

Premium NEET/JEE Revision

4.4 Important Compounds of Transition Elements

Master the chemistry, structures, and oxidizing behaviors of Oxides, Dichromates, and Permanganates.

Low Oxidation States (+2, +3)

Ionic & Basic

MnO

Cr₂O₃

High Oxidation States (+6, +7)

Covalent & Acidic

CrO₃

Mn₂O₇

The Oxygen Advantage

Oxygen stabilizes the highest oxidation states even better than fluorine due to its ability to form multiple bonds.

Highest Mn fluoride is MnF₄, but highest oxide is Mn₂O₇ (tetrahedrally surrounded by O's with a Mn-O-Mn bridge).

The Dichromate Ion



Metal Oxidation State: **Cr(VI)**

Color: **Intense Orange**

The Permanganate Ion



Metal Oxidation State: **Mn(VII)**

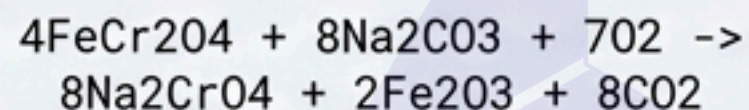
Color: **Dark Purple**

In these higher oxides, acidic character predominates, driving the formation of powerful oxoanions used as industrial oxidants.

Preparation of Potassium Dichromate

Step 1: Fusion

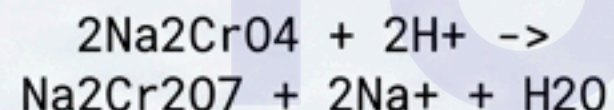
Chromite ore fused with carbonate in air.



Yellow Sodium Chromate

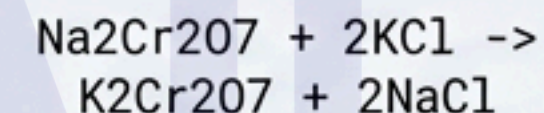
Step 2: Acidification

Acidified with sulphuric acid.



Orange Sodium Dichromate

Step 3: Conversion



Why use KCl?

Sodium dichromate is highly soluble. Treating it with KCl precipitates the much less soluble $\text{K}_2\text{Cr}_2\text{O}_7$ as orange crystals.



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

$$E=mc^2$$



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Practice Now

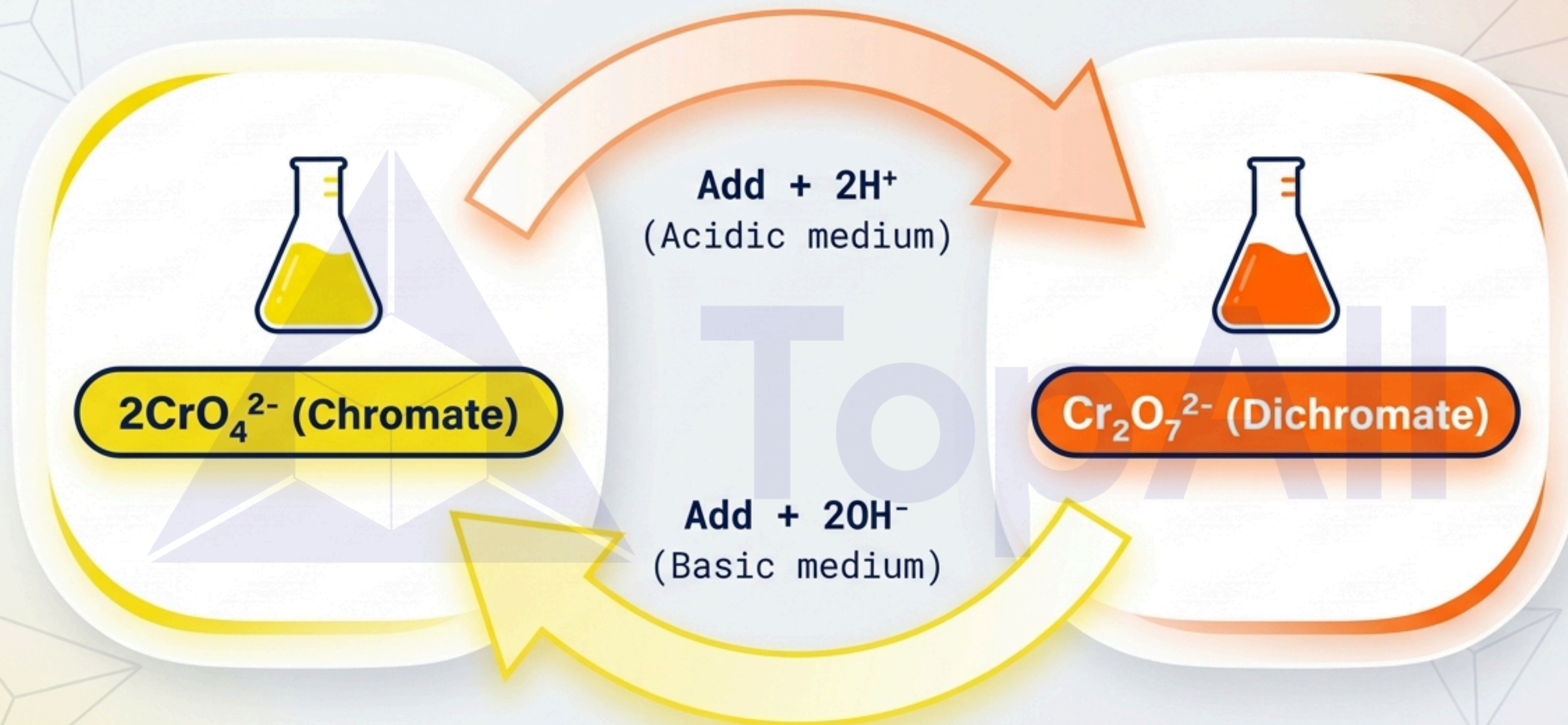


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- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter





CRUCIAL: The oxidation state of Chromium remains exactly +6 in both forms!

Preparation of Potassium Permanganate

Step 1: Alkaline Fusion

Pyrolusite fused with KOH and O₂ (or KNO₃).



Dark Green Potassium Manganate

Step 2: Electrolytic Oxidation

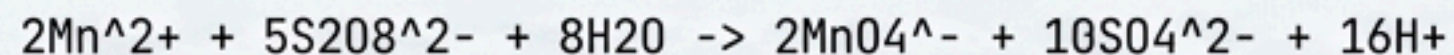
Oxidized in alkaline solution.



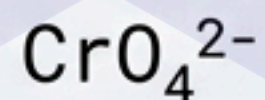
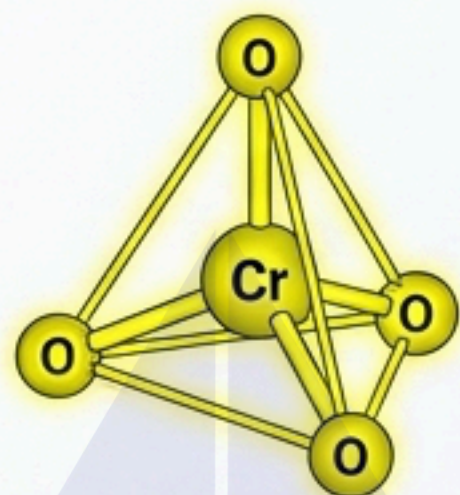
Purple Permanganate

Laboratory Preparation

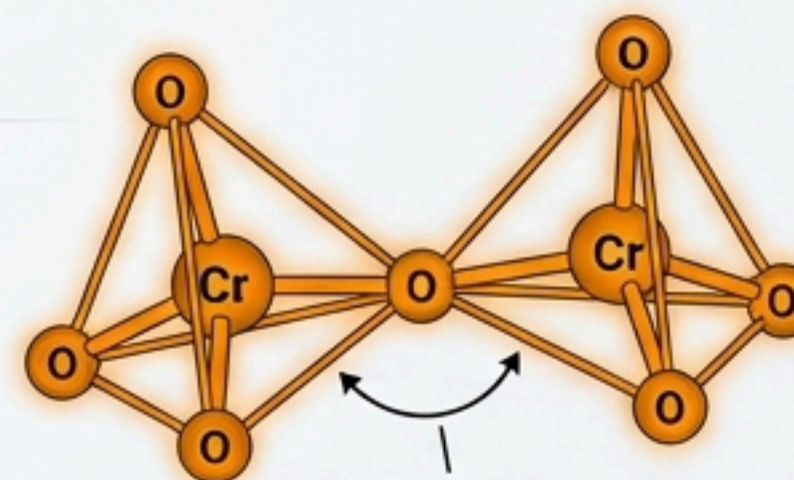
Mn²⁺ salt is oxidized by peroxodisulphate.



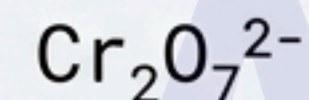
Chromate (CrO_4^{2-})



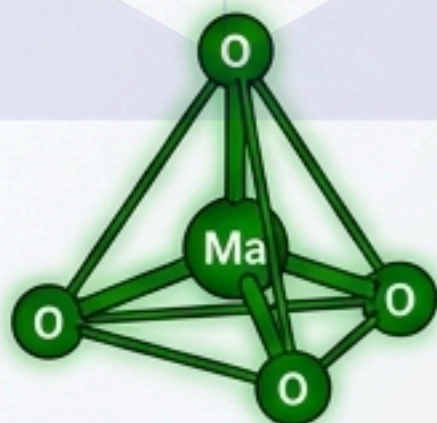
Dichromate ($\text{Cr}_2\text{O}_7^{2-}$)



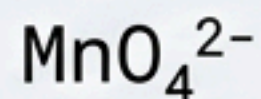
Cr-O-Cr bond angle = 126°



Manganate (MnO_4^{2-})



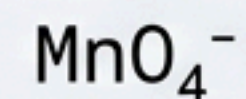
Paramagnetic (1 unpaired e-)



Permanganate (MnO_4^-)

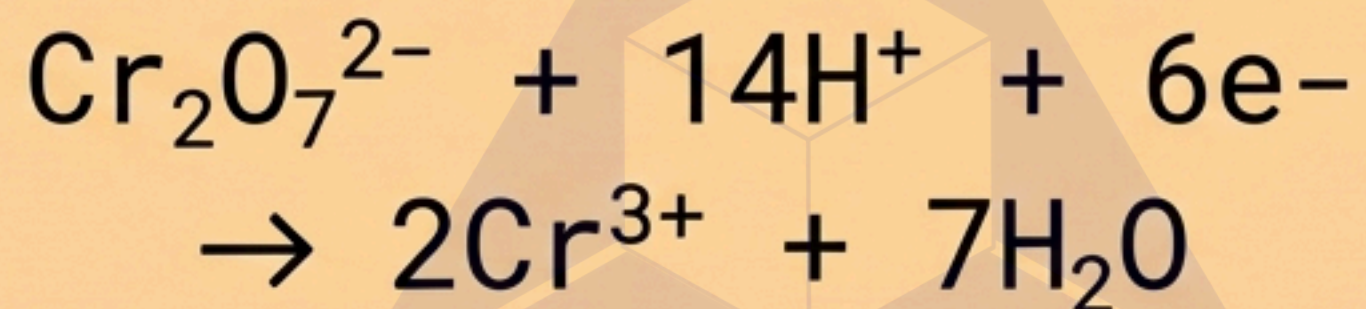


Diamagnetic (0 unpaired e-)
Bonding via O(p-orbital) overlap with Mn(d-orbital)



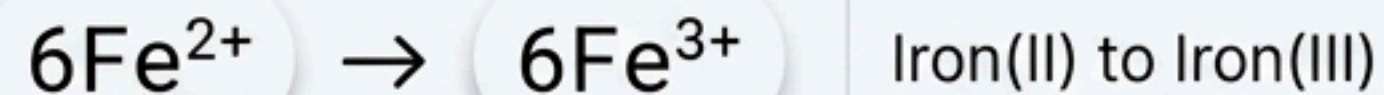
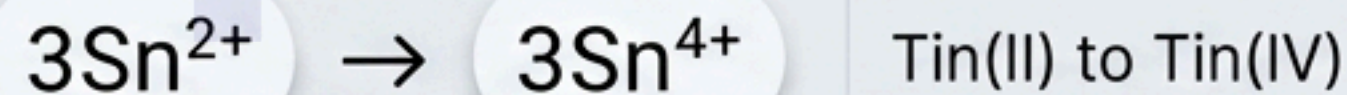
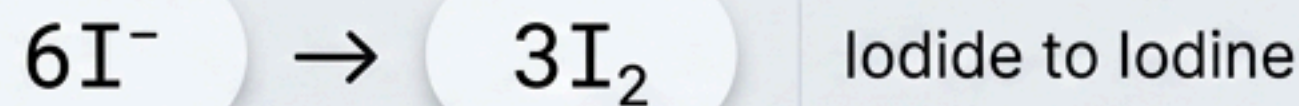
Oxidising Action of K₂Cr₂O₇ (Acidic Medium Only)

Main Half-Reaction



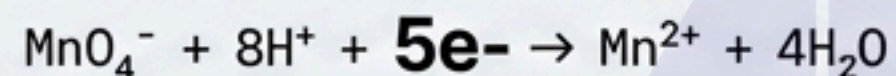
$$E^\circ = +1.33\text{V}$$

Key Reductions



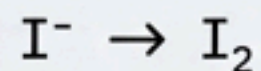
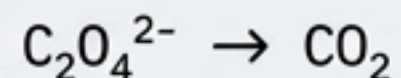
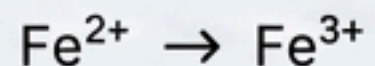
Permanganate's pH-Dependent Power

Acidic Medium

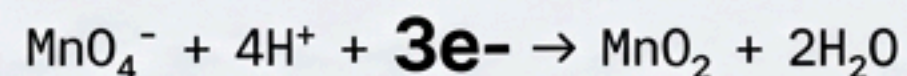


+1.52V

Key Conversions

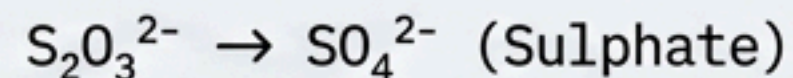
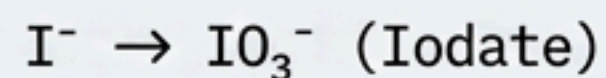


Neutral / Faintly Alkaline



+1.69V

Key Conversions



Strongly Alkaline



+0.56V



Exam Trap: Disproportionation!

Disproportionation occurs when an oxidation state becomes less stable relative to others, simultaneously oxidizing to a higher state and reducing to a lower state.

The Classic Example: Manganate(VI) in acidic solution.



Never titrate KMnO_4 with HCl ! Permanganate is strong enough to oxidize Cl^- to Cl_2 gas, ruining the titration.

Quick Revision: Dichromate vs. Permanganate



Feature	Potassium Dichromate	Potassium Permanganate
Formula & Metal Ox. State	$\text{K}_2\text{Cr}_2\text{O}_7$ (+6)	KMnO_4 (+7)
Source Ore	Chromite Ore (FeCr_2O_4)	Pyrolusite Ore (MnO_2)
Visual Color	Intense Orange	Dark Purple
Geometry	Two linked tetrahedra (126° angle)	Single tetrahedron
Magnetic Property	Diamagnetic	Diamagnetic (Temp-dependent weak para)
Active Oxidizing Medium	Acidic Only	Acidic, Neutral, and Alkaline



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