
- a rubber bung is connected to the gas syringe is immediately inserted to close the flask. The stop clock is started at the same time the flask is closed.
- The volume of carbondioxide gas collected in the syringe is read and recorded after time interval until the reaction stops.
- The volume of carbondioxide gas evolved is then plotted against time.

(b) (i)

rate of reaction after 15 minutes = 50g

rate of raectio after 27.5 minutes = 28g

The rate of reaction after 15 minutes is higher compared to the one after 27.5 minutes.