# d-block configurations and the Cr, Cu exceptions

24
Cr
Chromium

29
Cu
Copper

Why do chromium and copper break the filling rule?

The d- and f-Block Elements · NCERT 4.2

# The general configuration

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

Inner (n−1)d holds 1 to 10 electrons; outer ns holds 1 or 2.

4s fills before 3d.

Exception in 4d: palladium is $4d^{10}\ 5s^{0}$.

# The 3d series at a glance

Sc: $3d^1\ 4s^2$

Ti: $3d^2\ 4s^2$

V: $3d^3\ 4s^2$

Cr: $3d^5\ 4s^1$ ← exception

Mn: $3d^5\ 4s^2$

Fe: $3d^6\ 4s^2$

Co: $3d^7\ 4s^2$

Ni: $3d^8\ 4s^2$

Cu: $3d^{10}\ 4s^1$ ← exception

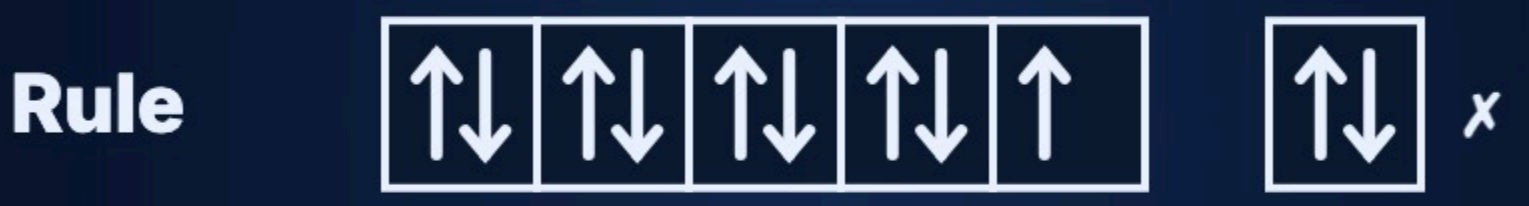
Zn: $3d^{10}\ 4s^2$

# Chromium: $3d^5\ 4s^1$




Not $3d^4\ 4s^2$: one 4s electron moves to 3d, giving a **half-filled $d^5$** set.

# Copper: $3d^{10}\ 4s^{1}$




Not $3d^{9}\ 4s^{2}$: one 4s electron moves to 3d, giving a **completely filled $d^{10}$** set.

# Why?






$d^5$



$d^{10}$

**3d and 4s are very close in energy**, so a small gain decides it.

**Half-filled ($d^5$) and full ($d^{10}$)** sets are extra stable (exchange energy, symmetry).

# Quick check




?

Molybdenum sits just below chromium. Write its configuration.

Hint: think like chromium.