1330: Transition elements

(Transition elements are used as catalysts in organic chemical reactions. The vacant *d* and *f* atomic orbitals play a key role. Check the energy level relationship with the *s* and *p* orbitals involved in bonding.)

Key words: Main group elements; Transition elements; Lanthanides (Lanthanide family); Actinides (Actinide family); Spin-orbital interaction

Please read this while looking at the periodic table posted. The transition elements (blue and purple parts) are a group of elements between the main group elements (orange parts) in the periodic table that have little vertical chemical similarity like the main group elements but have more horizontal similarity.

As explained in **1310**, the energy levels of atomic orbitals also change depending on the azimuthal and magnetic quantum numbers. The separated energy levels are shown in Figure 1.

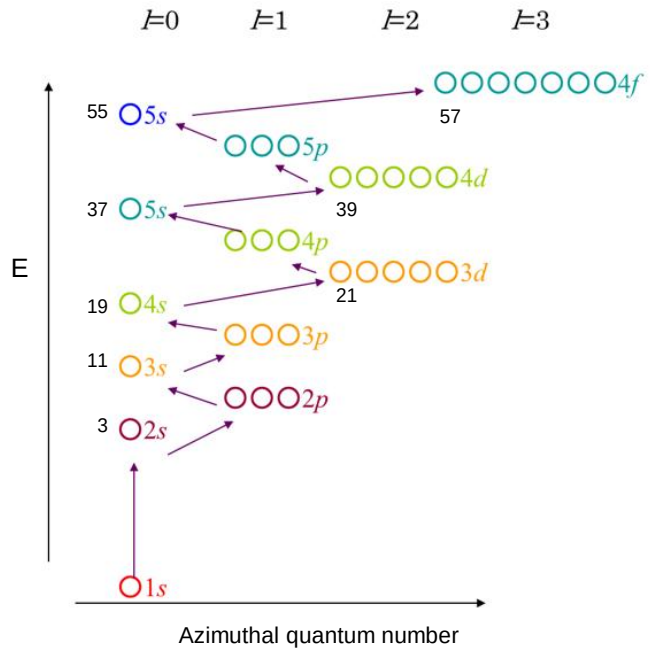

Figure 1. Changes in energy levels due to azimuthal and magnetic quantum numbers. In multi-electron atoms, electrons occupy these orbitals in ascending energy order according to Hund's rule (the numbers indicate the atomic numbers).

The first transition element to appear is Sc (scandium) at number 21. Looking at the electronic configuration, we can see that Zn returns to being a typical element as an electron enters the 3*d* atomic orbital and the 3*d* orbital become full. Similarly, the next transition elements start with **Y** (yttrium) and end with Cd (cadmium), and looking at their electronic configurations, they are in the 4*d* orbital row.

In lanthanides and actinides, when an electron enters one of the *d* orbitals, a phenomenon occurs in which the energy level of the *f* orbital is lower than the other *d* orbitals (spin-orbit interaction), causing a complex change in the electronic configuration. This is an area that is not very relevant to organic chemistry, so it should not be a problem if you do not know the details.

The chemical properties of an element are generally determined by the *s* and *p* orbitals of the atomic valence orbitals. The similarities in the chemical properties of transition elements can be understood from their electronic configurations.