Redox

1. Magnesium nitrate decomposes when heated, as shown in the equation.

$2Mg(NO_3)_2(s) \rightarrow 2MgO(s) + 4NO_2(g) + O_2(g)$

Using oxidation numbers, show which element has been oxidised and which has been reduced when magnesium nitrate decomposes.

State the changes in oxidation numbers, including all signs.

Element oxidised .....

Oxidation number change: from ..... to .....

Element reduced .....

Oxidation number change: from ..... to .....

[2]

2. This question is about compounds of magnesium and phosphorus.

A student plans to prepare magnesium phosphate using the redox reaction of magnesium with phosphoric acid, H_3PO_4.

$$3Mg(s) + 2H_3PO_4(aq) \rightarrow Mg_3(PO_4)_2(s) + 3H_2(g)$$

i. In terms of the number of electrons transferred, explain whether magnesium is being oxidised or reduced.

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[1]

ii. The student plans to add magnesium to 50.0 cm^3 of 1.24 mol dm^{-3} H_3PO_4.

Calculate the mass of magnesium that the student should add to react exactly with the phosphoric acid.

Give your answer to **three** significant figures.

mass of Mg = _____ g **[3]**

iii. How could the student obtain a sample of magnesium phosphate after reacting magnesium with phosphoric acid?

---**[2]**

iv. Magnesium phosphate can also be prepared by reacting phosphoric acid with a compound of magnesium.

Choose a suitable magnesium compound for this preparation and write the equation for the reaction.

Formula of compound ---

Equation ---**[2]**

3. Iodine can be used for the small-scale purification of drinking water.

i. Iodine reacts with water as shown below.

$$I_2 + H_2O \rightleftharpoons HI + HIO$$

Using oxidation numbers, explain why this reaction is a disproportionation.

---**[3]**

ii. Chlorine is used to purify water on a large scale.

State **one** disadvantage of using chlorine for the purification of drinking water.

---**[1]**

4. Aluminium is reacted with ethanoic acid.

i. The unbalanced equation for the reaction is shown below.

Balance the equation.

……. Al (s) + ……. $CH_3COOH(aq)$ → ……. $(CH_3COO)_3Al$ (aq) + …… $H_2(g)$

ii. This reaction is a redox reaction.

Deduce which element has been oxidised and which element has been reduced, and state the changes in oxidation number.

Element oxidised: …… oxidation number change: from …… to ……

Element reduced: …… oxidation number change: from …… to ……

[2]

5. Salts can be prepared in redox reactions of metals with acids. A student prepares a solution of aluminium sulfate by reacting aluminium with dilute sulfuric acid.

$$2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$$

Using oxidation numbers, show which element has been oxidised and which has been reduced in this reaction. State the changes in oxidation numbers, including all signs.

element oxidised ……

oxidation number change: from …… to ……

element reduced ……

oxidation number change: from …… to ……

[2]

6. Magnesium will undergo redox reactions with aqueous salts of less reactive metals.

i. A student reacts magnesium with aqueous copper(II) sulfate.

$$Mg(s) + CuSO_4(aq) \rightarrow Cu(s) + MgSO_4(aq)$$

Explain, in terms of **numbers** of electron transferred, the redox processes taking place in this reaction.

---**[2]**

ii. The student also noticed that the magnesium started fizzing.

The student thought the fizzing was due to the magnesium reacting with water in the mixture.

Write the equation for the reaction of magnesium with water.

Include state symbols.

---**[2]**

7. N_2O_3 is an unstable oxide of nitrogen that decomposes in a redox reaction.

$$N_2O_3(g) \rightarrow NO(g) + NO_2(g)$$

i. State the oxidation number of nitrogen in each oxide in the table below.

Oxide	Oxidation number of nitrogen
N_2O_3	
NO	
NO_2	

[1]

ii. Name this type of redox reaction.

In your answer you should use appropriate technical terms spelled correctly.

---**[1]**

8. Group 2 elements are metals that react with oxygen and water.

Magnesium is oxidised when it burns in oxygen to form an ionic compound.

i. Write the electron configuration, in terms of sub-shells, of a magnesium atom.

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[1]

ii. Explain what happens when magnesium is oxidised in terms of electron transfer.

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[1]

9 This question is about Group 7 elements

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Chlorine can be made by the redox reaction below.

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$$

Using oxidation numbers, show what has been oxidised and what has been reduced in this reaction.

Oxidised

……

……

Reduced

……

……

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[2]

10. An aqueous solution of aluminium chloride can be prepared by the redox reaction between aluminium metal and dilute hydrochloric acid.

A student reacts 0.0800 mol of aluminium completely with dilute hydrochloric acid to form an aqueous solution of aluminium chloride.

The equation for this reaction is shown below.

$$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$$

In terms of electron transfer, explain whether aluminium is being oxidised or reduced.

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[1]

11. Carbon monoxide can be made in the laboratory by heating a mixture of zinc metal and calcium carbonate. An equation for this reaction is shown below.

$$Zn(s) + CaCO_3(s) \rightarrow ZnO(s) + CaO(s) + CO(g)$$

This reaction is a redox reaction.

Deduce which element has been oxidised and which has been reduced, and state the change in oxidation number in each case.

element oxidised …… oxidation number change: from …… to ……

element reduced …… oxidation number change: from …… to ……

[2]

END OF QUESTION PAPER