**Name ……………………………..………...…………. Index No……………………….…………….**

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

**233/2**

**CHEMISTRY**

**PAPER 2**

**(THEORY)**

**TIME: 2 HOURS**

**Kenya Certificate of Secondary Education**

**INSTRUCTIONS:**

* Write your name and index number in spaces provided above.
* Answer **ALL** the questions in the spaces provided.
* Mathematical tables and silent electronic calculators may be used.
* All working must be clearly shown where necessary.

**FOR EXAMINER’S USE ONLY**

|  |  |  |
| --- | --- | --- |
| **Question** | **Maximum Score** | **Candidates score** |
| **1** | 13 |  |
| **2** | 15 |  |
| **3** | 11 |  |
| **4** | 10 |  |
| **5** | 10 |  |
| **6** | 10 |  |
| **7** | 11 |  |
| **80**  **TOTAL SCORE** |

***This paper consists of 13 printed pages.***

***Candidates should check to ensure that all pages are printed as indicated and no questions are missing***

1. The grid below represents the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E** |  |  |  |  |  |  |  | **F** |
| **G** | **D** |  |  |  | **K** |  | **N** |  |
|  |  |  | **W** |  | **T** |  |  | **M** |
| **R** | **Q** |  |  |  |  |  | **Y** |  |
|  |  |  |  |  |  |  |  |  |

1. i) Which letter represents an element that is least reactive? (1 mark)

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ii) Why are elements D and Q referred to alkali earth metals? (1 mark)

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1. How does the atomic radius of W and T compare? Explain. (2 marks)

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1. Select **two** letters representing elements that would react most explosively. (2 mark)

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1. Write the equation showing how Y forms its ion. (1 mark)

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1. Write the formula of:-
2. Chloride of D. ( ½ mark)

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1. Nitrate of W. ( ½ mark)

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1. What type of bonding exists between;
2. G and N. ( ½ mark)

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1. K and Y. ( ½ mark)

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1. Explain why melting point of Y is higher than N. (1 mark)

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1. The 1st, 2nd and 3rd ionization energies (in KJ/mol) of elements G and R are given below.

|  |  |  |  |
| --- | --- | --- | --- |
| Element | 1st I.E | 2nd I.E | 3rd I.E |
| G | 520 | 7,300 | 9,500 |
| R | 420 | 3,100 | 4,800 |

1. Define the term ionization energy. (1 mark)

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1. Apart from the decrease in energy levels, explain the big difference between 1st and 2nd ionization energies. (1 mark)

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1. Calculate the amount of energy in KJ/mol for the process. (1 mark)

R(g) R3+(g) + 3e-

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1. I. The scheme below shows some organic reactions. Study it carefully and answer the questions that follow.

**Heating**

**Step II**

**Red-bromine liquid**

**Excess Cl2 gas**

**Step I**

**NaOH(aq)**

**Reagent C**

**Step 4**

**CH3 COOH**

**Step 3**

**Na(s)**

**Step 5**

**CH3 CH2 COOH**

**CH3 CH2 COONa**

**CH3 CH2 CH2 OH**

**B**

**CH3 CH3**

**A**

**E**

**CH3 CH= CH2**

**CH3 CH2 CH3**

**D**

**CO2 + H2O**

1. Write the formula of compounds. (2 marks)
2. B

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

1. A

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1. Name the type of reaction, reagent and conditions for the reactions of the following steps.
2. Step 1: (2 marks)

Type…………………………………………………………………

Reagent

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

1. Step 4: (2 marks)

Type…………………………………………………………………

Reagent

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

1. Step 5: (2 marks)

Type…………………………………………………………………

Reagent

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1. Name reagent C.

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1. Draw and name the structural formula of D. (2 marks)

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1. Name the structure E. (1 mark)

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1. Give **one** property of compound B. (1 mark)

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II. Polymers and fibres are either synthetic or natural.

1. Give **two** examples of synthetic fibres and polymers. (1 mark)

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1. A polymer is formed whose formula is;

H H

n

N (CH2)6 N C (CH2)4 C

O O

Draw the structural formula of the monomers. (2 marks)

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

**Step I**

**Nitrogen**

**Air**

**PURIFIER**

**Hydrogen**

**D**

**COMPRESSOR**

**HEAT EXCHANGER**

**Step II**

**Aqueous Pb(NO3)2**

**Catalytic chamber**

**Copper (II) oxide**

**Compound**

**W**

**Step IV**

**Heat**

**Ammonia**

**Sulphur**

**Brown solid**

1. **Oxygen catalyst**
2. **Water**

**Nitric (V) acid**

**Step III**

**Brown Fumes**

**Solution K**

**Copper**

**Gas V**

**Brown solid**

**U**

1. Name the impurities removed by the purifier. (2 marks)

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1. What is the work of the heat exchanger? (1 mark)

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1. Write down the chemical equation for the reaction taking place where Nitric (V) acid is formed. (1 mark)

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1. Name;
2. Compound W. (1 mark)

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1. Substance U. (1 mark)

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1. Gas V. (1 mark)

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

1. Write down the formula of compound P. (1 mark)

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1. Other than manufacture of ammonia write down **one** other use of Nitrogen. (1 mark)

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1. Calculate the mass of Nitrogen in 6.6g of Ammonium Sulphate. (H = 1, S = 32, O = 16). (2 marks)

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1. The diagram below represents a paper chromatogram of pure substances W, X, Y and Z.



1. Name A. (1 mark)

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1. Explain why substance Y moves faster from origin than X. (1 mark)

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1. Explain the observation made on substance Z in the chromatogram. (1 mark)

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1. The relationship between pressure and volume of a fixed mass of a gas was studied at 25oC. The data was recorded as shown in table below.

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| --- | --- | --- | --- | --- |
| Volume (dm3) | 0.5 | 1 | 2 | 3 |
| Pressure (atmosphere) | 6 | 3 | 1.5 | 1 |
| Product of volume and pressure |  |  |  |  |

1. Complete the table by calculating the products of volume and pressure. (2 marks)
2. Using the data comment on the relationship between volume and pressure of fixed mass of gas at constant temperature. (1 mark)

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1. Use the information below to answer the questions that follow.

C(s) + O2(g) CO2(g) ΔH1 = -393.5 Kj/mol-1

H2(g) + ½ O2 (g)  H2O(g)  ΔH2 = -285.8 Kj/mol-1

C2H5OH (l) + 3O2(g) 2CO2(g) + 3H2O(l) ΔH3 = -1370 Kj/mol-1

1. Define the term heat of formation. (1 mark)

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1. Calculate the heat of formation of ethanol. (3 marks)

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1. a) Sodium is extracted in the Downcell shown below.

**X**

**Y**

**Z**

**Circular steel cathode**

**( - )**

**( - )**

**Cylindrical graphite anode**

(**+**)

1. Name Y. (1 mark)

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1. Down’s cell must operate at high temperature of about 600oC. Explain. (2 marks)

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1. Explain why anode is made of graphite instead of steel though it’s a better conductor. (1 mark)

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1. State the purpose of steel diaphragm. (1 mark)

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1. The set up below was used to prepare and collect dry sample of gas G. During the experiment, cleaned magnesium ribbon was strongly heated before heating the wet glass wool.



1. Why was the magnesium ribbon cleaned before it was used? (1 mark)

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1. State the observations that would be noted in the reaction tube. (1 mark)

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1. Name;
2. Gas G. (1 mark)

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1. Suitable liquid L. (1 mark)

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1. Write equation of reaction in the reaction tube. (1 mark)

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1. I) Study the standard electrode potential below and answer the questions that follow.

The letters are not the actual symbols of the elements.

M2+(aq) + 2e- M(s) Eθ = -0.76V

N2+(aq) + 2e- N(s) Eθ = -2.37V

2P+ + 2e- 2P(s) Eθ = +0.80V

R2+ + 2e- R(s) Eθ = - 0.14V

1. The standard electrode potential of Fe2+ is -0.44 volts. Select the element which would be best to protect iron from rusting. (1 mark)

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1. i) Calculate the Eθ value for cell represented as M(s) **/** M2+(aq) **//** P+(aq) + P(s). (2 marks)

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ii) Draw the electrochemical cell represented in b(i) above. (2 marks)

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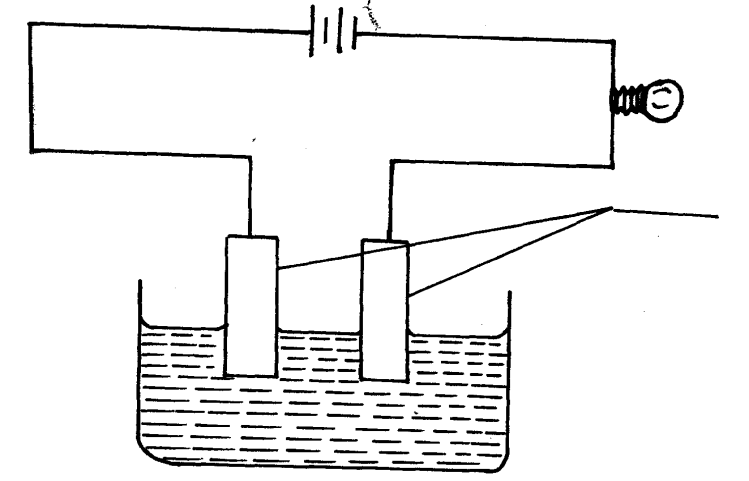
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II) The diagram below represents an experiment by a student.



**A**

**Electrodes**

**B**

**Aqueous KCl(aq)**

1. Name the products at the electrodes. (1 mark)

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1. Write equation of reaction at each electrode. (1 mark)

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III) During purification of copper by electrolysis, 1.48g of copper were deposited when a current was passed through aqueous copper (II) sulphate for 2½ hours. Calculate the amount of current that was passed. CU = 63.5 and 1 Faraday = 96500C. (3 marks)

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

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b) Study the table below and answer the questions that follow.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temp oC | 0 | 8 | 20 | 40 | 60 | 80 |
| Solubility in g/100g of the H2O | 254 | 225 | 140 | 80 | 25 | 10 |

1. Plot a graph of solubility in g/100g of water of copper (II) sulphate against temperature. (4 marks)



1. From the graph,

a) How does the solubility of Copper (II) sulphate vary with temperature? (1 mark)

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b) Determine solubility of Copper (II) sulphate in g/100g water at 35oC. (1 mark)

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1. If 30g of Copper (II) sulphate are dissolved in 100g of water at 30oC, is the resulting solution saturated, supersaturated or unsaturated. (1 mark)

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1. A saturated solution of copper (II) sulpahete is cooled from 70oC to 20oC.
2. Should the mass of copper (II) sulphate be reduced or increased for the solution to remain saturated. (1 mark)

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1. Determine the amount of mass in (iv) (a) above. (2 marks)

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