Transition Elements Overview

Here is the text extracted from the image:

1. The elements with partly filled d-subshells in their atoms or in common oxidation states are known as transition elements. The word transition is used because these elements are placed between electropositive metals (s-block elements) and electronegative nonmetals (p-block elements).
    - All the d-block elements are transition elements, except **Zn**, **Cd**, and **Hg**, because they do not show the properties of transition elements.
2. The general electronic configuration of transition elements is $(n-1)d^{1-10}ns^{0-2}$.
3. There are four transition series, called **3d**, **4d**, **5d**, and **6d** series. The elements present in them are:
    - **3d**: $3d_{21}Sc - 30Zn$
    - **4d**: $4d_{39}Y - 48Cd$
    - **5d**: $5d_{57}La, 72Hf - 80Hg$
    - **6d** starts with $89Ac$, but is incomplete.
4. All the transition elements are metals. They are less metallic than alkali and alkaline earth metals. They are all solids at room temperature, except **Hg**, which is liquid. They have high density, melting points, and boiling points. They form metallic bonds.
5. The transition elements (metals) exhibit all three types of structures: hexagonal close-packed, face-centred cubic, and body-centred cubic. The co-ordination numbers are high and range from 8 to 12.
6. The strength of metallic bond first increases and then decreases on moving from left to right. Greater the number of unpaired electrons, stronger is the metallic bond and hence higher is the melting point and more will be the enthalpy of atomisation. That is why melting points first rise to a maximum in group 6 and then fall.
    - The melting point and enthalpy of atomisation increase down the group.
7. The atomic and ionic radii of these elements decrease very slightly from left to right. In the case of transition elements, the added electron occupies an underlying (n-1)d shell which provides not much shielding effect for the outermost electrons. Therefore, a smaller decrease in size is expected.
    - In a group, there is an increase in atomic radius with an increase in atomic number. But due to lanthanoid contraction, the elements of the second and third transition series are very close in sizes as a result of which these elements have similar properties. Ionic radii also vary in a similar manner.
8. The transition elements possess high density and have close-packed structures.
    - In a series, the density increases across the period and reaches a maximum value in group (VIII). This is explained in terms of small radii, more atomic mass, and close-packed structures of the elements.
    - The density increases down the group.
9. In the transition series, the ionisation enthalpies increase along the period but not in a regular manner. The first ionisation enthalpy of **5d** elements is higher than those of **3d** and **4d** elements

due to intervening **4f** electrons, thereby weakening the shielding effect.

- In the **3d** series, second ionisation enthalpy increases almost regularly from **Sc** to **Zn**, except for **Cu** and **Cr** (for these elements, ionisation enthalpies are higher because of extra stability of half-filled and fully filled orbitals).
- Third ionisation enthalpies are quite high, and it is higher for **Mn** than for **Fe** and maximum for **Zn** as **Mn^{2+}** and **Zn^{2+}** have half-filled $\left(3d^5\right)$ and fully filled $\left(3d^{10}\right)$ electronic configurations, respectively. Due to high values of third ionisation enthalpies of **Ni**, **Cu**, and **Zn**, they generally do not possess more than **+2** oxidation states in their compounds.
- $IE_1 + IE_2$ for **Ni** is less than that of **Pt**. Hence, **Ni(II)** compounds are more stable than **Pt(II)** compounds.
- $IE_1 + IE_2 + IE_3 + IE_4$ for **Pt** is greater than that of **Ni**. Hence, **Pt(IV)** compounds are more stable than **Ni(IV)** compounds.