▶ Video explanation (YouTube Short)

What Makes an Element a Transition Element?

Zinc sits in the d-block, yet it is not called a transition metal. The test is about the **d subshell**.

1. The definition (NCERT 4.1)

A **transition element** has an **incompletely filled d subshell** either in its atom (ground state) or in any of its common ions (oxidation states).

2. Three worked cases

Element	Atom	Common ion	d subshell	Transition metal?
Iron, Fe	[Ar] $3d^6\ 4s^2$	Fe^{2+} $3d^6$, Fe^{3+} $3d^5$	incomplete	Yes
Copper, Cu	[Ar] $3d^{10}\ 4s^1$ (full)	Cu^{2+} $3d^9$	incomplete in the ion	Yes
Zinc, Zn	[Ar] $3d^{10}\ 4s^2$	Zn^{2+} $3d^{10}$	always full	No

When a d-block atom forms an ion, the **4s electrons leave first**, then 3d electrons.

3. Group 12

Zinc, cadmium and mercury have a full $(n-1)d^{10}$ subshell in the atom and in their common ions, so they are **not regarded as transition metals**, although they are d-block elements. (They are still studied with them.)

Solved example

Q. Silver is [Kr] $4d^{10}\ 5s^1$. Is it a transition element?
A. Yes. Its d subshell is full in the atom, but silver also forms Ag^{2+} ($4d^9$, e.g. in AgF_2), where the 4d subshell is incomplete.

Key takeaways

- Transition element = incomplete d subshell in the atom or a common ion.
- Cu ($3d^{10}$ atom) qualifies through Cu^{2+} ($3d^9$).
- Zn, Cd, Hg (always d^{10}) are d-block but not transition metals.

Practice questions

1. (MCQ) Which is NOT a transition metal? (a) Fe (b) Cu (c) Zn (d) Cr
2. (MCQ) The configuration of Cu^{2+} is: (a) $3d^{10}$ (b) $3d^9$ (c) $3d^8\ 4s^1$ (d) $3d^{10}\ 4s^1$
3. (MCQ) When Zn forms Zn^{2+}, the electrons removed are: (a) two 3d (b) one 3d, one 4s (c) two 4s (d) none

4. (Very short) Write the electronic configuration of Fe.
5. (Very short) Name the three group-12 elements.
6. (Short) Copper has a full 3d subshell in its atom. Why is it still a transition metal?
7. (Short) Why are Zn, Cd and Hg not regarded as transition metals?
8. (Application) Sc is [Ar] $3d^1\ 4s^2$ and Sc^{3+} is $3d^0$. Is scandium a transition element? Give a reason.

Answer key

1. (c) Zn.
2. (b) $3d^9$.
3. (c) two 4s.
4. [Ar] $3d^6\ 4s^2$.
5. Zinc, cadmium, mercury.
6. Its common ion Cu^{2+} is $3d^9$, an incompletely filled d subshell.
7. Their d subshell is full (d^{10}) in the atom and in their common ions.
8. Yes: the scandium atom has an incomplete 3d subshell ($3d^1$), which is enough by the definition.

▶ Watch the video explanation