**MARKING SCHEME**

1. The pH values of some solutions labeled **E** to I are given in the table **below**. Use the information to answer the questions that follow.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PH | 14.0 | 1.0 | 8.0 | 6.5 | 7.0 |
| Solution | E | F | G | H | I |

**(a)** Identify the solution with the highest concentration of hydroxide ions. Explain **(1 mark)**

***E, Strong base***

**(b).**Which solution can be used as a remedy for acid indigestion in the stomach? Explain

**(1 mark)**

***G, Magnesium Hydroxide***

**(c)** Which solution would react Explosively with Potassium metal? **(1 mark)**

***F, Dilute acids reacts with Alkali metals Explosively***

2. a) Distinguish between ionization energy and electron affinity (2mk)

***Ionization energy is the energy required to lose/donate an electron in an atom of an element in its gaseous state while electron affinity is the energy required to gain/acquire extra electron by an atom of an element in its gaseous state..Electron affinity is the energy required to gain an electron in an atom of an element in* gaseous state.** b) The table below shows first ionization energies of metals represented by letters A, B, C and D. The metals are in the same group of the periodic table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Metal** | A | B | C | D |
| **1st ionization energy (kJ/mole** | 402 | 496 | 520 | 419 |

Which of the metals has the largest atomic radius? Explain. (2mks)

***C, has the smallest atomic radius, hence stronger nuclear force of attraction holding the outermost electron***

1. An element is represented as :

(a) To which chemical family does it belong? **(1/2 mark)**

***Alkali metals***

(b) Write the electron arrangement of the atom.**(1/2 mark)**

***2.8.1***

(c) Draw the structure of its ion. **(1 mark)**

**X X**

**X X**

**+**

**X X**

**X X**

M

**X X**

1. (a) Define electrolysis. (1 mark)

***Process by which an electrolyte gets decomposed when an electric current is passed through it.***

(b) During the electrolysis of molten aluminium oxide, write the equations at the;

Anode - ***6O2-(l) -> 3O2(g)+12e*** (1 mark)

Cathode ***4Al 3+ (l) +12e -> 4Al (l)*** (1 mark)

1. In an experiment to determine the % purity of Sodium carbonate produced in the Solvay process ,2.15g of the sample reacted with exactly 40.0cm3 of 0.5M Sulphuric(VI)acid. determine the % purity of sodium carbonate in the sample.

***Na2CO3(aq)+H2SO4(aq) -> Na2SO4(aq)+CO2(g)+H2O(l)***

***Mole ratio Na2CO3 :H2SO4  => 1:1***

***Moles H2SO4 = Molarity x Volume***

***1000***

***=> 0.5 x 40.0 = 0.02 Moles***

***1000***

***Moles of Na2CO3 = 0.02 Moles***

***Molar mass of Na2CO3 = 106g***

***Mass of Na2CO3 = moles x Molar mass => 0.02 x 106 = 2.12 g***

***% of Na2CO3=(2.12 g x 100) = 98.6047%***

***2.15***

1. **Y** is a product of gaseous reaction which results in an equilibrium mixture being formed.

**Reactants Y**

The percentage of  **Y** in equilibrium at various temperatures and pressure is shown in the following table.

|  |  |  |  |
| --- | --- | --- | --- |
| Temperature (0C) | 1 atm | 100 atm | 200 atm |
| 550  650  750  850 | **0.77**  **0.032**  **0.016**  **0.09** | **6.70**  **3.02**  **1.54**  **0.87** | **11.9**  **5.71**  **2.99**  **1.68** |

Use this data to deduce, giving a reason for each case;

* + 1. Whether production of **Y**  is exothermic or endothermic. (2 marks)

***Exothermic .An increase in temperature reduces the yield of Y ; favours the backward endothermic reaction***

* + 1. Whether production of **Y** involves an increase or a decrease in number of moles of gas present. (2 marks)

***Decrease in the number of moles. Increase in pressure increases the yield of Y; favours forward reaction that reduces moles/volume/molecules of gas present***

1. **a**) State and explain what is observed when moist red flowers are dropped in a gas jar containing Sulphur (IV) oxide. (2marks)

***When moist red flowers are dropped into a gas jar containing sulphur(IV) oxide, the flowers are bleached/turn white. Sulphur(IV) oxide combines with moisture, forming sulphuric(IV) acid which combines with oxygen from the dye to form sulphuric(VI) acid. When the dye loses oxygen it becomes colourless/white/bleached, the dye undergoes reduction while the sulphuric(IV) acid is oxidised.***

***SO2(g) + H2O(l) Image H2SO3(aq)***

***H2SO3(aq) + Dye Image H2SO4(aq) + Colourless material.***

1. A sample of water from River Nzoia is suspected to contain sulphate ions. Describe an experiment that can be carried out to determine the presence of the sulphate ions.(3 marks)

***Add from Pb(NO3)2(aq)/Ba(NO3)2(aq); followed by acidify with dilute HNO3(aq)*** ***A white precipitate which persist on addition of the acid is formed; showing presence of SO42- ion;***

7. During distillation in a laboratory the distillate can be collected either by a beaker or a conical flask.

(a) Define the term distillate. (1 mark)

***condensed liquid collects in the receiver***

(b) Explain why a conical flask is the most preferred apparatus for the collection of the distillate. (1 mark)

***The narrow mouth ensures no spillage.***

(c) Draw the diagram of a graduated conical flask. (1 mark)

10. In an experiment to determine the proportion of oxygen in air, copper turnings were packed in excess in a long combustion tube connected to two syringes of 110cm3 each in volume. At the beginning of the experiment, syringe R contained 110cm3 of air while syringe M was closed and empty as shown.

Copper turnings

Heat

Syringe R

Syringe M

Glass wool

Air was passed over the heated copper slowly and repeatedly until there was no further change in volume. 97.5cm3 of air remained in syringe M.

(a) State and explain the observation made in the combustion tube. (2 marks)

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(b) If the volume of air in the **combustion tube** at the beginning of the experiment was 23.8cm3 and at the end of the experiment reduced to 10cm3, calculate the percentage of the active part of air. (2 marks)

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11. Below is a structure of an element X. Use it to answer the questions that follow.

+

+

+

+

+

+

1. Name the chemical family to which element X belongs. Give a reason. (2 marks)

***Alkaline- Earth metal. Has two valence electrons***

1. (i) Define covalent bond. (1 mark)

***Bond which involves sharing of electrons contributed by both atoms***

(ii) Using dots ( ) of cross ( **x** ) diagram, show bonding in Carbon (II) Oxide.(1 mark)

12. (a) (i) State ***two*** crystalline allotropes of Carbon. (1mark)

***Carbon-diamond***

***Carbon-graphite***

(ii) Explain the differences their densities. (2 marks)

***Diamond has very high density than graphite because;*** ***it has a very closely packed giant tetrahedral structure joined by strong covalent bonds***

(b) (i) Name the process used for large scale production of Sodium Carbonate using brine as raw material. (1 mark)

***Solvay Process.***

(ii) Write the overall chemical equation for the reaction in the carbonator. (1 mark)

***CO2(g)+H2O(l)+NaCl(aq)+NH3(g) ->NaHCO3(s)+NH4Cl(aq)***

(iii) Name two gases recycled in the above process (1 mark)

**Ammonia gas , Carbon(IV)Oxide**

13. Name the following compounds using the IUPAC system. (3 marks)

(i) CH3 CH2 CH2 CH2 C = CH

Br CH3  ***3-bromohept-2-ene***

(ii) CH3CH2CH2COOCH2CH2CH3

* ***propylbytonoate***

CH3

(iii) CH3CHCHCHCH3

Cl Cl ***2,4-dicloro-3-methylpentane***

14. Describe how to prepare Ethane gas starting with soda lime (3marks)

**Sodium ethanoate and an equal mass of soda lime is put in a hard glass test tube, upon mixing them thoroughly in a mortar. The mixture is heated thoroughly in the test-tube. *A colourless gas collects over water/syringe***

15. The diagram below shows how chlorine reacts with metals in the laboratory. Study it and answer the questions that follow.

R

**Fe**

P

Dry Chlorine gas

Q

Heat

Dilute NaOH(aq)

(a) Name substance **Q**. (1 mark)

***Iron (III) chloride***

1. Give a reason why substance Q is not collected in the combustion tube P.(1 mark)

***Iron (III) chloride sublimes on heating; the black solid changes to red-brown fumes on heating.***

(c) Write chemical equation for the reaction that occurs in the conical flask containing Sodium hydroxide. (1 mark)

***Cl2(g)+ 2NaOH(l) NaCl(aq) + NaClO(aq) + H2O(l)***

16. (a) Water sample is found to contain Mg2+,Cl-, SO42- , and Ca2+. Identify the type of water hardness (1mks)

***Permanent water hardness***

(b) Which type of detergent is more suitable with the water sample above. Give a reason (2marks)

***Soapless Detergent,does not form scam with water***

(c) Permanent water hardness cannot be removed by boiling. Explain (1mks)

* ***The soluble sulphates and chlorides of Mg and Ca do not decompose upon boiling hence can not be precipitated out.***

17. Starting with lead metal, write procedure on preparation of lead(II) nitrate crystals (3mks)

* ***Measure dilute Nitric(V) acid and transfer it into a beaker.***
* ***Add Lead powder a little at a time as you stir with a glass rod. Continue adding zinc powder until it is in excess.***
* ***Filter the solution and pour the filtrate into an evaporating basin.***
* ***Heat to Evaporate the filtrate to saturation***
* ***Allow the now saturated solution to cool .***

18. The following chemical equations show the effects of heat on nitrates.

2B(NO3)2(s) 2BO(s) + 4NO2(g) + O2(g)

2ANO3 (s) 2ANO2(s) + O2(g)

2CNO3(s) 2C(s) +2NO2(s) + O2(g)

1. Arrange elements A, B and C from the most reactive to the least reactive. (11/2mks)

**A,B,C**

b) Give one example of element A, B and C. (11/2mks)

**A Sodium/Potassium**

**B Magnesium/Zinc/Lead/Iron/Copper**

**C Silver/Mercury**

19. Copper (II) sulphate crystals, a boiling tube, a test-tube, a beaker and other necessary requirements were used in an experiment to determine the type of change that occurred when the crystals were heated.

1. Draw a labelled diagram to represent the set-up at the end of the first part of the experiment. (3mks)
2. After the second part of the experiment was done, state the conclusion that was made about the type of change undergone by copper (II) sulphate crystals when heated. (1mks)

***Chemical change***

20. (a). Distinguish between chromatography and a chromatogram. (1mk)

***Chromatography is a method of separating components of a solution mixture by passing it through a medium where the different components move at different rates while Chromatogram is the medium through which the solution mixture is passed***

1. State the role of chromatography in the administration of international athletics competions. (1mk)

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21. Study the polymer shown below.

O O H H

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H ― O ― C ― (CH2)4 ― C ― N ― (CH2)6 ― N ―H

1. Name the polymer. (1mk)

**Nylon 6,6**

1. Identify two monomers that make up the polymer. (2 mks)

**O O H H**

**Cl - C – (CH2 ) 4 – C – Cl H –N – (CH2) 6 – N – H**

***hexan-1,6-dioyl dichloride hexan-1,6-diamine.***

C) Give one use of the polymer (1mark)

***to make clothes, plastic ropes and carpets.***

22. (a) State Charles law. (1mk)

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(b) A gas occupies 450cm3 at 270C. What volume would the gas occupy at 1770C if its pressure remains constant? (2mks)

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23. A colourless liquid was suspected to be water. State two ways to confirm.

1. Purity of the water. (1mk)

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1. That the liquid was water. (2mks)

………………………………………………………………………………………………………………………………………………………………………………

24. Use the following information to answer the questions that follow

**ΔH lattice MgCl2 = +2489 KJ/ mol -1**

**ΔH hydration Mg2+ = - 1891 kJ/ mol**

**ΔH hydration Cl - = -384 kJ/ mol**

1. Calculate the heat of solution of magnesium chloride. (2mks)

MgCl2 **-**-breaking the crystal into free ions-**->** Mg2+ (g) + 2Cl- (g) ∆Hl = +2493 kJ

Hydrating the ions;

Mg2+(g) + aq**⎯→**Mg 2+ **(aq)** ∆Hh = - 1920 kJ

2Cl-(g) + aq **⎯→**2Cl-(aq) ∆Hh = (- 364 x 2) kJ

∆Hs =∆Hh +∆Hs **⎯→**

(-1920 kJ + (- 364x2 kJ)) + (+2493) kJ

= **-155.0 kJmole-1**

1. Draw an energy level diagram for the dissolving of magnesium chloride (2mks)

Mg2+ (g) + 2Cl- (g)

Enthalpy (kJ)

∆Hlattice = +2493 kJ ∆Hhydration =(-1920 kJ+ (- 364x2 kJ)

**MgCl2**(s) + H2O

∆Hsolution =**-155.0 kJmole-1**

Mg2+(aq) + **Cl -** (aq)

Reaction pathway

25. i) A solution of aqueous sodium hydroxide is added to a gas jar of nitrogen (IV) oxide and shaken. State and explain the observation made (2marks)

* ***The brown fumes disappear. Nitrogen (IV) oxide is an acidic gas because it can react with an alkali Forming sodium nitrate and sodium nitrite.***

ii) Write the chemical equation for the reaction above (1 mark)

**2NaOH(aq) + 2NO2(g)  2NaNO3(g) + NaNO2(aq) + H2O(l)**