**Secondary 4 Express and 5 Normal Academic Science(Chemistry)**
**Mid-Year Examination**
**Mark Scheme**

| Qn no. | Answer Scheme | | | | | | | Marks Allocated |
|---|---|---|---|---|---|---|---|---|
| 1 | **A** | 6 | **B** | 11 | **D** | 16 | **B** | [1] each |
| 2 | **D** | 7 | **D** | 12 | **D** | 17 | **A** | 20 m max |
| 3 | **C** | 8 | **C** | 13 | **B** | 18 | **D** | |
| 4 | **C** | 9 | **C** | 14 | **A** | 19 | **C** | |
| 5 | **A** | 10 | **C** | 15 | **A** | 20 | **D** | |

**1**

| purpose | name of substance |
|---|---|
| reducing the acidity in soil | **calcium oxide / calcium hydroxide / lime / slaked lime / calcium carbonate** |
| testing for presence of carbon dioxide gas | **limewater / calcium hydroxide** |
| testing for presence of chloride ions in water | **acidified silver nitrate / acidified lead(II) nitrate / acidified silver sulfate** |

1m each
**Reject: chemical formula of substances**

[3]

Total: 3

**2(a)** S [1]

**2(b)** N [1]

**2(c)** Q [1]

**2(d)** P [1]

Total: 4

**3(a)** Z belongs to **<u>group II</u>** because [1]
it contains **<u>two valence electrons</u>**. OR
It has **<u>two electrons</u>** in the **<u>outermost electron shell</u>**. [1] [2]

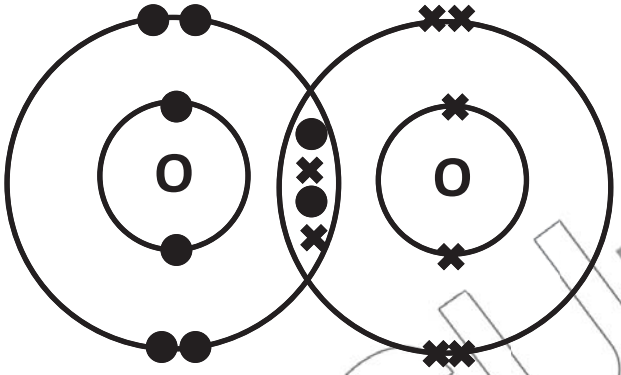
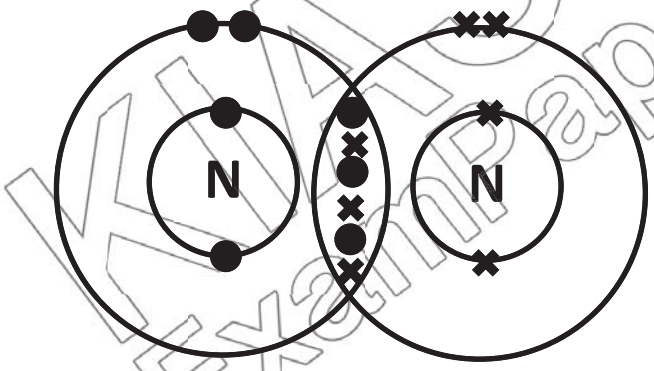
**3(b)(i)** $X_2W_3$ (**reject:** $W_3X_2$) [1]

**3(b)(ii)** The compound formed has a **<u>giant lattice structure</u>** [1]. Thus, large amount of energy is needed to **<u>overcome</u>** **<u>strong electrostatic forces of attraction between the oppositely charged ions</u>** [1]. [2]

Reject: "break strong electrostatic forces of attraction", "break ionic bonds", "giant ionic structure", "oppositely charged particles / molecules / atoms".

| | | |
|---|---|---|
| 3(c) | It has **eight valence electrons** / **a completely filled valence shell** / **does not need to take in, give out or share electrons with other elements**. | [1]<br><br>Total: 6 |
| 4(a)(i) | An alloy is a **mixture containing** at least **one metal with other elements / substances**. | [1] |
| 4(a)(ii) | It is **more corrosion-resistant / does not rust easily**. | [1] |
| 4(b) | Mass, $Fe_2O_3$, present = 30% x 1000 = **300 kg** [1]<br><br>Mole, $Fe_2O_3$ = (300 x 1000) ÷ (2 x 56 + 3 x 16) = **1875 mol** [1]<br><br>Mole ratio: 2 $Fe_2O_3$ : 3 C<br>1875 : 2812.5<br><br>Mass, C = 2812.5 x 12 = **33 750 g / 33.75 kg** [1]<br><br>Note:<br>1. Allow ECF for wrong answer.<br>2. –1 if no/wrong units written for final answer. | [3] |
| 4(c) | **Limestone** [1] is used to remove silicon dioxide. It **decomposes at high temperature** in Blast furnace to produce basic **calcium oxide** [1], which reacts with silicon dioxide. | [2] |
| 4(d) | Sulfur dioxide gas **dissolves in rainwater**, producing **acid rain** [1]. This causes the water bodies to be more acidic, **killing marine/aquatic lives / fishes** [1]. | [2]<br><br>Total: 9 |
| 5(a) | Low melting point / low boiling point / light-green in colour / does not conduct electricity / exist as diatomic molecules<br>[Any **two**] | [2] |
| 5(b) | Chlorine has an electronic structure of **2.8.7** [1], hence it contains **3 electrons shells** [1] filled with electrons. Therefore, it is in period 3. | [2] |
| 5(c) | $Cl_2$ (g) + Zn (s) → $ZnCl_2$ (s)<br>1m – correct balanced equation; 1m – correct state symbols | [2] |
| 5(d) | **Chlorine is more reactive than bromine** [1]. Hence, it can **displace bromine** [1] to form potassium chloride and bromine. | [2]<br><br>Total: 8 |

| | | |
|---|---|---|
| 6(a) | **C**, **A**, **B** (only answer) | [1] |
| 6(b) | Carbon **<u>is more reactive than zinc</u>** [1], but **<u>less reactive than sodium</u>** [1]. Hence it displaces zinc from zinc oxide but not sodium from sodium oxide. | [2] |
| 6(c) | By keeping sodium in oil, the oil **<u>creates a physical barrier</u>** [1] that prevents the surface of sodium metal to come in contact with **<u>oxygen gas</u>** [1] and **<u>water / water vapour</u>** [1], which causes corrosion. | [3]<br><br>Total: 6 |
| 7(a) | A – nitric acid or $HNO_3$<br>B – iron metal or Fe<br>C – hydrogen gas or $H_2$<br>D – iron(II) nitrate or $Fe(NO_3)_2$<br>E – iron(II) hydroxide or $Fe(OH)_2$<br>F – ammonia or $NH_3$<br>1m each; **accept chemical formula** | [6] |
| 7(b) | $Fe^{2+} + 2\ OH^- \rightarrow Fe(OH)_2$<br>1m – correct equation; 1m – balanced equation | [2] |
| 7(c) | A metal carbonate will **<u>produce carbon dioxide gas</u>**, instead of hydrogen gas. OR A metal carbonate **<u>does not produce hydrogen gas</u>** when reacted with acid. | [1]<br><br>Total: 9 |

| | | |
|---|---|---|
| 8(a)(i) | Fractional distillation | [1] |
| 8(a)(ii) | It changes from **moving rapidly in random directions / moving at great speed in different directions** to **sliding over each other randomly / in different directions** within the liquid. | [1] |
| 8(b)(i) | Each oxygen atom **gains two electrons from magnesium** [1], forming oxide ion. **Each magnesium atom loses/transfers two electrons** [1] to oxygen, forming magnesium ion. | [2] |
| 8(b)(ii) | Each oxygen atom **shares two valence electrons** [1] with **two fluorine atoms** [1]. | [2] |
| 8(c)(i) |  | [2] |
| 8(c)(ii) |  <br>Note: **1m deducted if students only shows valence electrons** | [2] |
| | | Total: 10 |

| | | |
|---|---|---|
| 9(a) | High density / High melting and boiling points / conducts electricity / conducts heat / malleable / ductile / shiny surface / Solid at room temperature / Pink/brown solid<br>[Any **two**] | [2] |
| 9(b) | **Heat/Burn copper metal in air / in oxygen to produce copper(II) oxide.** [1]<br>To an **excess amount of CuO**, **add** a fixed volume of **sulfuric acid** and stir the mixture. [1]<br>**Filter** to remove the excess CuO from the mixture. [1]<br>**Warm/Heat** the filtrate to saturation and then **allow it to cool** for crystallization to occur. [1] | [4] |
| 9(c)(i) | **Copper(II) carbonate is used up**. | [1] |
| 9(c)(ii) | At a higher concentration, there are **more reactant particles per unit volume** [1]. Hence, the **frequency of effective collisions between particles increases** [1], leading to a faster rate of reaction. | [2] |
| 9(c)(iii) | Graph showing **half the volume of carbon dioxide gas** and **faster rate of reaction** compared to Graph 1. Graph **must be labelled**. | [1] |
| | | Total: 10 |
| 10(a)(i) | Atomic radius **increases down the group** [1]and **decreases across the period** [1]. | [2] |
| 10(a)(ii) | The elements changes from **metals to non-metals across the period** / **becomes less metallic across the period** / **metallic to non-metallic character across the period** [1] and the oxides changes from **basic to acidic across the period** [1]. | [2] |
| 10(b) | Physical property trend: **melting or boiling point decreases** / **density increases** [1]<br><br>Chemical property trend: **chemical reactivity increases** [1] | [2] |

| | | |
|---|---|---|
| 10(c) | Reaction condition [1]: state the use of either **water / steam / dilute acids**<br><br>Data collection [1]: **counting the number of bubbles produced / measure volume of gas produced at regular intervals / measure lost in mass over regular intervals**<br><br>Comparison of data [1]:<br>The beaker / test-tube / boiling-tube **with more bubbles produced will be magnesium, followed by iron**. **Silver will not have any bubbles produced as it is unreactive towards acid**.<br><br>OR<br><br>**Measure the gas collected at regular intervals and plot a graph of volume of gas produced over time / Measure the lost in mass at regular intervals and plot a graph of mass reading on scale balance against time**. The graph with **steepest gradient will be magnesium,** followed by **iron**, followed by **silver which shows a horizontal line due to its chemical unreactivity**.<br><br>Justification of relative positions [1]:<br>Hence, **magnesium is the most reactive, followed by iron, and silver is the least reactive**. (or vice versa) | [4]<br><br>Total: 10 |