▶ Video explanation (YouTube Short)

Why Transition Metals Have High Melting Points

A tungsten filament glows near 3000 °C without melting (tungsten melts at 3422 °C). Transition metals are hard and melt high because of **strong metallic bonding**.

1. Metallic bonding

Metal atoms release their outer electrons into a "sea" of electrons that holds the positive ions together.

2. The d electrons join in (NCERT 4.3.1)

In transition metals, **(n−1)d electrons** take part in interatomic metallic bonding **in addition to the ns electrons**. More bonding electrons → stronger metallic bonds → harder metal, higher melting and boiling points, low volatility.

3. The trend across the 3d series

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
1541	1668	1910	1907	1246	1538	1495	1455	1085	420

Melting points (°C) rise to a **maximum near the middle** of the series (about d^5), then fall; **Mn** (and Tc in the 4d series) is anomalously low.

4. Zinc, cadmium and mercury

With a full d^{10} subshell they have no unpaired d electrons for bonding, so their metallic bonding is weak: Zn 420 °C, Cd 321 °C, Hg −39 °C (a liquid at room temperature).

Solved example

Q. Why is the melting point of chromium (1907 °C) much higher than that of zinc (420 °C)?
A. Chromium ($3d^5 4s^1$) has many unpaired electrons that take part in metallic bonding; zinc ($3d^{10} 4s^2$) has none in 3d, so its metallic bonding is much weaker.

Key takeaways

- (n−1)d + ns electrons in metallic bonding → high melting points.
- Maximum near the middle of a series; Mn anomalous.
- Zn, Cd, Hg (d^{10}) melt low; Hg is a liquid.

Practice questions

1. (MCQ) Transition metals have high melting points mainly because of: (a) ionic bonding (b) participation of d electrons in metallic bonding (c) hydrogen bonding (d) small mass
2. (MCQ) Lowest melting point in the 3d series: (a) Cr (b) Fe (c) Zn (d) V

3. (MCQ) Which metal is a liquid at room temperature? (a) Zn (b) Cd (c) Hg (d) Cu
4. (Very short) Which 3d metal shows an anomalously low melting point in the middle of the series?
5. (Very short) Name the transition metal used in bulb filaments.
6. (Short) Why do melting points rise to a maximum near the middle of the 3d series?
7. (Short) Why are the melting points of Zn, Cd and Hg low?
8. (Application) Arrange in increasing melting point: Zn, Cr, Cu.

Answer key

1. (b).
2. (c) Zn.
3. (c) Hg.
4. Manganese.
5. Tungsten (W).
6. The number of unpaired d electrons available for metallic bonding increases up to the middle (about d^5), then decreases as electrons pair up.
7. Their d subshell is full (d^{10}), so no d electrons take part in metallic bonding; the bonding is weak.
8. Zn (420) < Cu (1085) < Cr (1907).

▶ Watch the video explanation