Exemplar exam questions – Chapter 9

1 Which of the following is the balanced equation for a redox reaction? [1]

A $MnO_4^- + Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + Fe^{3+} + 4H_2O$

B $Zn + 2Ag \rightarrow Zn^{2+} + 2Ag^+$

C $Cr_2O_7^{2-} + 14H^+ + 6I^- \rightarrow 3I_2 + 2Cr^{3+} + 7H_2O$

D $MnO_4^- + 8H^+ + 3C_2O_4^{2-} \rightarrow 6CO_2 + Mn^{2+} + 4H_2O$

2 **a** Define **oxidation** and **reduction** in terms of oxidation numbers [1]

b Explain in terms of electrons which species is the oxidising agent in the equation: [2]

$$Cl_2(g) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(l)$$

Higher Level only

3 When a current of 1.00 A is passed through acidified water for 1 hour, 410 cm^3 of hydrogen gas is produced. Deduce the volume of oxygen gas produced. [2]

Commentary

1 The answer is **C**.

Although **A** represents a redox reaction, the equation is not balanced as the charges do not balance.
B shows two oxidation reactions and the charges do not balance.
D is almost correct, but again the charges do not balance.

2 **a** Care must be exercised here as the question requires a definition in terms of oxidation numbers and not in terms of electrons.

Model answer:

Oxidation is the increase in oxidation number, reduction is a decrease in oxidation number. [1]

b This question now requires an explanation in terms of electrons.

Model answer:

Cl_2 is the oxidising agent [1]

as it accepts electrons from the Br^- and therefore oxidises the Br^-. [1]

3 Although it is possible to carry out a full calculation using $Q = It$ using these data, this is not required by the syllabus and students are only required to calculate the relative amounts of products at the electrodes. The word 'deduce' implies that some explanation should be given and you cannot simply state the answer.

Model answer:

The half equations for the production of hydrogen and oxygen are:

$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ $\quad$ $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Twice as many electrons must pass around the circuit to produce one mole of oxygen as to produce one mole of hydrogen. Therefore, the volume of O_2 produced will be half the volume of H_2 when the same number of electrons flow. [1]

volume of oxygen = 205 cm^3 [1]