**TERM 2 - 2023**

**CHEMISTRY – PAPER TWO (233/2)**

**FORM FOUR (4)**

**Time - 2 Hours**

**Name …………………………………………….……… Admission Number …………….**

**Candidate’s Signature ………………….…...………... Class ……………………………**

**INSTRUCTIONS TO CANDIDATES:**

* Answer **all** the questions in the spaces provided.
* Write **your** **Name** and **Index Number** in the spaces provided above.
* Mathematical tables and electronic calculators may be used for calculations.
* All working **must** be clearly shown where necessary

**For Examiner’s Use only.**

|  |  |  |
| --- | --- | --- |
| **QUESTION** | **MAXIMUM SCORE** | **CANDIDATE’S SCORE** |
| 1 | 12 |  |
| 2 | 14 |  |
| 3 | 14 |  |
| 4 | 12 |  |
| 5 | 11 |  |
| 6 | 11 |  |
| 7 | 09 |  |
| **Total score** | **80** |  |

*This paper consists of* ***14*** *printed pages. Candidates should check the questions to ascertain that all the pages are printed as indicated and no questions are missing.*

**1**. (a) Study the information given below and answer the questions that follow.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element** | **Atomic radius (nm)** | **Ionic radius (nm)** | **Formula of oxide** | **Melting point of oxide (ºC)** | **Electrical conductivity of oxide in solid or molten state** |
| **A** | 0.064 | 0.136 | OA2 | -224 | Does not conduct |
| **B** | 0.117 | 0.040 | BO2 | 1710 | Does not conduct |
| **C** | 0.125 | 0.054 | C2O3 | 2045 | Conducts in molten state |
| **D** | 0.110 | 0.212 | D2O5 | 563 | Does not conduct |
| **E** | 0.157 | 0.095 | E2O | 1193 | Conducts in molten state |

(i) Select **two** elements, whose oxides have giant ionic structure (2 marks)

......................................................................................................................................................

......................................................................................................................................................

(ii) Which element is likely to be silicon? Give a reason. (2 marks)

......................................................................................................................................................

......................................................................................................................................................

 (iii) Explain why the melting point of the oxide of A is lower than that of the oxide of C

(2 marks)

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

(iv) State the nature of the solution formed when oxide of D, **D2O5**dissolves in water.

(1 mark)

......................................................................................................................................................

......................................................................................................................................................

(b) Study the information in the table below and answer the questions that follow (The letters do not represent the actual symbols of the elements)

|  |  |  |
| --- | --- | --- |
| **Element** | **Electronic configuration** | **Electron affinity(kJ/mol)** |
| **F** | 2.7 | -322 |
| **G** | 2.8.7 | -349 |
| **H** | 2.8.18.7 | -325 |

(i) What chemical family do the elements **F, G** and **H** belong? (1 mark)

......................................................................................................................................................

......................................................................................................................................................

 (ii) What is meant by the term electron affinity? (1 mark)

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

 (c) When a piece of calcium is placed in cold water, it sinks to the bottom and a colourless gas that extinguishes a burning splint with a pop sound is produced. Use a simple diagram to illustrate how this gas can be collected during this experiment. (3 marks)

..............................................................................................................................................................

..............................................................................................................................................................

..............................................................................................................................................................

.............................................................................................................................................................

**2**. (a) Draw the structures of;

 (i) the second member of the alkene homologous series ; (1 mark)

 ................................................................................................................................................

 ................................................................................................................................................

 ................................................................................................................................................

 .................................................................................................................................................

 (ii) pentanoic acid; (1 mark)

 .................................................................................................................................................

 .................................................................................................................................................

 .................................................................................................................................................

 (iii) 1-hexanol. (1 mark)

 ...................................................................................................................................................

 ...................................................................................................................................................

 ....................................................................................................................................................

 (b) State and explain how propan-1 –ol could be distinguished from propanoic acid (2 marks)

 .................................................................................................................................................................

 ..................................................................................................................................................................

 ..................................................................................................................................................................

 (c) Use the information in the scheme below to answer the questions that follow.

**Compound J**

**Acidified potassium dichromate (VI)**

**Step II**

 **Ethanol**

**Burn**

**Products**

**Hydrogen gas**

**Step I**

**Step III**

 **Step IV**

**Ethene**

**Bromine water**

 **Step V**

**H2/Nickel catalyst/200ºC**

 **Step VI**

**Compound K**

**Substance L**

(i) give the name of ;

(I) compound **J** (1 mark)

.....................................................................................................................................

 (II) compound **K**  (1 mark)

 .......................................................................................................................................

 (ii) Give the name of the reaction which occurs in step **V** (1 mark)

 .....................................................................................................................................................

 (iii) Write the equation for the chemical reaction in step **III** (1 mark)

 ......................................................................................................................................................

 (iv) Name the reagent(s) and conditions necessary for the reaction step **IV**

 Reagent(s) (1 mark)

..........................................................................................................................................

 Condition (s) (1 mark)

..........................................................................................................................................

 (v) State the observations made in step **II** (1 mark)

 ...................................................................................................................................................

 ...................................................................................................................................................

(d) The two reactions below show how a long chained alkanoic acid can be converted into

detergent **M**.

**Step I**

 CH2 — C17H35COOH

 |

 CH — C17H35COOH +3H2O 3C17H35COOH + C3H8O3

 |

 CH2 — C17H35COOH

 **Step II**

3C17H35COOH + 3NaOH C17H35COONa + 3H2O

 (detergent **M**)

 (i) Name the type of reaction in step **II** (1 mark)

 ..................................................................................................................................................

(ii) When detergent **M** is added to a beaker containing hard water a scum is formed. Write the formula of the scum. (1 mark)

.................................................................................................................................................

.................................................................................................................................................

**3** (a) The diagram below represents an industrial process for the manufacture of ammonia.

Study it and answer the questions that follow.

**Gas N**

**Hydrogen**

**Catalytic chamber**

**Liquid ammonia**

**Heat Exchanger**

**Purifier**

**Compressor**

**unreacted gases**

**Condenser**

**10%**

**ammonia**

 (i) Give the name of;

 (I) the process above (1 mark)

 .........................................................................................................................................

 (II) Gas **N** (1 mark)

 .........................................................................................................................................

(ii) Carbon (IV) oxide, sulphur (VI) oxide and dust are the impurities in this process. Give a reason why these impurities are removed. (1 mark)

......................................................................................................................................................

......................................................................................................................................................

 (iii) Other than iron catalyst, state **two** optimum conditions for this process (2 marks)

. ..................................................................................................................................................

..................................................................................................................................................

 (iv) Give **two** uses of ammonia (2 marks)

......................................................................................................................................................

......................................................................................................................................................

 (b) Urea, (CO(NH2)2) is prepared by reacting carbon (IV) oxide and ammonia.

 (i) Write an equation for the reaction which occurs. (1 mark)

 ......................................................................................................................................................

 ......................................................................................................................................................

(ii) 20 kilograms of urea was applied to a farm and 25 kilograms of ammonium nitrate applied to another farm. Determine the farm enriched with nitrogen.

(C=12, N = 14, O=16, H =1) (4 marks)

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

 ......................................................................................................................................................

 ......................................................................................................................................................

(c) State and explain what would be observed when aqueous ammonia is added dropwise until in excess to a solution of copper (II) chloride. (2 marks)

...............................................................................................................................................................

..............................................................................................................................................................

..............................................................................................................................................................

..............................................................................................................................................................

**4**. (a) (i) State Le Chatelier’s principle. (1 mark)

.....................................................................................................................................................

 .....................................................................................................................................................

 .....................................................................................................................................................

 (ii) Bromine water can be prepared by dissolving 1 cm3 of liquid bromine in

100 cm3of water. After shaking, the equilibrium below is established.

**Br2 (aq) + H2O (l) OBr - (aq) +Br- (aq) +2H+ (aq)**

 (***Yellow) (colourless)***

 State and explain the effect of adding sodium hydroxide to the above equilibrium

 (2 marks)

 .......................................................................................................................................

 .......................................................................................................................................

 .......................................................................................................................................

 .......................................................................................................................................

(b) Colloidal sulphur may be formed by reacting sodium thiosulphate and dilute hydrochloric acid shown in the equation below.

**Na2S2O3(aq) +2HCl(aq) 2NaCl(aq) + S(s) +SO2(g) + H2O (l)**

(i) State and explain the effect of increase in temperature on the rate of the reaction above. (2 marks)

 ....................................................................................................................................................

 .....................................................................................................................................................

 .....................................................................................................................................................

 .....................................................................................................................................................

 (ii) Other than temperature name **one** factor that can alter the rate of the reaction in

b (i) (1 mark)

......................................................................................................................................................

.......................................................................................................................................................

(c) 2.50 grams of a calcium carbonate was reacted with excess 1.8 M hydrochloric acid. The volume of carbon (IV) oxide evolved measured and recorded at 10 second intervals. The results were recorded as shown in the table below.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time (seconds) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| volume of gas ( cm3) | 0 | 150 | 295 | 420 | 525 | 580 | 600 | 600 | 600 |

 (i) (I) On the grid provided, plot a graph of volume (vertical axis) against time.

 (3 marks)



 (II) From your graph, determine the rate of reaction at 37th second.

 (3 marks)

 ..........................................................................................................................................

 .........................................................................................................................................

 .........................................................................................................................................

**5**. (a) The table below shows the standard reduction potentials for four half cells. Study it and

 answer the questions that follow.

|  |  |  |
| --- | --- | --- |
| **Number**  | **Half -reaction**  | **E0volts** |
| I | Ag+ (aq) + 2ē Ag (s)  | + 0.80 |
| II | Cu2+(aq) + 2ē Cu (s)  | + 0.34  |
| III | Pb2+(aq)  + 2ē Pb (s)   | - 0.13 |
| IV | Fe2+(aq)+ 2ē Fe (s)  | - 0.44 |

1. Identify the strongest oxidizing agent (1 mark)

…………………………………………………………………………………………………

(ii) Explain why it’s not advisable to store a solution of silver nitrate in a container made of lead (2 marks)

…………………………………………………………………………………………………

…………………………………………………………………………………………………

 (iii) In the space provided, draw a labeled diagram of the electrochemical cell that would be obtained when half-cell of copper and iron are combined.

(3 marks)

 (iv) Calculate the Eof the electrochemical cell constructed in (iii) above. (1 mark)

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

 (b) During the electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.75 A was passed through the cell for 3 hours and 45 minutes.

 (i) Write an ionic equation for the reaction that took place at the anode. (1 mark)

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

 ii) Determine the change in mass of the anode which occurred as a result of the

electrolysis process. (Cu=63.5 1 F = 96,500C) (3 marks)

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

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

…………………………………………………………………………………………………

**6**. The flow chart below shows the extraction of zinc from zinc ore(s). Study it and answer the questions that follow

**Zinc blende**

**Roaster**

**Roaster**

**Calamine**

**Reduction**

**Chamber**

**Gas Q**

**Carbon (IV) oxide**

 **Limestone**

**Oxygen gas**

 **Solid R**

**Molten Zinc**

(i) Give the formula of the ores;

 I zinc blende (1 mark)

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

 II Calamine (1 mark)

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

 (ii) Give the name of;

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

 Gas **Q** ……………………………………………………………………......(1 mark)

 (iii) Write a chemical equation for the reaction that produces Zinc metal (1 mark)

…………………………………………………………………………………………………

 (iv) What is the purpose of adding limestone in the reduction chamber? (1 mark)

…………………………………………………………………………………………………

…………………………………………………………………………………………………

 (v) Give t**wo** uses of zinc metal other than galvanizing iron (2 marks)

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

 (vi) Name **two** other industries that can be established alongside the zinc extraction plant

(2 marks)

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

 (vii) State **one** way in which the extraction of zinc causes air pollution (1 mark)

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

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

**7** (a) Study the flow chart below and answer the questions that follow.

Solid **Q**

Solution **R** and Colourlessgas **S**

Dil. sulphuric (VI) acid

 **Step I**

 **Step II**

3 drops of aqueous sodium hydroxide

 White precipitate **T**

 **Step III**

Excess aqueous sodium hydroxide

 Colourless solution **U**

 (i) Identify

 I Solid **Q**  (1 mark)

 ........................................................................................................................................

 II Colourless gas **S** (1 mark)

..........................................................................................................................................

 (ii) Give the formula of the compound in solution **U** (1 mark)

 ...............................................................................................................................................

 ...............................................................................................................................................

 (iii) Write the ionic equation for the reaction in step **II** (1 mark)

 ...................................................................................................................................................

 ...................................................................................................................................................

 (iv) Give two uses of white precipitate **T** (2 marks)

 ………………………………………………………………………………………………

 ………………………………………………………………………………………………

 ………………………………………………………………………………………………

(b) Calculate the number of sulphate ions present in 24.0 cm3 of 0.25 M aluminium sulphate solution. (L = 6.0 × 1023) (3 marks)

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

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

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

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

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

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

**………………………..……THIS IS THE LAST PRINTED PAGE…………………………….**