



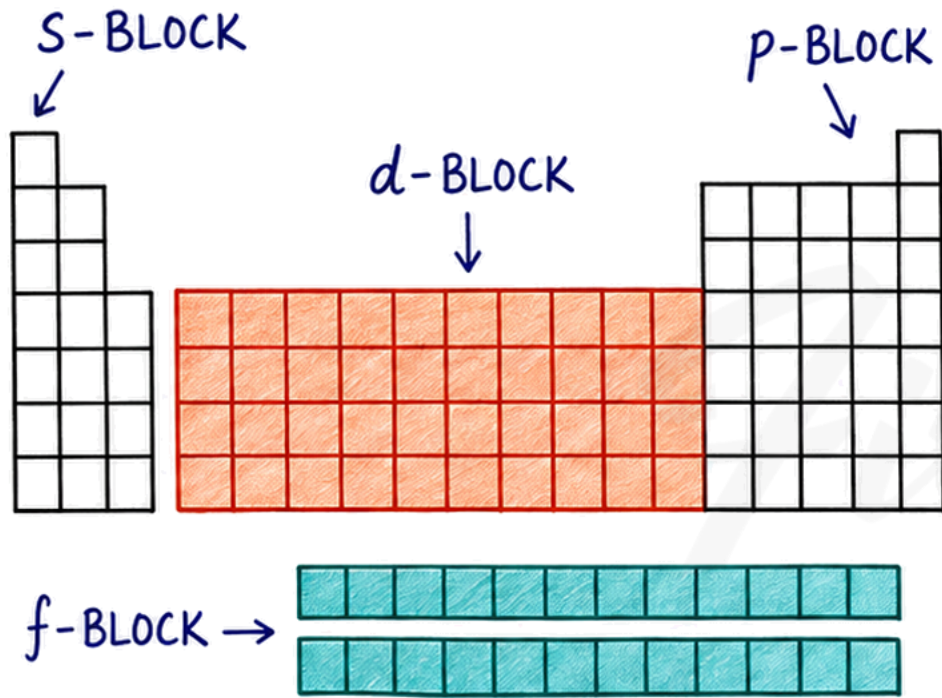
CHEMISTRY • CLASS 12

CHAPTER 4

The d- and f-Block Elements

CHAPTER NOTES

THE d- AND f-BLOCK ELEMENTS



d-block: Groups 3-12;
($n-1$)d orbitals are progressively filled.

f-block: 4f and 5f orbitals are progressively filled; shown separately below the main table.



TRANSITION ELEMENTS
for d-block chemistry



INNER TRANSITION ELEMENTS
for f-block chemistry



d-BLOCK $\neq$
automatically a
transition element

3d: Sc $\rightarrow$ Zn

4d: Y $\rightarrow$ Cd

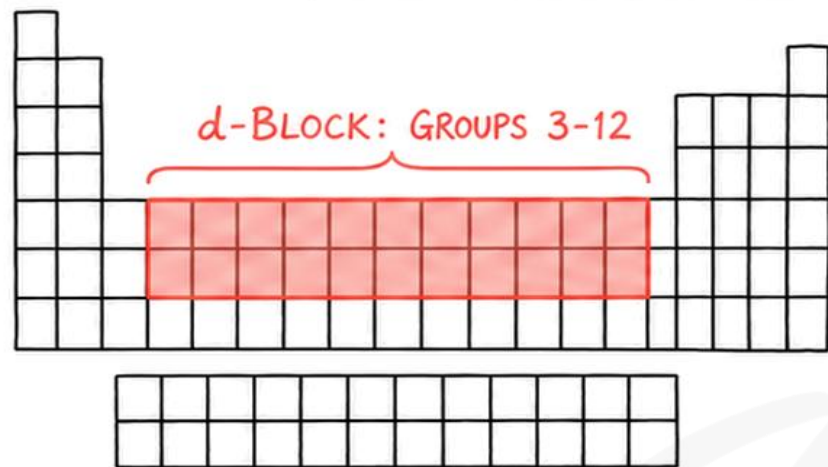
5d: La, Hf $\rightarrow$ Hg

6d: Ac, Rf $\rightarrow$ Cn

4f: Ce $\rightarrow$ Lu = LANTHANOIDS

5f: Th $\rightarrow$ Lr = ACTINOIDS

TRANSITION ELEMENTS: POSITION & DEFINITION



atom has
incomplete d?

OR

cation has
incomplete d?

TRANSITION ELEMENT

A transition element is an element whose **ATOM** has an incomplete d subshell, OR which can form **CATIONS** with an incomplete d subshell.

Sc: $[\text{Ar}] 3d^1 4s^2$
→ incomplete d → transition

Fe^{2+} : $[\text{Ar}] 3d^6$
→ incomplete d → transition

Ag^{2+} : $[\text{Kr}] 4d^9$
→ incomplete d → transition

Zn: $[\text{Ar}] 3d^{10} 4s^2$;
 Zn^{2+} : $[\text{Ar}] 3d^{10}$
→ filled d →
not a transition element

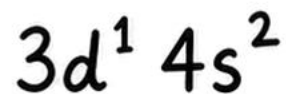
d-BLOCK ELEMENT $\neq$ ALWAYS A TRANSITION ELEMENT

Zn, Cd and Hg are normally excluded because their atoms and common ions are d^{10} .

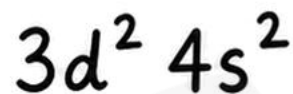
FIRST-ROW d-BLOCK CONFIGURATIONS

All configurations shown outside the [Ar] core.

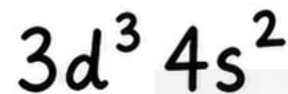
Sc



Ti



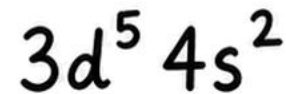
V



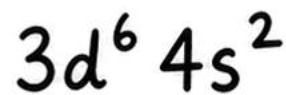
Cr



Mn



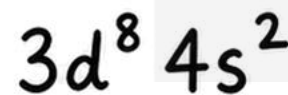
Fe



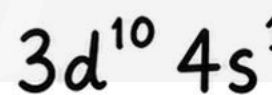
Co



Ni



Cu



Zn



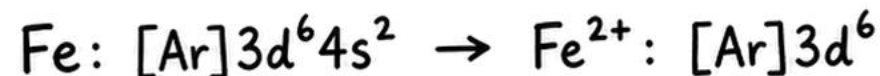
Expected Cr: $3d^4 4s^2 \rightarrow$ actual $3d^5 4s^1$

Expected Cu: $3d^9 4s^2 \rightarrow$ actual $3d^{10} 4s^1$

Small 3d-4s energy separation allows redistribution;
half-filled d^5 and filled d^{10} arrangements gain stability.

CATION RULE

When ordinary cations form, 4s electrons
are removed before 3d electrons.



HEAVIER d-SERIES: KEY CONFIGURATIONS

4d SERIES — outside [Kr]

Nb $4d^4 5s^1$

Mo $4d^5 5s^1$

Tc $4d^5 5s^2$

measured ground state;
not $4d^6 5s^1$

Ru $4d^7 5s^1$

Rh $4d^8 5s^1$

Pd $4d^{10} 5s^0$

outer s orbital empty

Ag $4d^{10} 5s^1$

5d SERIES — outside [Xe]4f¹⁴

Hf $5d^2 6s^2$

Ta $5d^3 6s^2$

W $5d^4 6s^2$

Ir $5d^7 6s^2$

Pt $5d^9 6s^1$

Au $5d^{10} 6s^1$

Hg $5d^{10} 6s^2$

$(n-1)d^{1-10} ns^{0-2}$

Small d-s energy gaps make exceptions common; measured configurations override simple filling rules.

6d superheavy configurations are often predicted or model-dependent — do not treat a simple pattern as exact data.



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