**BSJE 2021**

**Kenya Certificate of Secondary Education (KCSE)**

**233/2 - CHEMISTRY - Paper 2**

**(Theory)**

**Nov/Dec. 2021 – 2 Hours**

**Name: …………………………………..… Index No: ……….………...Stream ……..**

**School**: ………..…………………………………………………………………………...

**Candidate’s** **Signature**: ..………………………………...…. **Date**:……………………

**Instructions To Candidates**

1. *Write your name and index number in the spaces provided above*
2. *Sign and write the name of your school in the spaces provided*
3. *Answer* ***all*** *the questions in the spaces provided*
4. ***Non-programmable*** *silent electronic calculators and KNEC mathematical tables may be used*
5. *All working* ***must*** *be clearly shown where necessary*
6. *This paper consists of* ***16 printed pages***
7. ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
8. ***Candidates should answer the questions in English.***

**For Examiner's use only**

|  |  |  |
| --- | --- | --- |
| **Question** | **Max. Score** | **Score** |
| **1** | **11** |  |
| **2** | **11** |  |
| **3** | **12** |  |
| **4** | **12** |  |
| **5** | **11** |  |
| **6** | **12** |  |
| **7** | **11** |  |
| **TOTAL SCORE** | **80** |  |

1. The table **below** shows the ions of elements **W, X, Y**, **Z,** and their electron arrangement.

The letters do not represent the actual symbols of the element.

|  |  |
| --- | --- |
| **Ion**  | **Electron configuration**  |
| **W -** | **2.8.8**  |
| **X2+**  | **2.8.8**  |
| **Y3+**  | **2.8**  |
| **Z2-**  | **2.8**  |

1. Which **two** elements belong to the same period? Give a reason. (2 marks)

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1. In which group of the periodic table does **Y** belong? (1 mark)

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1. Write the formula of the compound formed between **W** and **X** (1 mark)

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1. What type of bond is formed between **W** and **X**. Explain. (2 marks)

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1. What is a coordinate bond? (1 mark)

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1. Draw a dot (**•**) cross (×) diagram to show bonding in the Ammonium ion (NH4+)

 (N = 7, H = 1) (2 marks)

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1. Aluminum chloride and sodium chloride are both chlorides of period 3 elements.

Use this information to explain the following observations.

1. A solution of **A1CI3** in water turns blue litmus paper red while that of **sodium chloride** does not (1 mark)

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1. The melting point of **sodium chloride** (801°C) is higher than that of **AlC13** (180°C).
 (1 mark)

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1. Give the names of the following compounds:
2. **CH3COOCH2CH3** (1 mark)

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1. **CH3CHCHCH2CH3**  (1 mark)

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1. Study the information in the table below ad answer the questions that follow.

|  |  |
| --- | --- |
| **No. of carbon atoms per molecule** | **Relative molecular mass of hydrogen** |
| 2 | 28 |
| 3 | 42 |
| 4 | 56 |

1. Write the general formula of the hydrocarbons in the table. (1 mark)

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1. Predict the relative molecular mass of the hydrocarbon with *5* carbon atoms. (1 mark)

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1. Determine the molecular formula of the hydrocarbon in **ii)** above and draw its structural formula. (2 marks)

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1. Study the scheme given below and answer questions that follow.

 

1. Name the reagent used in

Step I (1 mark)

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Step II (1 mark)

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Step III (1 mark)
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1. Write an equation for complete combustion of **CH CH** (1 mark)

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1. Explain **one** disadvantage of the continued use of items in **step III**. (1 mark)

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1. The solubilities of potassium nitrate and potassium bromide at different temperatures was determined. The following data was obtained.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Temperature 0C** | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| **Solubility g/100g H2O** | **KNO3** | 5 | 15 | 26 | 43 | 61 | 83 | 105 | 135 | 165 |
| **KBr** | 50 | 55 | 60 | 65 | 70 | 77 | 85 | 90 | 95 |

1. Plot a graph of solubility against temperature for both salts on the same axis (3 marks)



1. What was the solubility of each salt at 650C (1 mark)

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1. 100g of a saturated solution of potassium nitrate at 700C was cooled to 200C. What mass of the salt will be crystallized? (2 marks)

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

**Solid A**

**and**

**Gas B**

**Metal carbonate**

**Heat**

**Dil. HCl**

**Solution**

**C**

**Deep blue solution E**

**Solid D**

**A few drops of NH3(aq)**

**Excess of**

**NH3(aq)**

1. Write an equation for the formation of solid **A** and gas **B**. (1 mark)

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1. Name:

Solution **C** …………………………………………………………...…… (1 mark)

Solid **D** ………………………………………………………….………… (1 mark)

1. Write the formula of the complex ion in solution **E.** (1 mark)

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1. Study the flow chart **below** and answer the questions that follow.

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**Residue V** was yellow when hot and white when cold. Identify:

1. White precipitate **I.**  (1 mark)

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1. Solution **II.**  (1 mark)

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1. **Residue V**. (1 mark)

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1. Write an ionic equation for the reaction of **solution** **II** with **Pb(NO3)2 (aq)**  (1 mark)

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1. Write observations that would be made when ammonia solution is added drop-wise till in excess to the colourless **solution II** (l mark)

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1. The diagram **below** represents a set-up for large scale manufacture hydrochloric acid. Study it and answer the questions that follow:
2. Name **substance** **X.**  (1 mark)

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1. What is the purpose of glass beads? (1 mark)

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1. Give **one** source of **substance X** used in the above process. (1 mark)

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1. Give **two** uses of hydrochloric acid. (2 marks)

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1. The table below shows the ammeter readings obtained when two different electrolytes the same concentration was tested.

|  |  |
| --- | --- |
| **Electrolyte**  | **Ammeter reading (Amps)**  |
| Hydrochloric acid  | 4.0 |
| Ethanoic acid  | 1.2 |

 Why does Ethanoic acid give a lower ammeter reading? Explain your answer (2 marks)

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1. The figure below shows parts of Le’Clanche cell (dry cell).



1. Name:
2. Substance **D** (1 mark)

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1. Mixture **B** (1 mark)

………………………………………………………………………………………………...

1. Electrolyte **C** (1 mark)

………………………………………………………………………………………………..

1. In the cell, the electrolyte is a paste. Explain. (1 mark)

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1. The following reaction occurs when the cell is in use.

MnO2

Zn(s) + 2NH4+(aq) Zn2+(aq) + 2NH3(aq) + H2O(l)

Given that:

Zn2+(aq) + 2e- Zn(s) EФ = -0.76V

 MnO2

2NH+(aq) + 2e- 2NH3(g) + H2O(l) EФ = +0.74V

Calculate the e.m.f. of the cell. (2 marks)

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1. Use the standard reduction electrode potentials given below to answer the questions that follow.

Zn2+(aq) + 2e- Zn(s) EФ = -0.76V

Pb2+(aq) + 2e- Pb(s) EФ = -0.13V

Cu2+(aq) + 2e- Cu(s) EФ = +0.34V

Ag2+(aq) + 2e- Ag(s) EФ = +0.80V

The metal copper, zinc, silver and lead were placed in different solutions as shown:

|  |  |  |
| --- | --- | --- |
| **Metal** | **Metal ion** | **Reaction / No reaction** |
| Cu | Ag2+(aq |  |
| Zn | Cu2+(aq) |  |
| Ag | Pb2+(aq) |  |
| Pb | Zn2+(aq) |  |

1. Indicate in the table with a tick (√) where a reaction occurs and a cross (×) where no reaction occurs. (2 marks)
2. Identify the strongest reducing agent. (1 mark)

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1. Draw a well labeled diagram of the electrochemical cell when copper and magnesium half cells are connected. (3 marks)

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1. On the diagram you have drawn in **e i)** above, label the anode and the cathode and show the direction of flow of electrons. (2 marks)
2. The set up below is used to prepare nitric acid

**Glass cork**

**Mixture X**

**Red brown fumes**

1. Name the reagents in **mixture** **X** (1 mark)

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1. Write an equation for the reaction which takes place in the glass retort (1 mark)

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1. Explain the reason why the apparatus used is all glass and why heating should be gentle as possible. (2 marks)

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

 

1. Name **element M**. (l mark)

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1. Why is it necessary to use excess air in **step 4**? (1 mark)

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1. Identify **gas Q** (l mark)

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1. Write an equation for the reaction in **step 7** (l mark)

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1. Give **one** use of ammonium nitrate. (l mark)

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1. Ammonia can be formed by the reaction shown below

N2 (g) + 3H2 (g)  2NH3 (g) ; ∆H = - 92kJ/mol

State and explain what happens if:

1. The volume of the system is increased (1 mark)

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1. Cold water is poured over the system (1 mark)

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1. In an experiment to determine the heat of combustion of compound **X**, a pupil used heat from the burning compound of **X** to heat 100cm3 of water in a beaker. He obtained the following results:

Volume of water in the beaker = 100cm3

Initial temperature of water = 17oC

Final temperature of water = 420C

Initial mass of burner + compound X = 10.5g

Final mass of burner + compound X = 10.2g.

1. Determine the mass of the compound burnt? (1 mark)

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1. Calculate the rise in temperature? (1 mark)

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1. Determine the amount of heat produced by the compound (2 marks)

(specific heat capacity 4200Jg-1K-1, density of H2O = 1g/cm3)

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1. Calculate the molar heat of combustions of **compound X** (2 marks)

(R.M.M. of X = 256)

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1. Use the following thermochemical equations below to answer the questions that follow.

 C2H6 (g) + 7/2 O2 (g) 2CO2(g) + 3H2O (s) ∆H1, = -1560kJmol-1

 C (graphite) + O2(g)  CO2 (g)  ∆H2 = - 394 kJ mol-1

 H2 (g) + ½ O2(g) H2O(l) ∆H3 = - 286 kJ mol-1

1. Calculate the molar enthalpy of combustion of C2H6. (2 marks)

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1. Draw an energy level diagram for the reaction represented by the first equation above (3 marks)

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