Paper 3

Questions are applicable for both core and extended candidates

1 Magnesium is an element in Group II of the Periodic Table.

(a) Deduce the electronic configuration of magnesium.

.... [1]

(b) Magnesium can be produced by reducing magnesium oxide with barium.

$$MgO + Ba \rightarrow Mg + BaO$$

Explain how this equation shows that magnesium oxide is reduced.

.... [1]

2 This question is about iron.

(b) The equation for the reaction of iron with steam is shown.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$
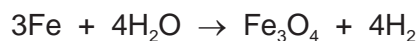
Describe how this equation shows that iron is oxidised.

.... [1]

3 This question is about metals and metal compounds.

(b) Iron is extracted in a blast furnace by reduction of iron(III) oxide, Fe_2O_3, with carbon monoxide.

Carbon monoxide is produced by the reaction of carbon with carbon dioxide.

$$C + CO_2 \rightarrow 2CO$$
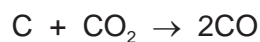
(i) Explain how this equation shows that carbon dioxide is reduced.

....

.... [1]

(ii) Name the type of chemical reaction where oxidation and reduction take place simultaneously.

.... [1]

4 (c) Hydrogen sulfide burns in air to produce sulfur dioxide and water.
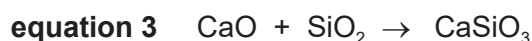
(i) Complete the chemical equation for this reaction.

$$.....H_2S + ...O_2 \rightarrow 2H_2O + 2SO_2 \qquad [2]$$

(ii) Explain how this equation shows that hydrogen sulfide is oxidised.

....

.... [1]

Paper 4

Questions are applicable for both core and extended candidates
unless indicated in the question

5 Iron ore contains iron(III) oxide, Fe_2O_3. A blast furnace is used to extract iron from Fe_2O_3.

Equations for some of the reactions in the blast furnace are shown.

equation 1 $\quad C + O_2 \rightarrow CO_2$

equation 2 $\quad CaCO_3 \rightarrow CaO + CO_2$

equation 3 $\quad CaO + SiO_2 \rightarrow CaSiO_3$

(b) Iron(III) oxide, Fe_2O_3, in iron ore is converted to iron when it reacts with carbon monoxide, CO, in the blast furnace.

(i) Calculate the percentage by mass of iron in iron(III) oxide, Fe_2O_3.

percentage = ...% [2]

(ii) State the name of the iron ore which consists mainly of iron(III) oxide.

.... [1]

(iii) Describe how carbon monoxide is formed in the blast furnace.

.... [1]

(iv) Write the symbol equation to show the reaction that occurs when iron(III) oxide is converted to iron in the blast furnace.

.... [2]

(v) Name the chemical process which happens to iron when iron(III) oxide is converted to iron in the blast furnace.

.... [1]

(c) State the type of reaction shown by **equation 2**.

.... [1]

6 **(a)** The symbols of the elements in Period 2 of the Periodic Table are shown.

Li   Be   B   C   N   O   F   Ne

Use the symbols of the elements in Period 2 to answer the questions that follow.
Each symbol may be used once, more than once or not at all.

Give the symbol of the element that: **(extended only)**

(vi)   only has an oxidation number of zero. .... [1]

7 This question is about sulfur and compounds of sulfur.

Sulfur is converted into sulfuric acid, H_2SO_4, by the Contact process.

The process involves four stages.

stage 1   Molten sulfur is converted into sulfur dioxide.

stage 2   Sulfur dioxide reacts with oxygen to form sulfur trioxide.

stage 3   Sulfur trioxide combines with concentrated sulfuric acid to form oleum, $H_2S_2O_7$.

stage 4   Oleum reacts to form concentrated sulfuric acid.

(a) (i) In **stage 1**, iron pyrites, FeS_2, can be used instead of molten sulfur.
The iron pyrites is heated strongly in air.

Balance the equation for the reaction occurring when iron pyrites reacts with oxygen in the air.

$$.....FeS_2 \; + \; .....O_2 \; \rightarrow \; .....Fe_2O_3 \; + \; .....SO_2$$ [1]

(ii) Name Fe_2O_3. Include the oxidation number of iron.   **(extended only)**

.... [1]

8 Ethanol is manufactured by **two** methods:

(c) The catalyst in method 2 is phosphoric acid, H_3PO_4. Dilute phosphoric acid is a weak acid which contains phosphate ions, PO_4^{3-}.
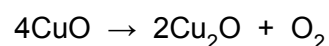
(iii) Determine the oxidation number of phosphorus in the PO_4^{3-} ion. **(extended only)**

Show your working.

oxidation number = ... [2]

9 Copper is a transition element. It has variable oxidation states.

(b) When copper(II) oxide is heated at 800 °C it undergoes the reaction shown by the equation.

$$4CuO \rightarrow 2Cu_2O + O_2$$

(i) Identify the changes in oxidation numbers of copper and oxygen in this reaction.

Explain in terms of changes in oxidation numbers why this is a redox reaction. **(extended only)**

change in oxidation number of copper: from …………… to ……………

change in oxidation number of oxygen: from …………… to ……………

explanation ....

....
[3]