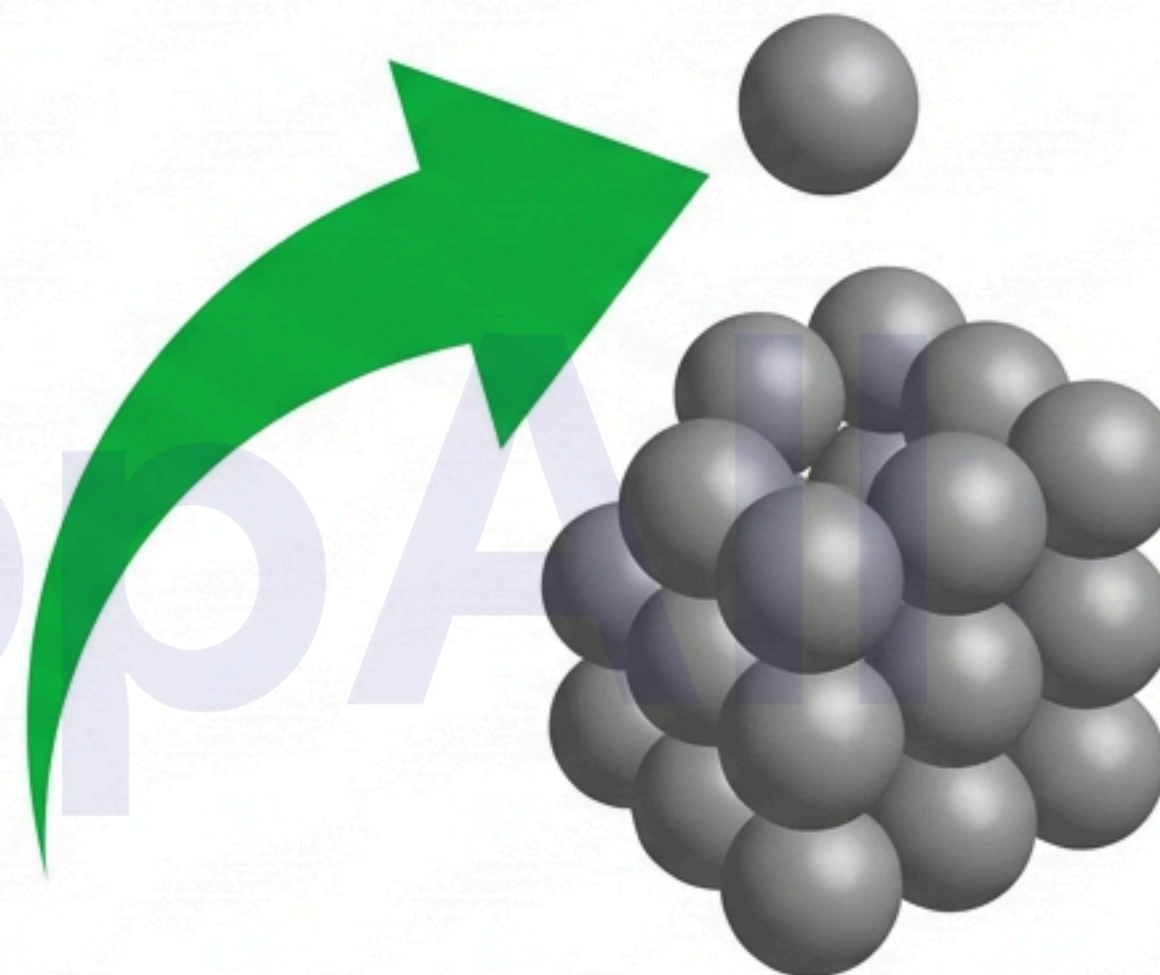


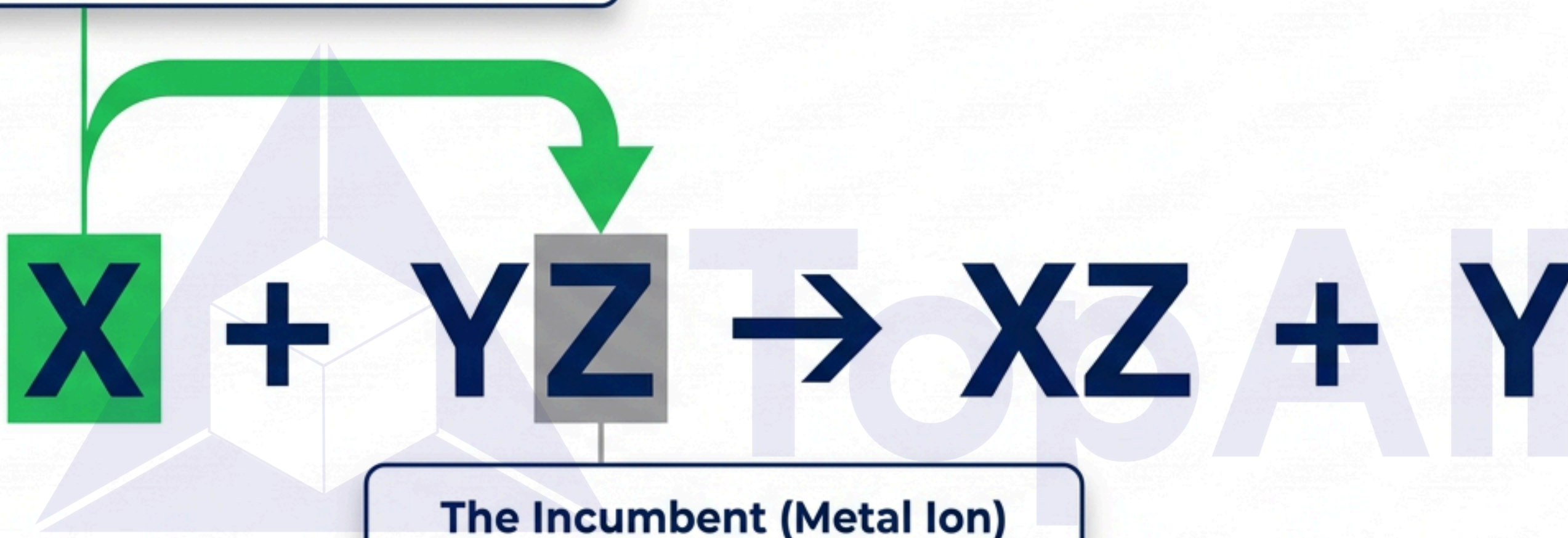
The Stronger Metal Takes Over

Metal Displacement
Redox Reactions



The Invader (Uncombined Metal)

Must be more reactive (a better electron donor) than Y.



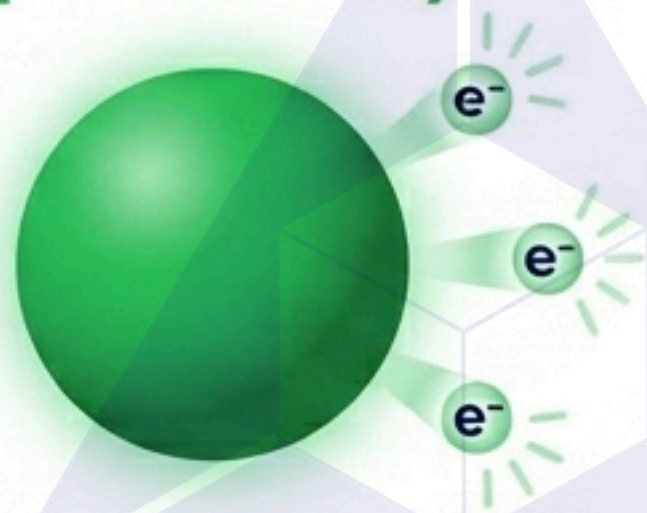
The Incumbent (Metal Ion)

Forced to accept electrons and precipitate out as a pure solid.

Core Rule: A metal in a compound can only be displaced by another metal in the uncombined state if the uncombined metal is a stronger reducing agent.

The Micro-Mechanism: Competition for Electrons

Better Electron Donor (Reductant)

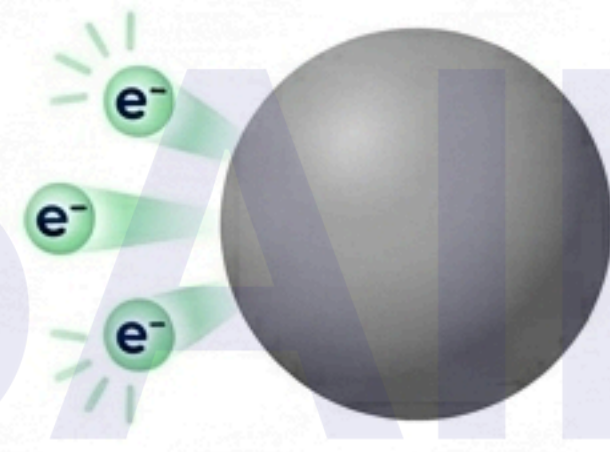


Has a higher capability
to lose electrons.

Undergoes Oxidation.



Forced Electron Acceptor



Cannot hold onto its
non-metal partner.

Undergoes Reduction.

Reducing Agent (Strong) + Oxidizing Agent (Weak) → Products



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$$E=mc^2$$



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The Classic Laboratory Proof

State 1 (Before)



Blue Cu^{2+} aqueous solution
+ Solid Zn strip.



State 2 (After)



Colorless Zn^{2+} aqueous solution
+ Reddish Cu solid deposit.



Scaling Up: The Engine of Metallurgy

Displacement reactions are the primary tools used to extract pure, valuable metals from rocky ores.

1. The Raw Ore



Metal compound found in nature (e.g., Oxides, Chlorides). Target metal is trapped in a positive oxidation state.

2. The Reductant Tool



Introduce a **stronger metal** (like Ca, Mg, Al) to force electrons onto the trapped metal ions.

3. The Pure Metal



Target metal is displaced, dropping to a 0 oxidation state, yielding pure industrial metal.

Heavy-Duty Extraction: The Ore-to-Metal Matrix

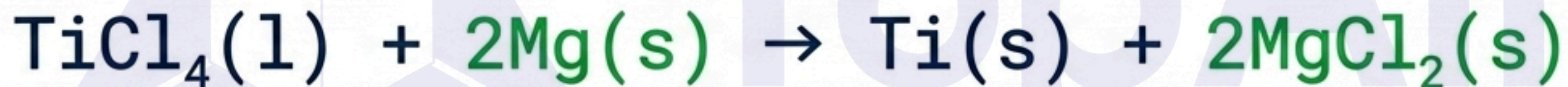


Ore (Reactant) | Active Metal (Reductant) | Pure Metal (Product)

Vanadium Extraction



Titanium Extraction

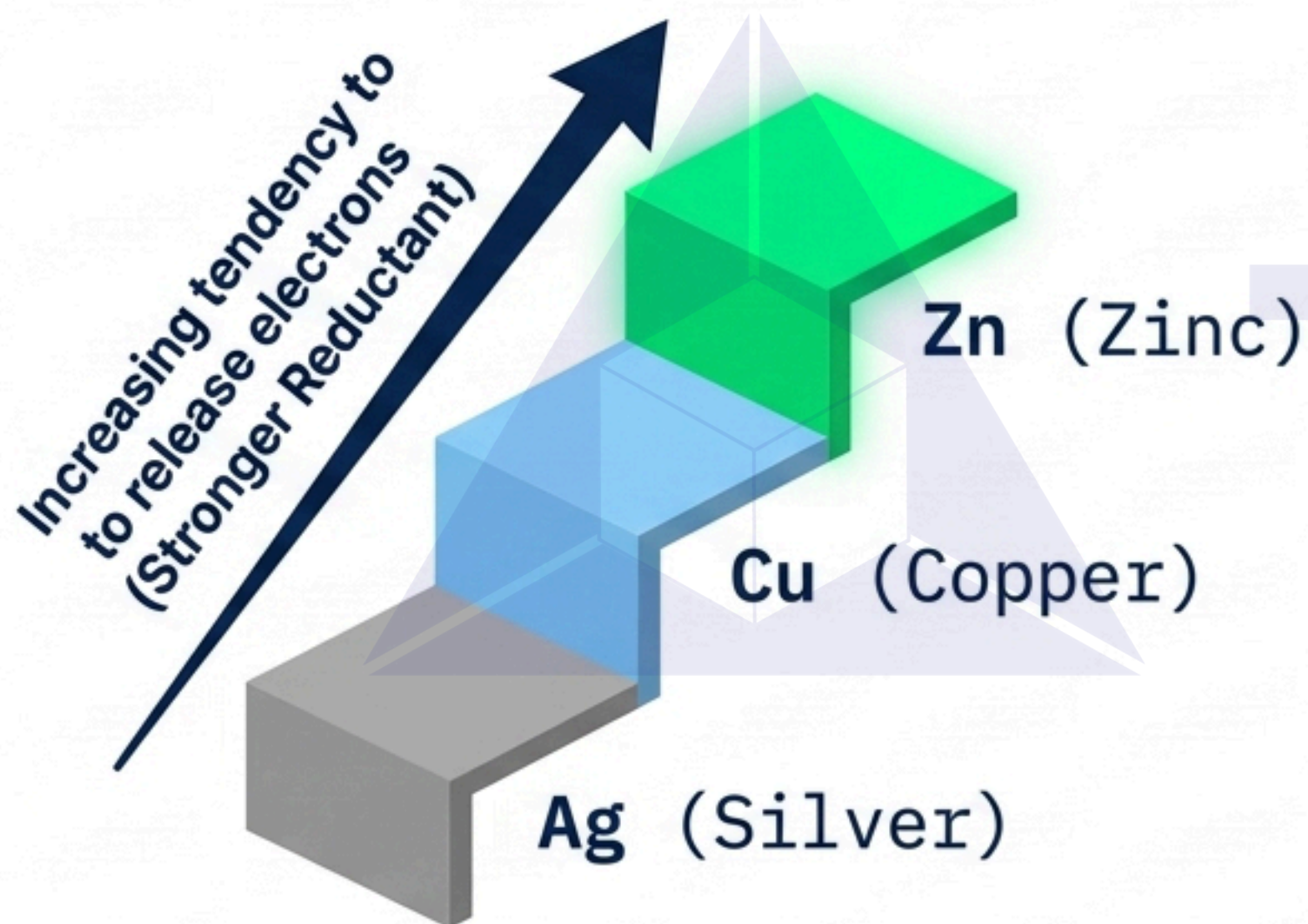


Chromium Extraction



Takeaway: Ca, Mg, and Al act as the ultimate electron-donating bullies of the periodic table.

NEET Exam Summary: The High-Yield Cheat Sheet



Hierarchy: $\text{Zn} > \text{Cu} > \text{Ag}$

Oxidation State Rule

The displaced metal always drops to an oxidation state of 0 (uncombined solid).

Reductant Identification

The metal that gets oxidized (increases in oxidation number) is the Reducing Agent.

The Ultimate Test

If X displaces Y, X is universally a stronger reducing agent than Y.



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