5 (a) Re-write $Mg_{(s)} + 2HC\ell_{(aq)} \rightarrow MgC\ell_{2(aq)} + H_{2(g)}$ in terms of ions.

[2]

(b) Re-write $C\ell_{2(aq)} + 2KBr_{(aq)} \rightarrow Br_{2(aq)} + 2KC\ell_{(aq)}$ in terms of ions.

[2]

Aqueous ions which undergo *no net chemical change* in processes can be removed from both sides of an equation and the species remaining constitute the IONIC EQUATION for the reaction – the usefulness of this procedure is that it emphasises more clearly the changes taking place.

In the reaction $Cu_{(s)} + 2Ag^{1+}_{(aq)} + 2NO_3{}^{1-}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2NO_3{}^{1-}_{(aq)} + 2Ag_{(s)}$ it is evident that the nitrate ions, $NO_3{}^{1-}_{(aq)}$, are identical on the r.h.s. and l.h.s of the equation – removing them generates the ionic equation for the process, namely

$$Cu_{(s)} + 2Ag^{1+}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$$

6 Re-write the following as *ionic* equations by eliminating the spectator ion(s)

(a) $Mg_{(s)} + 2H^{1+}_{(aq)} + 2C\ell^{1-}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + 2C\ell^{1-}_{(aq)} + H_{2(g)}$

[2]

(b) $C\ell_{2(aq)} + 2K^{1+}_{(aq)} + 2Br^{1-}_{(aq)} \rightarrow Br_{2(aq)} + 2K^{1+}_{(aq)} + 2C\ell^{1-}_{(aq)}$

[2]

Ionic equations for **redox** processes can be split into two half-equations (ion-electron equations), one representing the **oxidation process** and the other the *complementary* **reduction process**.

Consider once again the reaction occurring when a spiral of copper wire is placed in a gas jar filled with aqueous silver nitrate solution which can be represented by the following ionic equation:

$$Cu_{(s)} + 2Ag^{1+}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$$

By considering the difference in sub-atomic particles (*i.e.,* electrons) between the two copper-containing species, and also between the two silver-containing species, it is possible to write an equation for the oxidation process and the reduction process:

Oxidation	$Cu_{(s)} - 2e^{-} \rightarrow Cu^{2+}_{(aq)}$	- **loss** of electrons
Reduction	$2Ag^{1+}_{(aq)} + 2e^{-} \rightarrow 2Ag_{(s)}$	- **gain** of electrons

Copper metal, Cu, is the reducing agent since it has been oxidized while the silver(I) ion, Ag^{1+}, is the oxidizing agent since it has been reduced. Remember that

a **good oxidizing agent** is a substance which is *easily reduced* while

a **good reducing agent** is a substance which is *easily oxidized*.

7 Split the following ionic equations into two half-equations, one for the **oxidation process** and the other for the **reduction process** and state both the *oxidizing agent* and *reducing agent*:

(a) $Mg_{(s)} + 2H^{1+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + H_{2(g)}$

Oxidation process .... [1]

Reduction process .... [1]

Oxidizing agent .... [1]

Reducing agent .... [1]

(b) $C\ell_{2(aq)} + 2Br^{1-}_{(aq)} \rightarrow Br_{2(aq)} + 2C\ell^{1-}_{(aq)}$

Oxidation process .... [1]

Reduction process .... [1]

Oxidizing agent .... [1]

Reducing agent .... [1]