**JOINT EXAM**

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

**MARKING SCHEME**

1. The following table gives information on four elements by letters **W**, **X**, **Y** and **Z.**
2. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Electron** **Arrangement** | **Atomic radius (mm)** | **Ionic radius (mm)** |
| **W** | 2.8.2 | 0.136 | 0.065 |
| **X** | 2.8.7 | 0.099 | 0.181 |
| **Y** | 2.8.8.1 | 0.203 | 0.133 |
| **Z** | 2.8.8.2 | 0.174 | 0.099 |

1. Which **two** elements have similar properties? Explain. (2mks)

***W & Z √1***

***They belong to the same group/group II elements/can lose 2 electrons/ have two valence electrons √1***

1. What is the most likely formula of the oxide of **X**. (1mk)

***X2O √1***

1. Which element is a non-metal? Explain. (2mks)

***X √1***

***Can gain one electron/group seven/ionic radius longer than atomic radius √1***

1. Explain the difference in the atomic radii of **Y** and **Z**. (1mk)

***Z has more protons than Y/ / z has a higher nuclear attraction than Y/Zhas a higher nuclear charge than Y √1***

1. The table below shows the two properties of two chlorides

|  |  |  |
| --- | --- | --- |
| **Substance**  | **Meting point oC** | **Electrical conduction (liquid)**  |
| **A** | 2580 | Good |
| **B** | -164 | Poor |

i) State the structure of substance **B** (1mk)

***Simple molecular √1***

ii) In terms of bonding present in each compound .Explain the difference in the electrical conduction of the liquids (2mks)

***A has free mobile ions √1 while B does not contain ions√1***

c) Metal **P** reacts with an oxide of metal **Q** but metal **R** does not .Metal **P** can remove oxygen from an oxide of **S** but metal **Q** cannot. Arrange the metal in order of their reactivity starting with the most reactive (2 mks)

 ***P S Q R*** ***√2***

1. (a) The following apparatus was set-up to study the movement of gas molecules. A white disc is formed where the two gases meet and mix.

 A B C

 Cotton wool Cotton wool

 soaked in conc. Soaked in conc.

 Ammonia solution Hydrochloric acid

1. Where is the white disc most likely to be formed? Explain your answer. (2mks)

 ***C √1***

***Ammonia diffuses faster than hydrogen chloride gas/ ammonia is less denser than hydrogen chloride gas√1***

1. Write the equation of the reaction leading to the formation of the white disc. (1mk)

**HCl(g) + NH3 (g) NH4Cl(s) *√1***

 (b) (i) State the Grahams law of diffusion (1mk)

***Rate of diffusion of a gas is inversely proportional to the square root of its density at constant temperature and pressure √1***

 (ii)The molar masses of gases **W** and **X** are 16.0 and 44.0 respectively. If the rate of diffusion of **W** through a porous material is 12cm3 s-1 .Calculate the rate of diffusion of **X** through the same material. (2mks)

$$ \frac{Rx}{Rw}=\frac{\sqrt{Dw}}{√Dx}$$

$\frac{Rx}{12}=\frac{\sqrt{16}}{√44}$ ***√1***

 **RX =7.236 cm3s-1 *√1***

d) A piece of cover slip was weighed before and after a student made a circle on it using a pencil lid of pure graphite. The masses were as shown below;

Mass of cover slip before drawing the circle - 1.804g

Mass after drawing the circle – 1.9053g

Determine

1. The mass of graphite from the above data (1mk)

***1.9053 – 1.804*** √ 1/2 ***= 0.1013g*** √ 1/2

1. The number of moles of carbon atoms used to draw the circle. ( C =12) (1mk)

***0.103/12*** √ 1/2 ***= 0.008442*** √ 1/2

1. The number of carbon atoms used to draw the circle( Avogadro’s number =6.00 x 1023) (1mk)

***0.008442 x 6 x 1023*** √ 1/2 ***= 5.065 x 1021*** √ 1/2

1. (a) Wooden splint was dipped in manganese IV oxide powder and then soaked in hydrogen peroxide as shown below.

**Manganese IV oxide**

**Wooden splint**

**Hydrogen peroxide**

State and explain the observations. (2mks)

***Bubbles of gas/ effervescence*** √ 1

***Manganese (IV) oxide catalyses decomposition of hydrogen peroxide*** √ 1/2 ***to produce oxygen*** √ 1/2

 (b) Calculate the percentage of oxygen in Epson salt, MgSO4. 7H2O.

(Mg = 24, S = 32, O = 16. H = 1) (2mks)

**MgSO4. 7H2O = (24+32+64+126) = 246** √ 1/2

**64/246** √ 1/2 ***x 100%*** √ 1/2 ***= 26.02%*** √ 1/2

1. Unknown substances had pH values as shown in the table below.

|  |  |
| --- | --- |
| **Substance** |  **pH value** |
| **A****B****C****D** | 6.02.010.07.0 |

 State which substance was likely to be?

1. Lemon juice (1mk)

 ***A √1***

1. Ash solution. (1mk)

 ***C √1***

1. An ash that collects in the lower compartment of a jiko was added to water, the mixture shaken and Filtered. Suggest the colour of the filtrate in;

(i) Methyl orange indicator (1mk)

 ***Yellow √1***

(ii) Phenolphthalein indicator. (1mk)

***Pink √1***

1. The diagram below represents a sketch of a set – up for the study of a property of hydrogen.

**Solid Q**

**H2 gas**

 ***Combustion tube with hot copper (i) oxide √1***

 ***A jet of excess hydrogen burning √1***

1. Complete the diagram by showing how hydrogen gas can be passed over heated copper(I) oxide safely (2mks)
2. state the name and function of solid **Q** (2mk)

***calcium oxide/ fused calcium chloride √1***

***drying agent √1***

1. State the observations that would be made when hydrogen gas was passed over hot copper (I) oxide. (1mks)

***Red copper (i) oxide*** √ 1/2 ***turns to brown copper*** √ 1/2 ***NB -first mark must be correct for the second to score***

 ***-brown alone***√ 1/2

1. (a)The table below shows solubilities of two salts **x** and **y** at different temperatures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temperature OC |  | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 |
| Solubility in g/100g of water | Salt x | 4.6 | 7.0 | 9.8 | 13.0 | 16.9 |
| Salt y | 10.2 | 14.6 | 20.1 | 27.4 | 35.9 |

1. Define the term solubility. (1 mark)

***Mass of solute that saturates 100g of water at a given temperature***√1

1. A solution contained 15gram of a mixture of **x** and **y** in the ratio of 1:2 in 50grams of water at 50oC. What is the total mass of crystals of salt **x** that would be obtained on cooling this solution to 10oC? (2mks)

 ***Mass of X in 50g of water = 15/3 = 5g***√ 1/2

 ***Solubility of X at 10oC = 4.6***

 ***Mass of X in 50g of water at 10oC =2.3g***√ 1/2

 ***Mass of crystals = 5 – 2.3 = 2.7g***√1

1. 1cm3 of dilute sulphuric (VI) acid was added to four test tubes containing cation as shown below.

 **A** **B** **C** **D**

 **Ba2+**   **zn2+** **Pb2+** **Mg2+**

1. In which **two** test tubes was a white precipitate formed? (1mk)

***A and C*** √1

1. Write the ionic equation for the formation of one of the precipitates formed. (1mk)

***Ba2+(aq) + SO4 (aq) BaSO4 (s) any one correct*** √1

***Pb2+(aq) + SO4 (aq) PbSO4 (s)***

1. When a few drops of soap solution are added into the contents of test tube D, a white substance is formed on the sides of the test tube. Name the white substance. (1mk)

 ***Scum*** √1 ***/ magnesium stearate***

1. Three samples of water were collected from three counties labeled X, Y and Z. some soap solution were added to equal volumes of each water samples and the soap volumes required to form lather before and after boiling the samples were as recorded in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Sample of water from counties  | X | Y | Z |
| Volume of soap solution before boiling | 20 | 5 | 11 |
| Volume of soap solution after boiling | 20 | 5 | 5 |

1. From which county is the water sample likely to be soft? Explain. (2mks)

***Y*** √1

***Lowest volume of soap formed lather before and after boiling***√1

1. Which county has temporary hard water? Explain. (2mks)

***Z*** √1

 ***Less volume of soap solution formed lather after boiling*** √1

1. Give **two** other methods other than boiling that can be used to remove hardness in water. (2mks)
* ***Addition of sodium carbonate***
* ***Ion-exchange***
* ***Distillation any two correct each*** √1
1. In the test for the chloride ions in solution, a little nitric acid is added followed by silver nitrate solution, why is nitric (v) acid added. (1 mark)
* ***To dissolve any carbonate present which could otherwise form a precipitate/ to prevent any carbonate present to precipitate.*** √1
1. (a) Ethanol and pentane are miscible liquids. Explain how water can be used to separate a mixture of ethanol and pentane (2mks)

-***add water to the mixture*** √ 1/2

***- Ethanol dissolves in water whereas pentane does not*** √ 1/2

***- separate pentane and a mixture of ethanol and water using a separating funnel*** √ 1/2

***- obtain ethanol by simple distillation at 78oC*** √ 1/2

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

**L + H2O**

**Ca(OH)2**

**Gas J**

**K**

 **H H**

 **C C**

 **H Cl**

**CH3 CH2 OH**

**C2H4**

**CH3 CH3**

 Step 3

 1mole

 HCl step2

 Step 1 Step 2

 1mole step 4

 H2(g)

 Ni, H2, 150oc

 Step 5 Step 6

(i) Identify reagent **L**. (1mk)

 ***Calcium carbide / CaC2*** √1

(ii) Name the catalyst used in step 5. (1mk)

 ***H2O catalyst*** √1

 (iii) Draw the structural formula of gas **J**. (1mk)

 **H-C C-H** √1

1. Name the process in: (3mks)

 Step 3 ***Addition polymerization/ polymerization*** √1

 Step 5 ***hydrolysis*** √1

 Step 6 ***hydrogenation*** √1

State **one** commercial application of the process which takes place in step 6. (1mk)

***Hardening of fats*** √1

1. Write equation for the reaction in Step 2 (1mk)

 **HCl + C2H2 C2H3Cl √1 ignore state symbols**

1. a) State Hess’ law. (1mk)

***No matter the multiple steps or intermediates in a chemical reaction, the total enthalpy change is equal to the sum of each individual reaction.* √1 accept any other correct statement**

b) Use the thermo chemical equations below to answer the questions that follow:

1. C 2H6 + 7/2O2 (g) 2CO2(g) + 3H2O(l):  H1= 560Kj/mole
2. C graphite + O2 (g) CO 2( g): H2 = -394Kj/mol
3. H2 (g) +  O2 (g) H2O (L): H3= 286Kj/mol
4. Name **two** types of heat changes represented by H3. (2mks)

***Molar heat of formation of water* √1**

***Molar heat of combustion of hydrogen* √1**

1. Draw an energy level diagram for the reaction represented by equation 1. (2mks)

 **C 2H6 + 7/2O2 (g)**

 **Energy  H1= 560Kj/mole**

 **2CO2(g) + 3H2O(l):**

 **Reaction path**

1. Calculate the standard enthalpy of formation of ethane. (2mks)

***2C graphite + 3H2 (g) C 2H6 Hf***

 ***Hf = (2 x-394) + (3 x-286) – -560* √1**

 ***= -1086 Kj/mole* √1**

(c) When a sample of ethane was bunt, the heat provided raised the temperature of 500cm3 of water by 21.5k (specific heat capacity of water = 4.2kJ/kg/k and density of water = 1g/cm3

 Calculate the:-

1. Heat change for the reaction. (1mk)

 ***= mc T***

***= 0.5 x 4.2 x 21.5*** √ 1/2

***= 45.15 kJ or 45150J*** √ 1/2

 (ii)Mass of ethane burnt (RFM of ethane = 30). (2mks)

**Mass = ( 45.15/560) x30 √ 1**

 **= 2.419 g** √ 1

1. (a) Study the scheme below and answer the questions that follow.

Dark viscous liquid

Amber liquid

Solid sulphur

Step I Step 2

 1130C 1600C – 2500C

 Step 3

 4000C

Sulphur vapour

Mobile liquid

 Step 4

 4440C

Explain the observations made in:

1. Step 1 (1 mark)

**Weak intermolecular forces are broken √ 1**

1. Step 2 (1 mark)

**Covalent bonds break to form long S8 molecules that entangle √ 1**

1. Step 3 (1 mark)

 **More covalent bonds break to form short S2 molecules √ 1**

 (b) Identify an acid in the forward reaction given by the equation below:

$ HSO\_{4 (aq)}^{-} + H\_{2}O\_{(l)} ⇋ H\_{2}SO\_{4 (aq)} + OH\_{(aq)}^{-}$ (1 mark)

 $H\_{2}O\_{(l)}$ **√ 1**

 (c) Hydrogen sulphide is a highly toxic and flammable gas and is usually prepared in the fume chamber.

(i) Name any two reagents that can be used to prepare hydrogen sulphide in the laboratory. (1mk) ***Dilute hydrochloric acid and iron II sulphide* √ 1 *or any dilute acid and a metal sulphide that doesn’t form an insoluble salt***

b) Hydrogen sulphide could be used to produce sulphur as shown in the equation below:

2H2S (g) + SO2 (g) 3S(s) + 2H2O(l)

In the equation above, identify the reducing agent and give a reason for your answer. (1mk)

H2S √ 1/2

Because it is oxidized to S √ 1/2

c) Other than Vulcanisation of rubber, identify two other uses of Sulphur. (2 mk)

**Manufacture of Sulphuric VI acid √ 1**

**Used in medicine √ 1**

**Any other use, 1mark each**

d) When hydrogen sulphide gas was bubbled into an aqueous solution of Iron (III) chloride, a yellow precipitate was deposited.

1. State another observation that was made. (1 mark)

 **The solution changed from brown/yellow** √ 1/2 **to**

 **Green solution of iron II ions** √ 1/2

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

**2FeCl3 (aq) + H2S(g) 2 FeCl2 (aq) + 2HCl(aq) + S(s)** **√ 1**

e) Explain why old newspapers slowly turn brownish when exposed to air and sunlight. (1 mark)

**newspapers that were bleached by reduction** √ 1/2 **are re-oxidized back to the original colour** √ 1/2

f) Describe a chemical test that can be used to distinguish sodium sulphate and sodium sulphite. (2 marks)

**Add barium nitrate/chloride to the samples followed by dilute nitric/hydrochloric acid √ 1**

**For sodium sulphate, a white ppt doesn’t dissolve in the acid √ 1/2**

**For sodium sulphite, a white ppt dissolves in the acid √ 1/2**

***Or***

***Add lead II nitrate to the samples followed nitric V acid and warm* √ 1**

***For sodium sulphate, white ppt doesn’t dissolve both in the acid and on warming* √ 1/2**

***For sodium sulphite , white ppt dissolves in nitric V acid* √ 1/2**