**16.4 Half Equations for Complex Redox Reactions**

School labs have a number of very strong oxidants that can be used when a substance needs to be oxidised. These are often very dangerous chemicals that need to be stored well away from other materials, particularly those that are flammable. These chemicals include potassium permanganate, potassium dichromate and potassium chromate. To write the more complex redox reactions of these oxidants you need to follow a specific technique that uses H+(aq) and H2O(l).

Consider the following redox reaction:

MnO4-(aq) + 8H+(aq) 5Fe2+(aq) Mn2+(aq) + 4H2O(l) + 5Fe3+(aq)

We could describe this reaction in words as follows:

We will learn how to develop the overall equation for a more complex reaction such as this.

We begin with the oxidation of iron(II) ions to iron(III) ions with the simple equation:

This is the oxidation half equation.

The conversion of MnO4- to Mn2+ involves reduction. The following steps are required to balance this half equation.

**Step 1. Balance all atoms in the half equation except oxygen and hydrogen.**

**Step 2. Balance the oxygen atoms by adding water (Oxygen atoms react to form water in acidic solutions)**

**Step 3. Balance the hydrogen atoms by adding H+ ions (which are present in acidic solutions)**

Note that the total charge on the left side of the incomplete equations is (-1) + (+8), which equals +7. The total charge on the right side is +2. Balanced equations should have the same total charge on each side.

**Step 4. Balance the charges on both sides of the equation by adding electrons to the more positive side. Add states.**

Now add the oxidation half equation to the reduction half equation to get the overall equation. In this example each Fe2+ ion loses one electron only, so we need to multiple it by 5 to balance the number of electrons used in the reduction reaction.

**Worked Example 16.4a**

**Potassium dichromate (K2Cr2O7) reacts with potassium iodide (KI) in acidified solution. The dichromate ion (Cr2O72-) is reduced to form Cr3+, and the iodide ion (I-) is oxidised to I2.**

**Write:**

1. **The half equation for the oxidation of the I- to I2.**
2. **The half equation for the reduction of Cr2O72- to Cr3+.**
3. **An overall ionic equation for the reaction**

**( the potassium ions are spectator ions and do not appear in the ionic equation)**

1. The oxidation of I- to I2 is represented by a simple equation:
2. The equation to represent the reduction of Cr2O72- to Cr3+ use the 4 steps above using the H+(aq) and H2O(l).

**Step 1**

**Step 2**

**Step 3**

**Step 4**

**Write the overall equation.**

**Textbook Questions (page 283) 9 & 10**