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D & F-BLOCK ELEMENTS

last e⁻ in d-subshell
(n-1)d n → valence shell
(n-1) penultimate shell.
General configuration - (n-1)d¹⁻¹⁰ ns⁰⁻²

TRANSITION ELEMENTS

→ An completely filled d-orbital either in ground state or in oxidation state.

Zn → [Ne] 4s² 3d¹⁰ ground state
Zn²⁺ → [Ar] 3d¹⁰ 4s⁰ oxidation state
Zn, Cd, Hg (Not transition elements).
3d - Sc²¹ Ti²² V²³ Cr²⁴ Mn²⁵ Fe²⁶ Co²⁷ Ni²⁸ Cu²⁹ Zn³⁰
4d - Y³⁹ Zr⁴⁰ Nb⁴¹ Mo⁴² Tc⁴³ Ru⁴⁴ Rh⁴⁵ Pd⁴⁶ Ag⁴⁷ Cd⁴⁸
5d - La⁵⁷ Hf⁷² Ta⁷³ W⁷⁴ Re⁷⁵ Os⁷⁶ Ir⁷⁷ Pt⁷⁸ Au⁷⁹ Hg⁸⁰
6d - Ac⁸⁹ Rf¹⁰⁴ Db¹⁰⁵ Sg¹⁰⁶ Bh¹⁰⁷ Hs¹⁰⁸ Mt¹⁰⁹ Ds¹¹⁰ Rg¹¹¹ Cn¹¹²
Lanthanoids; 58 - 71
Actinoids; 90 - 103

D-BLOCK

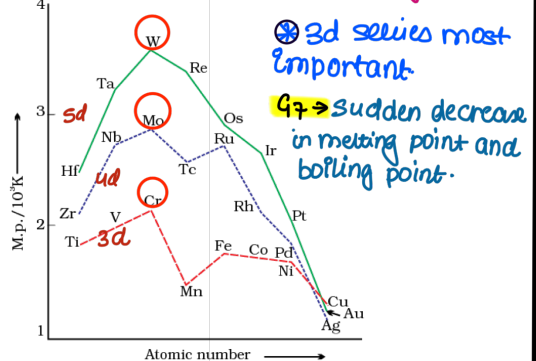
21	22	23	24	25	26	27	28	29	30
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
39	40	41	42	43	44	45	46	47	48
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
57	72	73	74	75	76	77	78	79	80
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
89	104	105	106	107	108	109	110	111	112
Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn

PROPERTIES

→ High tensile, malleable, ductile, lustrous
electrical conductivity, less volatile
→ Generally in crystal lattice.
Zn, Cd, Hg, Mn → do not form lattice.

MP and BP:

Metallic bonding & No. of unpaired e⁻ MP/BP
Cr → 6 unpaired e⁻ G₆
Mo → (max) G₁₂
W → (min) BP & MP
Cd 0 unpaired electron
Hg 0 unpaired electron



ENTHALPY OF ATOMISATION

energy required to break metal lattice & convert into gaseous.



ATOMIC SIZE :- *

3d → Sc > Ti > V > Cr > Mn > Fe > Co > Ni < Cu < Zn
Z_{eff} > screening effect. Z_{eff} ≈ screening effect. Z_{eff} < screening effect.
Factors; Atomic size ∝ 1/Z_{eff} & screening effect

NOTE:

→ 3d < 4d ≈ 5d
P₄ P₅ P₆

IONISATION ENERGY:-

2, 6, 7
3d → Sc < Ti > V < Cr < Mn < Fe > Co > Ni < Cu < Zn
Highest Energy - G₁₂ = Zn, Cd, Hg
Reason = ns² nd¹⁰ stable e⁻ configuration.

OXIDATION STATE:-

→ All d-block elements show variable OS.
Except; Sc and Zn
Entire periodic table → max OS = +8
Max OS in d-block = Mn
MnF₂ does not exist, why?
F Mn F Steric hindrance (Repulsion)
MnO₃F exist, why? F Mn O O multiple bond

EXCEPT Sc and Zn		Entire Periodic Table	
Sc	Ti	Mn	Fe
+3	+2, +3, +4	+2, +3, +4, +5, +6, +7	+2, +3, +4, +5, +6, +7

HALIDES AND OXIDES

Halide	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Se	TiX ₄	VX ₅	CrX ₃	MnX ₂	FeX ₃	CoX ₂	NiX ₂	CuX ₂	ZnX ₂
No Halide	TiX ₃	VX ₃	CrX ₂	MnX ₃	FeX ₂	CoX	NiX	CuX	ZnX
VCl ₅									

NCERT:-

Cu₂X₂ exist except Cu₂I₂
* Cu⁺ compound unstable in aq^o medium and undergoes disproportionation rxn.
2Cu⁺(aq) → Cu²⁺(aq) + Cu(s)
very stable due to high hydration energy.

OXIDES:-

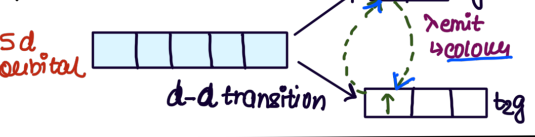
3d series	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Se ₂ O ₃	TiO	VO	CrO	MnO	FeO	CoO	NiO	CuO	ZnO
Ti ₂ O ₃	VO ₂	CrO ₂	Mn ₂ O ₃	Fe ₂ O ₃	Co ₂ O ₃	Ni ₂ O ₃	Cu ₂ O		
Ti ₂ O ₅	VO ₂	CrO ₂	Mn ₂ O ₄	Fe ₃ O ₄	Co ₂ O ₃	Ni ₂ O ₃	Cu ₂ O		

MAGNETIC PROPERTY

Diamagnetic zero unpaired e⁻ Repelled by magnetic field μ = 0
Paramagnetic At least 1 unpaired e⁻ Attract by magnetic field. μ = √n(n+2) BM
Ferromagnetic strong attract

COLOUR OF COMPOUND

→ unpaired e⁻, charge transfer (Max OS)
Sc⁺³ } 0 unpaired
Zn⁺² } colourless



NOTE: We do not use HCl in acidic medium, HCl + KMnO₄ → Mn²⁺ + Cl₂
* V₂O₃ - Basic Cu₂O → Basic
Amphoteric Cu₂O₂ - Acidic
V₂O₅ amphoteric Cu₂O₃ ↑ Mn₂O₇ - Acidic

CATALYTIC PROPERTY:-

Hydrogenation: Ni, Pt, Pd due to variable OS.
Haber's Process: Fe
Contact process: V₂O₅ } p-block

INTERSTITIAL COM*

Interstitial site (H, C, N, B)
* High MP, very hard, chemically inert, electrical conductivity.

ALLOYS:-

→ Mixture of 2 or more metals.
BRASS → Cu + Zn
BRONZE → Cu + Sn
Gun metal → Cu + Zn + Sn
German silver → Cu + Zn + Ni

POTASSIUM DICHROMATE K₂Cr₂O₇

Prep: Chromite ore + washing soda
FeCr₂O₄ Na₂CO₃
FeCr₂O₄ + Na₂CO₃ + O₂ → Na₂Cr₂O₇ + CO₂
Na₂Cr₂O₇ + [H⁺] → Na₂Cr₂O₇ (orange) K₂Cr₂O₇ (orange) Potassium dichromate



* CrO₄²⁻ + H⁺ ⇌ Cr₂O₇²⁻ + OH⁻
Yellow Orange
K₂Cr₂O₇ ⇒ strong oxidising agents
I⁻ → I₂, H₂S → S, Fe²⁺ → Fe³⁺, Sn²⁺ → Sn⁴⁺

Chloride Chromyl Test

Chloride + conc^o H₂SO₄ + K₂Cr₂O₇ → CrO₂Cl₂ (Red vap^o)
Chromyl chloride

POTASSIUM PERMANGANATE KMnO₄

Preparation: MnO₂ ⇒ Pyrolusite Ore
MnO₂ + KOH + O₂ → K₂MnO₄ Manganate (MnO₄²⁻) + H₂O + MnO₂
disproportionation rxn.
commercial Preparation: MnO₂ fused with KOH + HNO₃ → green manganate
MnO₄²⁻ → MnO₄⁻ (purple) permanganate

lab preparation: Mn²⁺ + S₂O₈²⁻ → MnO₄⁻ + SO₄²⁻
* Manganate; Permanganate
green purple
Paramagnetic diamagnetic

NOTE: We do not use HCl in acidic medium, HCl + KMnO₄ → Mn²⁺ + Cl₂
* Acidic medium; Fe²⁺ → Fe³⁺
I⁻ → I₂, S²⁻ → S, SO₃²⁻ → SO₄²⁻
* Neutral / faintly alkaline; Fe²⁺ → Fe³⁺
I⁻ → IO₃⁻