**24 The 3d block**

**Topic summary**

**•**  The **3d block** includes the elements from scandium to zinc inclusive.

**•**  The elements titanium to copper show features associated with **transition metals**, that is variable oxidation states and coloured ions.

**•**  The elements of the 3d block have high melting points, boiling points and densities.

**•**  The first and second ionisation energies increase only slightly across the block from scandium to zinc, as 4s electrons are being removed which are shielded from the nuclear attraction by the inner 3d electrons. The third ionisation energies increase more rapidly as a 3d electron is being removed.

**•**  Most of the elements form M2+ ions by loss of the 4s electrons, and some form M3+ ions as well.

**•**  The elements chromium and manganese have a maximum oxidation number equal to the sum of the numbers of 3d and 4s electrons.

**•**  The ions of all the 3d-block elements form **complex ions** by receiving electrons from two, four or six **ligands**.

**•**  Complex ions may exist in different forms (isomerism) and in different shapes (stereoisomerism).

**•**  The stability of the complex is measured by the stability constant, *K*stab.

**•**  Some ligands join onto the metal ions by more than one pair of electrons. These form **chelates**, which are especially stable.

**•**  d0 and d10 ions are colourless. Other d-block ions are coloured because of **d-to-d transitions** in the visible region of the spectrum.