**s Name…………………………………………………….Index No…………………./…………**

**School…………………………………………Adm No…………………Stream………………**

**Date………………………………………………………Sign…………………………………..**

233/2

**CHEMISTRY**

Paper 2

(THEORY)

NOVEMBER/DECEMBER 2021

**TIME: 2 HOURS**

**SAMIA SUB-COUNTY JOINT EXAMINATION-2021**

***Kenya Certificate of Secondary Education (K.C.S.E) Trial Examination***

**CHEMISTRY**

**PAPER 2**

**MARKING SCHEME**

**INSTRUCTIONS TO CANDIDATES**

* *Write your* ***name****,* ***School*** *and* ***Index Number*** *in the spaces provided above.*
* ***Sign*** *and* ***write date*** *of examination in the spaces provided above.*
* *Answer* ***ALL*** *questions in the spaces provided.*
* *Mathematical tables and silent non-programmable electronic calculators may be used.*
* *All working* ***MUST*** *be clearly shown where necessary.*
* *Candidates should answer the questions in* ***English***
* *Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing*
* *This paper contains 9 printed pages*

**For Examiner’s Use Only**

|  |  |  |
| --- | --- | --- |
| **Questions** | **Maximum score** | **Candidate’s Score** |
| **1** | **12** |  |
| **2** | **10** |  |
| **3** | **13** |  |
| **4** | **11** |  |
| **5** | **11** |  |
| **6** | **11** |  |
| **7** | **12** |  |
| **Total** | **80** |  |

1. The information below relates to element N, P,Q, Rand S . Study it and answer the questions that follow. The letters are not the actual symbols for the elements.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Atomic radius(mm) | Ionic radius(mm) | Formula of oxide | Melting point of oxide |
| N | 0.364 | 0.421 | N2O | -119 |
| P | 0.830 | 0.711 | PO2 | 837 |
| Q | 0.592 | 0.485 | Q2O3 | 1466 |
| R | 0.381 | 0.446 | R2O5 | 242 |
| S | 0.762 | 0.676 | SO | 1054 |

1. Name the elements that are metal. **Give** a reason. (2mks)

* PQRS; Ionic radius is smaller than atomic radius

1. Compare the melting points of the oxides of S and R in terms of structure and bonding. (2mks)

* S has higher melting point than R; SO has a simple molecular structure(or in terms of bonds)

1. Name the pair of elements that would react most vigorously with each other?

**Explain**  (2mks)

* P and N; P is a metal with the smallest atomic radius ;
* N is a non-metal with the smallest atomic radius

1. The table below has information about chlorides of elements in period 3 of the periodic table:

**Sulphur to sulphur**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Chloride** | NaCI | MgCI2 | AICI3 | SiCI4 | PCI5 |
| **Melting point (oC)** | 801 | 712 | Sublimes at 183 | -70 | -80 |

What are the possible PH values of the solutions formed when the following chlorides are dissolved in water? Explain

**MgCI2**  (1mk)

* PH 7.0; a chloride of group II element.

**AICI3**  (1mk)

* PH 3.0; It hydrolyses in water to form HCI acid.

1. The molecular formula of Aluminum chloride is AI2CI6. Draw the structural (not dot and cross diagram) of Aluminum chloride indicating clearly the different types of bonds present. (2mks)

CI CI CI

AI AI

CI

CI CI

1. Using dot ( ) and cross (×), draw a diagram to show bonding in sodium chloride. (Na=11, CI=17) (2mks)

+ -

Na CI

2. What is the molar enthalpy of neutralization? (1mk)

* The enthalpy change/ heat change when one mole of H+ ions react with one mole of OH- ions to form one mole of water; OWTTE

1. In order to determine the molar heat of neutralization of sodium hydroxide, 100cm3 of 1M sodium hydroxide and 1M of hydrochloric acid both at the initial temperature were mixed and stirred continuously using a thermometer. The temperature of the resulting solution was recorded after every 30seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for a further two minutes.
2. Why was it necessary to stir the mixture of the two solutions? (1mk)

* To obtain a uniform mixture of reagents; uniform distribution of heat;

1. Write an ionic equation for the reaction that took place. (1mk)

H+(aq) + OH-(aq) H2O(I)

H3O+(aq) + OH-(aq) 2H2O(l)

Penalise ½mk for missing SS

1. The sketch below was obtained when temperature of the mixture was plotted against time. Study it and answer the questions that follow.

Y2

Y3

Temperature (oC)

Y1

Time (**Seconds**)

Explain the temperature changes between points

**Y1 and Y2** (1mk)

Reaction is taking place ; producing heat;/Reaction is exothermic;

**Y2 and Y3**  (1mk)

Reaction has come to an end; the mixture is cooling;

1. If the initial temperature for both solution was 25oC and the highest temperature was 31.4oC for the mixture. **Calculate;**

Heat change for the reaction (Specific heat capacity of solution=42Hg-1K-1, Density of the solution =1gcm-3) (2mks)

DT=31.4-25=6.4oC

Heat change =200×6.4×4.2

=5376J//5.376KJ

Molar heat of neutralization of sodium hydroxide. (2mks)

Moles of NaOH =100 ×1 =0.1Moles

1000

* 1. moles=5376

1mole=5376 × 1

* 1. 1000

=53.76KJ/Mole

1. **Explain** how the molar heat of neutralization obtained in this experiment would compare with one that would be obtained using 1.0M ethanoic acid and 100cm3 of 1M sodium hydroxide solution. (2mks)

* Lower; Ethanoic acid is partially ionized/dissociated;//week acid// fewer H+ions thus some energy is used to change the unionised molecules into ions first;

**Draw** an Energy level diagram for the reaction represented by reaction between hydrochloric acid and sodium hydroxide solution. (3mks)

H+(aq) +OH-(aq)

DH neutr. = +53.76KJMole-

Energy (KJ)

H2O(l)

Reaction path

1. Give the name of **one** reagent which when reacted with concentrated hydrochloric acid produces chlorine gas. (1mk)

* Potassium manganite(vii)//Manganese(iv)oxide//Lead (iv)oxide//Calcium hypochlorite

ALC KMnO4//MnO2/PbO2/CaOCI2

1. The set up below was used to prepare iron (III) chloride using the apparatus shown in the diagram below.

Guard tube

Iron fillings

Dry chlorine gas Iron(III) Chloride

Heat

1. State **one** precaution that should be taken in carrying out the above experiment. (1mk)

* The experiment should be carried out in a fume cupboard; CI2 should not be allowed to escape into the environment since it’s poisonous/toxic.

1. **Explain why**

**Calcium oxide would be preferred to calcium chloride in the guard tube.** (2mks)

CaO absorbs CI2 and moisture; while CaCI2 only absorb moisture;

CaO absorbs only CI2 award 1mark

CaCI2 absorbs only moisture

**It is necessary to pass chlorine gas through the apparatus before heating begins**. (2mks)

* To remove all air/oxygen; which would react with iron //form Iron (III) oxide; instead of Iron (III) Chloride.

1. Write a **chemical** equation for the reaction that took place in the guard tube.(1mk)

CaO(s) + H2O(l) Ca(OH)2(s)/(aq)

//CaO(s) + CI2(g) CaOCI2(s)

//Ca(OH)2(s) +CI2(g) CaOCI2. H2O(s)

1. What property of Iron (III) chloride makes it possible to be collected as shown in the diagram? (1mk)

* It sublimes

1. During the reaction in the combustion tube, the total mass of iron (III) chloride formed was found to be 1.5g. **Calculate** the volume of chlorine gas that reacted with iron. (Fe=56.0, CI=35.5 and molar gas volume at 298k is 24,000cm3) (3mks)

2Fe(s) +3CI2(g) 2FeCI3(s) Ignore ss

RFM of FeCI3=162.5

Moles of FeCI3 =1.5 =0.0092

16.3

Moles of CI2 =3/2 × 0.0092 =0.0138

Volume of CI2 =0.0138 × 24000

=332.31cm3

// 2Fe(s) +3CI2 2FeCI3(s)

3 × 24000=162.5 × 2

3×24000×15 =332.31cm3

162.5×2

1. **Draw** and **name** the structure of the compound formed when excess chlorine gas is reacted with ethane gas. (2mks)

CI CI

CI C C CI Account any other possible structure

CI CI Reject condense S.F

1. State **one** use of chlorine gas. (1mk)

* Manufacture of hydrochloric acid
* Treatment of Cvuter
* Manufacture of PVC Any other possible use

1. Give the systematic names for the following compounds

HCOOCH2CH3 (1mk)

* Propanoic acid/Propan –l-IOC acid

CH3CH2CH2CHCH2 (1mk)

* Pent -l-eneRj. Structural formular/ 1-pentene

CH C CH2 CH3 (1mk)

* But-l-yne RjS.F/l-Butyne

1. Study the flow chart below and use it to answer the questions that follow

Pro-I-ene

CI2(g)

M

Step I

Sodium metal

Products

Propan-ol

Step III

Step II

CH3CH2COOH

Na2CO3(s)

CH3CH2COONa(գ)

CO2(g)

H2O(i)

Mixture of Na OH and Ca(OH)2

Organic compound K

1. Identify the organic compound **K** (1mk)

Ethane

1. Write the formula of **M** H H H (1mk)

C3H6CI2 // H C C C H

H CI CI

Any other correct S.F

1. Give **one** reagent that can be used in

Step I (1mk)

* Water/steam/conc. Sulphuric (vi) acid; Rej. Dillute Sulphuri (vi)acid
* Sulphuric acid award ½ mark only

Step II (1mk)

* Acidified Potassium manganite (vii)/Acidified potassium chromate(vii)

H+(aq)/KMnO4(aq) H+(aq) /K2CrO7(aq)

1. Write the equations for the reaction in **step II** (1mk)

2CH3CH2CH2OH +2Na 2CH3CH2CH2ONa +H2

Ignore SS unless wrongly committed

1. The structure below represents a type of cleansing agent.

SO3-Na+

R

**Describe** how the cleansing agent removes grease from a piece of cloth. (3mks)

* Cleansing agent has a polar end / hydrophilic; and non-polar/hydrophobic end; polar end/ hydrophilic end; is attracted to water while non-polar/hydrophobic end; to grease; Results in formation of micelles//lower surface tension of water//emulsification of grease;

1. The set up below was used to collect gas F, produces by the reaction between water and calcium metal

Test tube

Gas F

Beaker

Calcium metal

Water

1. Name gas **F** (1mk)

Hydrogen;

1. At the end of the experiment, the solution in the beaker was found to be a week base. **Explain** why the solution is a weak base. (2mks)

* Ca(OH)2 formed is slightly soluble in water hence only a few OH- ions are produced in solution

1. Give **one** laboratory use of the solution formed in the beaker (1mk)

* Used for testing the presence of CO2 gas.

1. When excess calcium metal was added to 50cm3 of 2 M aqueous copper (II)nitrate in a beaker, a brown solid and bubbles of gas were observed.
2. Write **two** equations for the reactions which occurred in the beaker. (2mks)

Ca(s) +2H2O(l) Ca(OH)2 (aq)+H2(g)

Ca(s) + Cu(NO3)2(l) Ca(NO3)2(aq) +Cu(s)

// Ca(s) + Cu2+(aq) Ca2+(aq) +Cu(s)

1. **Explain** why it is not advisable to use sodium metal for this reaction. (2mks)

* The reaction is explosive /highly enothermic;
* Advice; sodium is more reactive than calcium

1. **Calculate** the mass of calcium metal reacted with copper(II)nitrate solution (Relative atomic mass of Ca=400 (2mks)

Moles of Cu(NO3)2 =50 × 2 =0.1moles

1000

Moles ratio from equation above= 1:1

Moles of Ca=0.1

Moles of Ca=0.1 × 40

= 4g

1. Write the **formula** of the complex Ion formed in each of the reactions below.
2. Lead metal dissolves in hot alkaline solution. (1mk)

2-

Pb(OH)4

1. Zinc hydroxide dissolves ammonia solution. (1mk)

2+

Zn(NH3)4

1. Give the name of each of the processes described below which takes place when the salts are exposed to air for some time.
2. Anhydrous copper (II) sulphate becomes wet. (1mk)

* Hygrosiopy

1. Iron (III) chloride forms an aqueous solution. (1mk)

* Deliquence

1. Fresh crystals of sodium carbonate decahydrate become covered with a powder of solution of carbonate monohydrate. (1mk)

* Efflorence

1. A certain hydrate salt has the following composition by mass. Iron 20.2%, sulphur 11.5%, water 45.5% and the rest oxygen. Its relative formula mass is 278.
2. **Determine** the formula of the hydrated salt (Fe=56,S=52, O=16, H=1) (3mks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Fe | S | O | H2O |
| % Composition | 20.2 | 11.5 | 22.8 | 45.5 |
| R.A.M | 56 | 32 | 16 | 18 |
| Ratio % | 20.2=0.36  56  0.36 =1  0.36 | 11.5=0.36  32  0.36 =1  0.36 | 22.8  16  1.43 =4  0.36 | 45.5 =2.5  18  2.5 =7  0.36 |

FeSO 4.7H2O

1. 6.95g of the hydrated salt were dissolved in distilled water and the total volume made to 250cm3 of solution. **Calculate** the concentration of the salt solution. (2mks)

6.95g in 250cm3

X=1000cm3

= 6.95 × 4000cm3 =0.1M

250cm3 × 278

1. The table below shows solubility of potassium nitrate and lead nitrate

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Temperature oC** | **0** | **20** | **40** | **60** | **80** | **100** |
| Solubility of KNO3 in 100g of H2O | 12.5 | 32.5 | 62.5 | 110.0 | 137.5 |  |
| Solubility of Pb(NO3)in 100g of H2O | 37.5 | 52.5 | 69.0 | 87.5 | 110.0 | 131.0 |

1. Draw the solubility curves for both salts on the same axis. (Temperature on the x-axis) (3mks)



1. A solution of lead nitrate contains 90g of the salt dissolved in 100g of water at 100oC. This solution is allowed to cool to 25oC

At what temperature will crystals first appear? (1mk)

60oC

What mass of crystals will be present at **25oC** (1mk)

90g-58=32g

Correct value of solubility at 25oC

1. Which of the **two** salts is more soluble at 30oC (1mk)

* Lead nitrate Pb(NO3)2

1. Determine the concentration of lead nitrate in moles per litre when the solubility of the two salts are the same. **(Pb=207.0, O=16.0, K=39.0, N=14.0)** (3mks)

Solubility of Pb(NO3)2 =75g/100water

Value read from the graph

Mass of P(NO3)2 in 100cm3=75 × 100

100

Value from graph × 100

100

=75g

Molar mass of Pb(NO3)2 =331

Conc. Of Pb(NO3)2 = 75 =0.2266M // answer (i) =answer(ii) M

331 331