**Term 1 – 2023 OPENER EXAM**

**CHEMISTRY**

**PAPER 2 (233/2)**

**FORM FOUR (4)**

**Time: 2 Hours**

**MARKING SCHEME**

**Instructions;**

1. *Write* ***your name*** *and* ***Admission number*** *in the spaces provided above.*
2. ***Sign*** *and write* ***the date of examination*** *in the spaces provided above.*
3. *Answer all the questions in the spaces provided.*
4. *Mathematical tables and silent electronic calculators many be used.*
5. *All working* ***must*** *be clearly shown where necessary.*
6. ***This paper consists of 14 printed pages. Candidates must check to ensure that no page is missing.***

**FOR EXAMINER’SUSE ONLY**

|  |  |  |
| --- | --- | --- |
|  **QUESTION**  | **MAXIMUM SCORE**  | **SCORE** |
| 1 | 14 |  |
| 2 | 13 |  |
| 3 | 08 |  |
| 4 | 13 |  |
| 5 | 12 |  |
| 6 | 13 |  |
| 7 | 07 |  |
| **Total score** | **80** |  |

***Turn Over***

**1** The diagram below shows part of the periodic table. The letters do not represent the actual symbols of the elements. Study it and answer the questions that follow.

|  |  |  |
| --- | --- | --- |
| A |  |  |
|  | B |  |  | C |  | **J** |  | D |
| E |  | F |  | G |  | H |  |
| I |  |  |  |  |  |  |  |  |

1. Select from the table;

(i) the most reactive metal (1 mark)

 **I**

 (ii) the least reactive element (1 mark)

**D**

1. State and explain the trend in :

 (i) Reactivity of elements **A** and **E**. (2 marks)

**E is more reactive than A. E has a larger atomic radius than A and can easily lose the outermost electron which is weakly held/experiences weaker nuclear force of attraction.**

 (ii) Atomic radii of elements **F** and **G**. (2 marks)

**Atomic radius of G is smaller than that of F. G has a higher nuclear charge than F/ G has a higher number of protons than F**

1. What name is given to the elements in the same group as element **H**? (1 mark)

**Halogens**

1. Write down the formula of the sulphite of element **E** (1 mark)

**E2SO3**

1. The atomic number of an **element J** is 8. Locate **element J** on the grid. (1 mark)

**Shown in the table**

1. Name the type of structure present in :

(i) Chloride of **F** (1 mark)

**Simple molecular**

(ii) element **C** (1 mark)

**Giant covalent/atomic structure**

1. A sample of the oxide of **I** was dissolved in distilled water. Both blue and red

litmus papers were dipped into this solution. State and explain the observations made. (2 marks)

**Blue litmus paper remains blue. Red litmus paper changes to blue. Hydroxide of A / solution formed is alkaline.**

1. Give **one** use of element **B** (1 mark)
* **In gears and cogs in aviation industry**
* **Making windows for X-rays tubes**
* **In nuclear reactors**
* **Heavy duty brake drums**
* **In alloys with copper to make gyroscopes and springs**

**2** (a) One of the naturally occurring allotropes of carbon is graphite.

 (i) Give the other allotrope of carbon. (1 mark)

**Diamond**

 (ii) Name **one** use of the allotrope in **a (i)** above (1 mark)

* + - **As a jewel**
		- **Polishing**
		- **Diamond speaker domes**
		- **Cutting glass and other diamonds**
		- **File coatings usage in optical laser equipment**

 (iii) Name **one** other element which exhibit allotropy (1 mark)

* **Sulphur**
* **Phosphorous**
* **Tin**
* **Oxygen**

 (b) Fullerenes are synthetic allotropes of carbon obtained by manipulating carbon using laser beams. Given that the molecular formula of fullerene is C60, determine its molar mass. (C=12.0) (2 marks)

 **60×12= 720**

 (c) Carbon (IV) oxide may be prepared by reacting dilute sulphuric (VI) acid and a carbonate.

 (i) Explain why lead (II) carbonate wouldn’t be suitable for use in this reaction.

 (2 marks)

**Insoluble lead (II) sulphate would coat lead (II) carbonate** **thus preventing further reaction.**

 (ii) State and explain the observations made when carbon (IV) oxide is bubbled through a solution of calcium hydroxide. (2 marks)

**Formation of a white precipitate. Carbon (IV) oxide reacts with calcium hydroxide to form calcium carbonate which is a white precipitate**

 (iii) Name **one** use of carbon (IV) oxide other than in fire extinguishers.(1 mark)

* **As a drying agent**
* **Inflating life rafts**
* **Immobilizing animals before slaughter**
* **In soft drinks**

 (d) The diagram below shows a Jiko when in use. Study it and answer the questions that follow.

 

**Air**

 (i) Write the equation taking place at region **A**. (1 mark)

 **C(s) + O2(g) CO2(g)**

 (ii) Why is not advisable to place such a Jiko in a closed room? (2 marks)

 **Poisonous carbon (II) oxide would be formed since air is limited**

**3** (a) What is the effect of impurities on the;

 (i) boiling point of water (1 mark)

 **Raises boiling point**

 (ii) melting point of naphthalene (1 mark)

**Lowers melting point**

(b) Why is rock salt poured on roadways during winter in some countries in Europe? (1 mark)

**Prevent formation of ice by lowering melting point of water/ Clear ice from the roadways**

 (c) In an experimentto determine the freezing point of a certain solid, solid **G**, students heat the solid to melting and then allowed to cool. The temperature was recorded after every 30 seconds and the table below was obtained

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Time (seconds)** | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 |
| **Temperature (OC)** | **85.0** | **80.0** | **75.5** | **72.0** | **70.0** | **68.0** | **66.0** | **65.0** | **65.0** | **62.5** |

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

 (3 marks)



**Temperature**

**90**

**80**

**70**

**60**

  **0 30 60 90 120 150 180 210 240 270**

 **Time (minutes)**

 (ii) From the graph determine the freezing point of **solid G** (1 mark)

 **65° C. ½ mark correct showing and ½ mark correct reading**

 (d) Give the type of change that occurs when;

 (i) Iron nail rusts (½ mark)

 **Permanent chemical change**

 (ii) lead (II) nitrate is heated (½ mark)

 **Permanent chemical change**

**4** (a) Other than manufacture of dyes and fireworks, Name **two** uses of sulphur (2 marks)

* **As a fungicide**
* **Vulcanization/ hardening of rubber**
* **Manufacture of sulphuric (VI) acid**
* **Manufacture of bleaching agents**
* **Making car batteries**
* **In matches, fireworks**

(b) Sodium sulphite reacts with hydrochloric acid according to the equation below.

 Na2SO3(aq) + 2HCl (aq) 2NaCl (aq) + SO2(g) + H2O (l)

 25.0 cm3 of 2 M sodium sulphite was reacted with excess hydrochloric acid. Determine the volume of SO2 (g) produced. (Molar gas volume at r.t. p = 24 dm3) (3 marks)

 **Moles of Na2SO3 =** $\frac{2×25}{1 000}$

 **= 0.05**

 **Moles of SO2(g) = 0.05 (mole ratio =1:1)**

**Volume of SO2(g) = 0.05 × 24 dm3**

 **= 1.2 dm3 or 1 200 cm3**

 (c) State and explain the observations made when sulphuric (IV) oxide gas is bubbled in a solution of acidified potassium manganate (VII). (2 marks)

 **Acidified potassium manganate (VII) changes from purple to colourless. SO2 reduces potassium manganate (VII) to manganese (II) ions while SO2(g) is oxidized to SO42-.**

(d) Study the flow chart below which shows the preparation of sulphur (VI) acid and answer the questions that follow

 **SO3** (g)

 **Air**

**Heat exchanger**

**Catalytic chamber**

**Purifier**

 **A**

 **Oleum**

 **Water**

 **SO3** (g)

**Absorption tower**

**Dilution chamber**

 **B**

**B**

 (i) Give the name of substances;

 (I) **A** **sulphur (IV) oxide** (1 mark)

 (II) **B** **concentrated sulphuric (VI) acid** (1 mark)

 (ii) Name the catalyst used in the above process. (1 mark)

 **Vanadium (V) oxide**

 (iii) Write the equation for the reaction between water and oleum (1 mark)

 **H2S7O7 (l) + H2O (l) 2H2SO4(l)**

 (iv) State **two** uses of sulphuric (VI) acid (2 marks)

* **Manufacture of paints**
* **Refining of petroleum**
* **In domestic acid drain cleaners**
* **Electrolyte in lead-acid batteries**
* **Dehydrating agent**
* **Tanning leather**
* **Laboratory reagent**
* **Processing of iron, copper and steel**
* **Manufacture of detergents**

**5** (a) Give the name of the following organic compounds;

 (i) C(CH3)4 (1 mark)

 **2,2 - dimethylpropane**

(ii) CH3CHCHCH2CH3 (1 mark)

 **Pent-2-ene / 2-pentene**

(iii) CHCCH2CH3 (1 mark)

 **But-1-yne / 1 -butyne**

(b) (i) Name **two** reagents that can be used to prepare ethyne (1 mark)

* **Water**
* **Calcium carbide**

(ii) Write the equation for the reaction that takes place in b (i) above (1 mark)

 **CaC2 (s) +2H2O (l) C2H2 (g) +Ca(OH)2 (aq)**

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

 **B**

**Step III**

 **Chloroethane**

**H2, Ni,**

**200 °C**

**Step II**

  **A**

**Ethene**

**Step I**

**Ethanol**

**Polyethene**

**Step V**

**Acidified potassium manganate (VII)**

**Step IV**

(i) Give the reagent and condition for the reactions in **step** **I** and **step III**

 **Step I**

 Reagent: **concentrated Sulphuric (VI) acid** (1 mark)

 Condition(s) **Temperature 170 ºC - 180 ºC** (1 mark)

 **Step III**

 Reagent: **Chlorine** (1 mark)

 Condition(s). **U.V light** (1 mark)

(ii) Draw the structure of compound **B** (1 mark)

 

(iii) Give the name of compound **A** (1 mark)

 **Ethane**

 (iv) State **one** use of Polyethene (1 mark)

* **In packaging film**
* **Insulation for wires and cables**
* **Food packaging**
* **Agricultural mulch**
* **Making toys**

**6** (a) The flow chart below was used in preparation of magnesium hydroxide. Study it and answer the questions that follow.

**Sodium**

**Magnesium**

**Step I**

**Magnesium hydroxide**

**Filtration**

**Products**

**Step III**

**Step II**

**Water**

**Solution L**

**+**

**Gas M**

**Solution K**

**+**

**Gas M**

**Dilute**

**Sulphuric (VI) acid**

 (i) State, with a reason the precaution that should be taken in step **II** (1 mark)

 **Use small piece(s) of sodium since larger piece would react explosively with water.**

 (ii) Identify;

 I solution **K** (1 mark) **Magnesium sulphate**

 II solution **L** (1 mark)

 **Sodium hydroxide**

 (iii) Describe the chemical test for gas **M**  (2 marks)

 **Introduce a burning splint at the mouth of a test-tube containing gas M. The burning splint is extinguished with a pop sound**.

 (iv) Give **one** use of magnesium hydroxide (1 mark)

 **As an anti-acid**

 **As a laxative**

(b) Starting with barium carbonate, describe how a dry sample of barium sulphate would be prepared in the laboratory. (3 marks)

 **Add dilute hydrochloric acid to excess barium carbonate in a beaker and stir until effervescence stops. Filter unreacted barium carbonate. To the filtrate, add a soluble sulphate e.g sodium sulphate to precipitate barium sulphate. Filter, wash the residue and dry it in between filter papers.**

(c) (i) Urea, **(NH2)2CO**, is prepared by passing carbon (IV) oxide through ammonia solution. Explain why urea is a better nitrogenous fertilizer than ammonium nitrate.(C=12.0, N=14.0,H=1.0, O=16.0) (3 marks)

 **Percentage of nitrogen in urea =** $\frac{28×100}{60}$

 **= 46.67 %**

 **Percentage of nitrogen in ammonium nitrate =** $\frac{28×100}{80}$

 **= 35 %**

 **Urea is a better fertilizer since it has higher nitrogen content than ammonium nitrate**

 (ii) Other than manufacture of fertilizer give **one** use of ammonia (1 mark)

* **As a refrigerant**
* **Softening hard water**
* **Removal of greasy stains**
* **Manufacture of hydrazine**

**7** (a) Name the gas produced when concentrated sulphuric (VI) acid is reacted with sodium chloride crystals. (1 mark)

 **Hydrogen chloride gas**

(b) (i) State **two** uses of chlorine gas. (2 marks)

* + - **Water treatment**
		- **Bleach in paper manufacture**
		- **Making pesticides**
		- **Manufacture of HCl gas**
		- **Manufacture of PVC**

 (ii) State and explain the observations made when a moist blue litmus paper is dropped in a gas jar full of chlorine. (2 marks)

 **Changes to red then white. Chlorine gas is acidic and a bleaching agent**

 (c) DDT is a pesticide which has limited use in disease vector control.

 (i) What does DDT stand for? (1 mark)

 **Dichlorodiphenyltrichloroethane**

 (ii) Name **one** environmental impact of DDT (1 mark)

* **Persistent organic pollutant**
* **Toxic to living organisms e.g marine animals**

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