

Chemical Reactivity & E° Values

Thermodynamics vs. Kinetics in Transition Metals

The Players: Two Key Extremes



Noble Metals

Metals with very high **enthalpies of atomisation** and **positive E° values**. They are highly **resistant to oxidation** and tend to be **unreactive** (e.g., Pt, Au).



Reducing Agent

A species that **loses electrons** to **reduce another substance**. In the 3d series, early divalent cations (Ti^{2+} , V^{2+} , Cr^{2+}) are exceptionally strong reducing agents.

The Titanium & Vanadium Disconnect



The Expectation

Ti and V have highly **negative E°** values. Thermodynamics suggests they should react **easily and rapidly** with acids.



The Reality

At room temperature, Ti and V are practically **passive** to dilute non-oxidising acids due to the formation of a stubborn, protective oxide layer.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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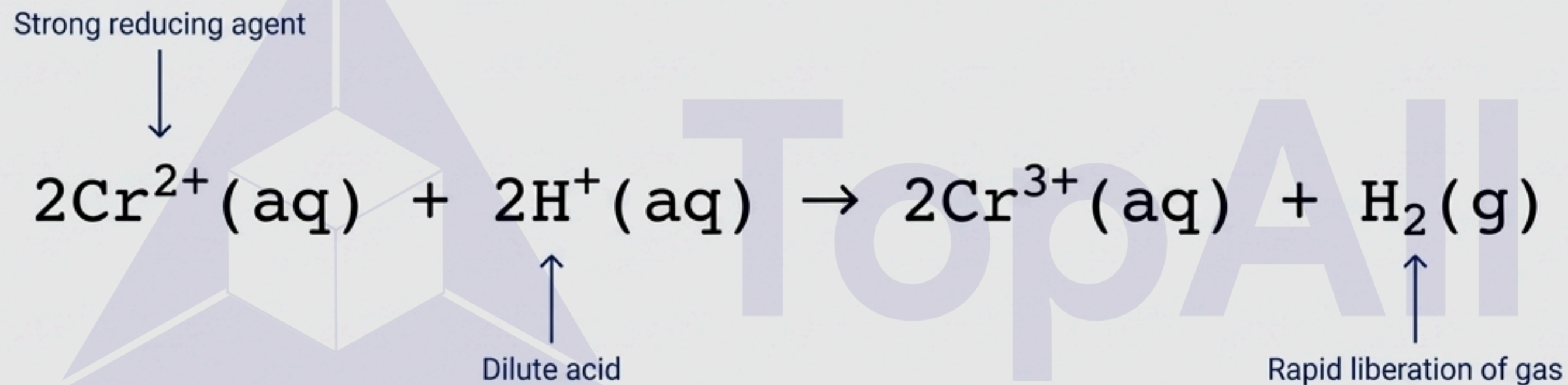
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Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
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Strong Reducing Agents in Action



Cr^{2+} rapidly liberates hydrogen gas from dilute acids, achieving the highly stable d^3 configuration of Cr^{3+} .

 **Watch for this!**

Favorable $E^\circ \neq$ Fast Reaction.

Standard electrode potential (E°) only tells you if a reaction is thermodynamically possible. It tells you absolutely nothing about kinetics (how fast the reaction will actually happen).

Do not assume a highly negative E° means an explosive reaction at room temperature. Kinetics and thermodynamics are separate!

Why are Titanium (Ti) and Vanadium (V) passive to dilute non-oxidising acids at room temperature?

A. Their E° values are highly positive.

B. They are thermodynamically incapable of reacting.

C. They are kinetically slow, despite having favorable E° values.

D. They act as strong oxidizing agents.

Module Complete: Key Takeaways

①

Ti²⁺, V²⁺, and Cr²⁺ are strong reducing agents.

They have a strong tendency to oxidize to the +3 state, with Cr²⁺ easily liberating H₂ from dilute acids.

②

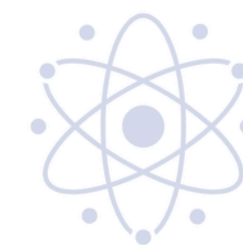
Thermodynamics and kinetics are completely separate.

A favorable (negative) E° indicates a reaction can happen, but elements like Ti and V remain practically passive at room temperature due to slow kinetics.



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