**Term 2 - 2022**

**FORM 4**

**CHEMISTRY PAPER 1 (233/1)**

**Time: 2 Hours**

**INSTRUCTIONS TO CANDIDATES**

* *Write your* ***Name****,* ***Index Number*** *and* ***School*** *in the spaces provided above.*
* *Answer* ***all*** *the questions in the spaces provided after each question.*
* ***KNEC*** *Mathematical tables and* ***silent******non-programmable*** *electronic calculators may be used.*
* ***ALL*** *working* ***must*** *be clearly shown where necessary.*
* *Candidate should* ***check*** *the question paper to ascertain that* ***all*** *the pages are printed and that no questions are missing.*
* *Candidates* should answer the questions in **English**.

**FOR EXAMINER’S USE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTIONS** | **MAX SCORE** | **CANDIDATE’S SCORE** |
| **1 – 29** | **80** |  |

*This paper consists of* ***13*** *printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.*

**1** (a) Give the name of the ﬁrst member of the alkyne homologous series (1 mark)

**Ethyne**

(b) Describe a chemical test that can be used to distinguish ethanol from ethanoic acid. (2 marks)

**Put ethanol and ethanoic acid into separate test tubes. Add two drops of orange**

**acidified potassium dichromate (VI) into each of the test tube. The acidified**

**potassium dichromate (VI) will change to green in the test tube with ethanol and**

**remain orange in test tube with ethanoic acid.**

**2** (a) Name the raw material from which aluminium is extracted (l mark)

**Bauxite**

(b) Give a reason why aluminium is extracted using electrolysis. (1 mark)

**It is highly reactive**

(c) Give **one** use of aluminium metal. (l mark)

**Used to make airplane parts**

**3**  (a) What is meant by lattice energy? (1 mark)

**The energy change that occurs when an ionic substance is formed from its constituent ions in the gaseous state.**

(b) Study the energy level diagram below and answer the question that follows:

**NaOH (aq) + H2O (l)**

**∆H**

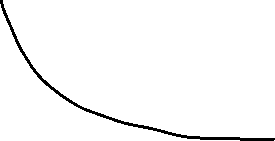
**Na+ (aq) + OH- (aq)**

What type of reaction is represented by the diagram? (1 mark)

**Exothermic**

**4**  (a) Sketch a graphical representation of Boyles law on the axes below. (1 mark)

Pressure (mmHg)



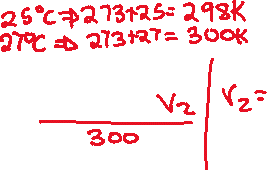
Volume (cm3)

(b) A gas occupies 400 cm3 at 25°C and 100,000 Pa. What will be its volume at 27°C and 101325 Pa? (2 marks)

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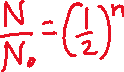
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**5** (a) What is half- life? (1 mark)

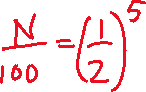
**The time taken for a given mass/ amount of radioactive isotope to decay to half its original mass.**

(b) The half-life of protactinium - 234 is 1.17 minutes. Determine the mass that decays in 5.85 minutes starting with 100 g of the sample. (2 marks)

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**6** State **two** disadvantages of hard water. (2 marks)

* **It stains white clothes**
* **Forms boiler scales that reduce the efficiency of boilers**
* **Wastes soap**

**7**  Hydrogen chloride gas can be prepared by reacting sodium chloride with an acid.

(a) Name the acid. (1 mark)

**Concentrated sulphuric (VI) acid**

(a) Write an equation for the reaction between sodium chloride and the acid. (1 mark)

**NaCl (s) + H2SO4 (l) → NaHSO4 (s) + HCl (g)**

(c) State **two** uses of hydrogen chloride. (1 mark)

* **Used to clean metal surfaces**
* **Used to make dyes, drugs and photographic materials such as silver bromide.**
* **Sewage treatment**
* **Water treatment**
* **pH control and neutralisation in industries that require purity.**

**8**  When solid **B** was heated strongly, it gave off water and a solid residue. When water was added to the solid residue, the original solid **B**, was formed.

(a) What name is given to the process described? (1 mark)

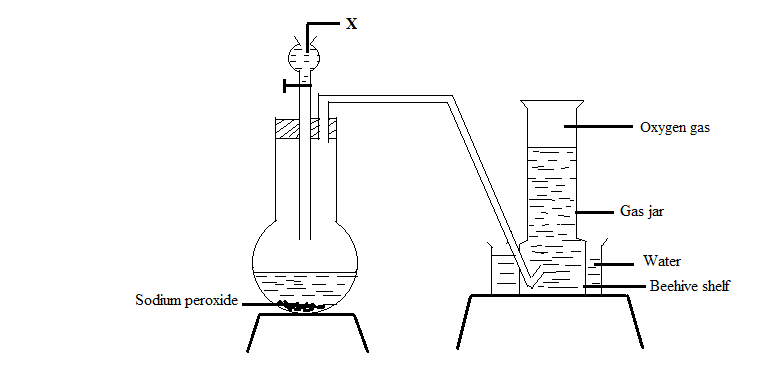
**Temporary chemical change**

(b) Give **one** example of solid **A**. (1 mark)

**Hydrated copper (II) sulphate**

**Hydrated cobalt (II) chloride**

**9**  The set up below can be used to prepare oxygen gas. Study it and answer the questions that follow.



**Sodium peroxide**

1. Identify **X**. (1 mark)

**Water**

(c) Write the equation for the reaction which occurs in the flask. (1 mark)

**2Na2O2 (s) + 2H2O (l) → 4NaOH (aq) + O2 (g)**

(d) State **one** use of oxygen other than in welding (1 mark)

* **Air enriched with oxygen is used in hospitals for patients with breathing difficulties.**
* **Oxygen mixed with helium is used by deep sea divers and mountain climber.**
* **Used to burn rocket fuels**
* **Used as one of the reactants in fuel cells**

**10** The atomic number of an element, **M** is 13.

(a) Write the electronic conﬁguration of the ion **M3+.** (1 mark)

**2.8**

(b) Write the formula of the chloride of **M**. (1 mark)

**MCl3**

(c) State the structure of the compound formed in (b) above (1 mark)

**Giant ionic structure**

**11** Concentrated sodium chloride was electrolysed using graphite electrodes. Name the product formed at the anode and give a reason for your answer. (2 marks)

**Chlorine. Chloride ions are preferentially discharged due to high concentration.**

**12**  The curve shown below shows the variation of time against temperature for the reaction between sodium thiosulphate and hydrochloric acid.

**Time(s)**

**Temperature (°C)**

(a) Explain the shape of the curve. (2 marks)

**Less time is taken for the reaction to take place at higher temperatures. As temperature increases, the kinetic energy of the reacting particles increases and this leads to higher frequency of effective collisions between the reacting particles, hence rate of reaction increases.**

(b) Other than temperature name **one** factor that affects the rate of reaction. (1 mark)

* **Concentration**

**13** (a) Dry ammonia was passed over heated copper (II) oxide in a combustion tube.

(i) State the observations made in the tube (1 mark)

**Black solid changes to brown**

(ii) Write an equation for the reaction that occurs. (1 mark)

**3CuO (s) + 2NH3 (g) → 3Cu (s) + N2 (g) + 3H2O (l)**

(b) What products would be formed if red hot platinum is introduced into a mixture of ammonia and oxygen? (1 mark)

**Brown fumes are seen/ produced**

**14** The table below shows behaviour of metals P, Q, R and S. Study it and answer the questions that follow:

|  |  |  |  |
| --- | --- | --- | --- |
| **Metal** | **Appearance on exposure to air** | **Reaction with water** | **Reaction with dilute sulphuric (VI) acid** |
| **P** | Remains the same | Doesn’t react | Reacts moderately |
| **Q** | Remains the same | No reaction | Doesn’t react |
| **R** | Slowly tarnishes | Slow | Vigorous |
| **S** | Slowly turns white | Vigorous | Violent |

(a) Arrange the metals in the order of reactivity starting with the most reactive.

(2 marks)

**S, R, P and Q**

(b) Name a metal which is likely to be **R** (1 mark)

**Magnesium**

**15** Given the following substances: sodium carbonate, orange juice and sodium bromide.

(a) Name **one** commercial indicator that can be used to show whether sodium carbonate, orange juice and sodium bromide are acidic, basic or neutral. (1 mark)

* **Phenolphthalein**
* **Methyl orange**
* **Litmus**
* **Litmus papers**

(b) Classify the substances in 15 (a) above as acids, bases or neutral. (2 marks)

|  |  |
| --- | --- |
| **Acid** | **orange juice** |
| **Base** | **sodium carbonate** |
| **Neutral** | **sodium bromide** |

**16** The ﬂow chart below shows various reactions of zinc metal. Study it and answer the questions that follow:

**HNO3 (aq)**

**Zinc nitrate**

**Zinc oxide**

**Step 2**

**Reagent Q**

**Step 3**

**Step I**

**Heat**

**Colourless solution**

**Reagent P**

**Zinc chloride**

**Zinc**

**Step 5**

**Step 4**

**H2SO4 (aq)**

**Products**

(a) (i) Other than water, name another reagent that could be **Q**. (1 mark)

**Excess sodium hydroxide**

(ii) Write the formula of reagent **P**. (1 mark)

**HCl**

(b) Write an equation for the reaction in **step 4**. (1 mark)

**Zn (s) + H2SO4 (aq) → ZnSO4 (aq) + H2O (l)**

**17** (a) One of the allotropes of sulphur is monoclinic sulphur, name the other allotrope (1 mark)

**Rhombic sulphur**

(b) Concentrated sulphuric (VI) acid reacts with copper and prapanol. State the property of the acid shown in each case. (2 marks)

Copper ……**oxidizing property**

Propanol …**Dehydrating property**

**18**  Study the standard electrode potentials in the table below and answer the questions that follow.

|  |  |
| --- | --- |
| **Half -reaction** | **E θ(V)** |
| Ag+(aq) + e Ag(s) | + 0.80 |
| Cu2+(aq) + 2e Cu(s) | + 0.34 |
| Mg2+(aq) + 2e Mg(s) | - 2.38 |
| Ca2+(aq) + 2e Ca(s) | - 2.87 |

(a) Which of the metals is the strongest oxidising agent? (1 mark)

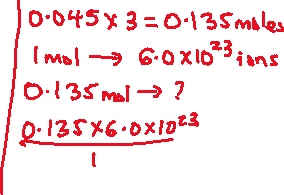
**Cu (s) / copper**

(b) What observations will be made if a copper coin was dropped into an aqueous solution of calcium nitrate? Explain. (2 marks)

**No change. Copper has a more positive electrode potential and hence it is a weaker reducing agent. Therefore, it cannot displace calcium ions from the calcium nitrate solution.**

**19**  Calculate the number of sulphate ions present in 22.5 cm3 of 2 M aluminium sulphate solution. (L=6.0 × 1023) (3 marks)

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**20**  (a) A crystal of iodine, heated gently in a test tube gave off a purple vapour.

(i) Write the formula of the substance responsible for the purple vapour.

(1 mark)

**I2**

(b) What type of bond is broken when the iodine crystal is heated gently? (1 mark)

**Van der Waals forces of attraction**

(b) State **one** use of chlorine. (1 mark)

* **Used in making PVC, aerosols (CFCs), Pesticides eg DDT**
* **Used in water treatment**
* **Used to manufacture hydrochloric acid**
* **Used to manufacture bleaching agents**

**21** Describe how samples of barium (II) sulphate, ammonium chloride and common salt can be obtained from a mixture of the three. (3 marks)

**Heat the mixture for ammonium chloride to dissociate into HCl gas and ammonia gas and recombine on a cool surface. Collect ammonium chloride. Add water to the remaining mixture and stir. Sodium chloride dissolves and barium sulphate remains undissolved. Filter the mixture to obtain barium (II) sulphate as the residue and sodium chloride as the filtrate. Rinse the residue and collect it. Heat the filtrate to evaporate the water and remain with solid common salt (sodium chloride).**

**22** (a) Give the name of the process which takes places place when maize flour is converted to ethanol (1 mark)

**Fermentation**

(b) Write the formula of the compound formed when ethanol reacts with sodium metal. (1 mark)

**C2H5ONa**

**23** (a) Study the graph below which shows variation of atomic radius with atomic number

Atomic radius

Potassium

Sodium

Lithium

Atomic number

State and explain the trend shown in the graph above. (2 marks)

**Atomic radius increases from Lithium to potassium. Potassium has four occupied energy levels while sodium has three and lithium has only two.**

(b) State **one** use of sodium. (l mark)

* **Sodium vapour is used in streetlights to give the yellow glow.**
* **Sodium and potassium alloy is used as a coolant in nuclear reactors**

**24**  A farmer intended to plant blueberries in her farm. She first tested the pH of the soil and found it to be 10.0. In order to obtain high yield, what advice would be given to the farmer if blueberries do well in acidic soil? (2 marks)

**The farmer should add acidifying substances such as vinegar and lemon.**

**25** Starting with calcium nitrate solution, describe how a pure dry sample of calcium carbonate can be prepared in the laboratory. (3 marks)

**Add sodium carbonate solution to calcium nitrate solution and stir. A precipitate of calcium carbonate is formed. Filter the mixture to obtain calcium carbonate as the residue. Rinse the residue with distilled water and dry it between filter papers.**

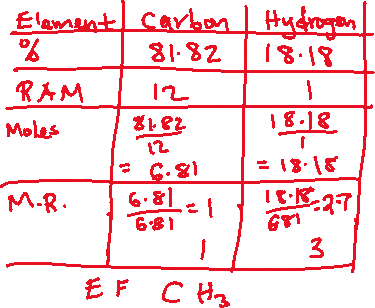
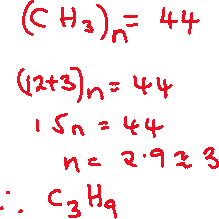
**26**  A hydrocarbon contains 81.82% of carbon. If the molar mass of the hydrocarbon is 44, determine the molecular formula of the hydrocarbon. (C = 12.0; H = 1.0) (3 marks)

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**27** (a) Describe how Carbon (II) Oxide can be distinguished from Carbon (IV) Oxide using calcium hydroxide solution. (2 marks)

**Bubble the gases into separate test tubes with calcium hydroxide. The test tube in which a white precipitate is formed indicates that the gas is carbon (IV) oxide. No white precipitate when carbon (II) oxide is bubbled.**

(b) What is the role of carbon (IV) oxide in ﬁre extinguishing? (l mark)

**Carbon (IV) oxide does not support combustion and it is denser than air. It covers the flame cutting off oxygen supply and also extinguishes the flame.**

**28**  (a) Name **one** source of alkanes. (1 mark)

**Crude oil**

(b) Methane gas was reacted with one mole of chlorine gas. State the condition necessary for this reaction. (1 mark)

**U.V. light**

**29** (a) What is meant by heating value of a fuel? (1 mark)

**Heating value/ Calorific value of a fuel is the amount of energy given out when a unit mass of fuel is completely burnt in oxygen.**

(b) Other than heating value, name **one** factor to be considered when choosing a fuel.

(1 mark)

* **Availability**
* **Ease of storage**
* **Cost of the fuel**
* **Environmental effects**

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