S & P Block:

M.Pt & B.Pt:

→ Across Period:

IA ⟶ IVA

↳ M.Pt/B.Pt ↑

↳ No of bonding es ↑

VA ⟶ VIIIA

↳ M.pt & B.pt ↓

↳ No of bonding es ↓

→ Group:

IA ⟶ IIA T-B

↳ M.pt & B.Pt ↓

↳ size ↑ ↳ loose packing.

VIIA ⟶ VIIIA

Top to bottom

↳ M.Pt & B.Pt ↑

↳ Size ↑ ↳ LDF ↑

3rd Period:

Si > Al > Mg > S > Na

P > Cl > Ar

Electrical Conductivity:

IA ⟶ IIA ⟶ IIIA →

Na Mg Al

↳ Electrical conductivity ↑ ∝ no. of free es ↑

Ag > Cu > Au > Al

Group IA: (Alkali metals).

n↑, e=same

2 Li_s

3 Na_s

4 K_s

5 Rb_s

6 Cs_s

Top to Bottom ↑:

→ Num of shells

→ shielding es

→ size

→ density

→ Reducing power

→ Electro positivity

→ Reactivity

Top to Bottom ↓:

→ M.pt & B.Pt

→ E.A

→ I.E

→ E.N

density order

Li < K < Na < Rb < Cs

Sol $\propto \frac{m}{V}$

① O^{-2} (N.O)
② O_2^{-1} (Per)
③ $O_2^{-1/2}$ (super)

Reactions Of IA:

Elements: Li, Na, K, Rb, Cs

H_2O:
(s) ⟶ (l)
→ Exothermic
→ Hydroxide
→ Basic hydroxide
→ Basic nature ↑
K, Rb, Cs
React at -100℃
$M + H_2O \rightarrow MOH + H_2$

O_2:
(s) ⟶ (l)
oxide:
↳ N.O → white
↳ Per → pale yellow
↳ Super ↳ Orange yellow
(Basicity ↓)
• $Li + O_2 \rightarrow Li_2O$ (N.O)
• $Na + O_2 \rightarrow Na_2O$ (N.O)
↳ Na_2O_2 (P.O)

Cl_2:
(s) ⟶ (l)
chloride
• Li & Na → slow
• K, Rb, Cs → fast
$2Li + Cl_2 \rightarrow 2LiCl$ → max. covalent c. / minimum ionic character
$2Cs + Cl_2 \rightarrow 2CsCl$ → min. covalent c. / maximum ionic character

Group IIA:

Be → more B.P/M.P
Mg → minimum B.P/M.P
Ca
Sr
Ba

H_2O:
$Be + H_2O \rightarrow$ No Rxn
$Mg + H_2O$ (cold) $\rightarrow Mg(OH)_2 + H_2$ → milk of magnesia
$Mg + H_2O$ (steam) $\rightarrow MgO + H_2$
Ca, Sr, Ba (H_2O cold) $\longrightarrow Ca(OH)_2 + H_2$
→ Hydroxide
→ Basic
→ Exothermic

∴ alkali metals are more basic than alkaline earth metals

O_2: (oxide)
→ Amphoteric → BeO → covalent
→ Basic (all other)
(all other ionic)

$Be + O_2 \rightarrow BeO$
$Ca + O_2 \rightarrow CaO$

$Sr + O_2 \rightarrow SrO_2$ } Peroxide
$Ba + O_2 \rightarrow BaO_2$ }

N_2:
$Be + N_2 \rightarrow Be_3N_2$ — Covalent & Volatile
$Ba + N_2 \rightarrow Ba_3N_2$ — Ionic & Non volatile

Cl_2:
$Be + Cl_2 \rightarrow BeCl_2$ → covalent
C.C ↓
I.C ↑
$Ba + Cl_2 \rightarrow BaCl_2$ → Ionic

Group IIIA:

B Al Ga In Th.

Non metal — metals

Reaction of Al:

→ • Air (O_2 & N_2):

Pieces: $Al + O_2 \longrightarrow Al_2O_3$ (pieces) — limited reaction.

Powder: $4Al + O_2 \longrightarrow 2Al_2O_3$ ∴ entraped air during reaction.

$4Al + 2N_2 \longrightarrow 4AlN$

→ • Other Non metals:

$Al + S \longrightarrow Al_2S_3$

$Al + P \longrightarrow AlP$

$4Al + 3C \longrightarrow Al_4C_3$

→ Rxn with Acid & Base:

$Al + HCl \longrightarrow AlCl_3 + H_2$

$Al + NaOH \longrightarrow Na[Al(OH)_4] + H_2$

Al / Al_2O_3 / $Al(OH)_3$ — Amphoteric Nature

Diagonal Relation:

Li Be B C N

Na Mg Al Si P

→ These diagonals have close
→ Electronegativity
→ Stability
→ M.P / B.P

[d-full or empty]
no color

d & f Block Elements

Transition Elements:

↳ Elements having (partial) filled d or f orbitals

Outer Transition Elements (d-block)

Elements: ↳ series:

10 → 3d Sc_{21} — Zn_{30} (4th period)
→ 4d Y_{39} — Cd_{48} (5th period)
→ 5d La — Hf — Hg (6th period) ← Lanthanum is not included in f.b.c Lanthanum
57 72 80
→ 6d:

Inner Transition elements (f-block)

→ Lanthanide: 14 elements (58 — 71)
→ Actinide: 14 elements (90 — 103)

T.E

→ Typical
→ Non-Typical

Typical

All other are typical T.elements.

VIB	IB
Cr $4s^1 3d^5$	Cu $4s^1 3d^{10}$
Mo $5s^1 4d^5$	Ag $5s^1 4d^{10}$
(W) $6s^2 5d^4$	Au $6s^1 5d^{10}$

] both violate E.C except W

↳ Tungsten → doesn't violate E.C

Non-Typical

	IIIB	IIB
3d	Sc	Zn
4d	Y	Cd
5d	La	Hg

] → just make complexes, that's why

Their properties doesnot match with T.E

3d Series:

IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn

Properties: of d-block:

$n \geq 4$

1: Electronic Configuration: $(n-1)d^{1-10} ns^{1-2}$

$Sc_{21} = \underset{K}{1s^2} \; \underset{L=9\bar{e}}{2s^2 2p^6} \; \underset{M=9\bar{e}}{3s^2 3p^6 3d^1} \; \underset{N}{4s^2}$

	M shell	N shell	d unpair	d pair
$Sc_{21} = [Ar]_{18} 4s^2 3d^1$	9	2	1	0
$Cr_{24} = [Ar]_{18} 4s^1 3d^5$	13	1	5	0
$Mn = [Ar]_{18} 4s^2 3d^5$	13	2	5	0

$Fe = [Ar]_{18} 4s^2 3d^6$	14	2	4	0
$Cu = [Ar]_{18} 4s^1 3d^{10}$	18	1	0	5
$Zn = [Ar]_{18} 4s^2 3d^{10}$	18	2	0	5

2: Binding Energy:

B.E ↑ IIIB ⟶ VIIB

B.E ↓ VIIB ⟶ IIB

B.E depends:

B.E ∝ no. of free $\bar{e}$s — max → Vanadium (closely packed)

B.E ∝ stable structure. — minimum → Zinc (no free $\bar{e}$ all paired)

B.E ∝ M.pt / B.pt.

3: Variable Oxidation:

→ Variable oxidation state is due to involvement of 'd' as well as 's' electrons.

→ Common → +2/+3

→ Max → +7 (Manganese)

→ +2 (Zinc)

metal → High oxidation state → Oxidizing agent

→ Low oxidation state → Reducing agent

→ High oxi comp → Covalent

→ Low oxi comp → Ionic

4: Catalytyst:

→ Variable Oxidation state

→ Formation of Intermediate compound.

→ d and s orbital.

T.E elements

element	Cmpd.
Ni / Pt / Pd / Cu / Zn	V_2O_5 / $TiCl_3$

5: Magnetic Properties:

Dia → d^0/d^{10}

Para → d → unpair ē
Para ∝ no. of free ēs

Ferro → (Fe, Ni, Co)

6: Alloy:

→ Mixture of metal + metal
metal + nonmetal (steel)

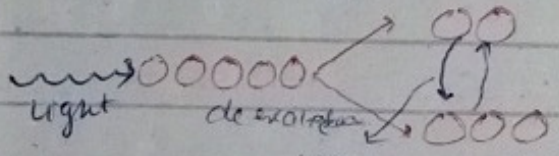
↳ due to comparable → there is no big differences in their sizes.

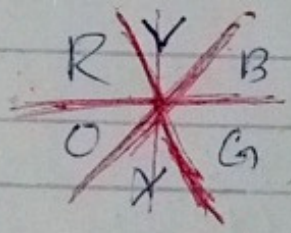
Alloy → chemical → same
↳ physical → change

7: Color Compleres:

↳ due to d-d transition

⇝ When approach by ligand





d^0/d^{10} → colourless.

Metal → Highest O.state → Usually Colourless

But $KMnO_4$ → Pink why?

Co-ordination Compounds:

↳ compounds that maintain their identity in solid state as well as aqueous solution

$K_4[Fe(CN)_6]$ → ligands

Central metal atom → Lewis acid → ē pair acceptor.

ligands
↳ molecules
↳ ions
↳ Lewis base
↳ ē pair donor
↳ ē rich.

$N_2H_4 - H_2N - N_2H_2$ → hydrazine

N_2H_5 → hydrazinium

Bidentate: EN (Ethylene diamine) $\ddot{N}H_2 - CH_2 - CH_2 - \ddot{N}H_2$

$(-ive)C_2O_4^{-2}$ → oxalate ion.

EDTA: Ethylene diamine tetra acetate.

Ligands

Base on charge:
- +ive → H_3O^+, ...
- -ive → halides, OH^-, CN^-, NO_3^-, NO_2^-
- neutral → H_2O, NH_3, CO

Base on e pair:
- monoden. → one e pair. (H_2O, NH_3, CO, halide ions, H_3O^+)
- Polyden. → more than one. EDTA → most stable complexes.

[ ] → Coordination sphere

$K_4[Fe(CN)_6]$ → Ionization sphere

Charge on sphere:
- $K_4^{+4}[Fe(CN)_6]^{-4}$
- $K_3^{+3}[Fe(CN)_6]^{-3}$
- $[Cu^{+2}(NH_3)_4]SO_4^{-2}$

Charge on central metal atom:
- $Cu + 4NH_3 = +2$
  $Cu + 4(0) = +2$
  $Cu = +2$
- $Fe + 6CN = -4$
  $Fe + 6(-1) = -4$
  $Fe = -4 + 6 = +2$

$NO^{+3}[Cr(C_2O_4)_2]^{-3}$

$Cr + 2(-2) = -3$

$Cr - 4 = -3 \Rightarrow -3 + 4 = +1$

Nomenclature:

Rules: $\overset{+}{N}a\overset{-}{Cl}$

→ Cation (1st) + Anion (2nd).
- Cation: simple / Complex
- Anion: simple / complex.

→ within coordination sphere name first ligand and then central metal atom
- prefix → same ligand

→ different ligands → alphabetic order.

→ ligand → same → poly
- prefix → 2 → bis
- 3 → tris
- 4 → tetrakis.

→ oxidation state ( )
→ Name of metal.

Cationic complex → Retain
Anionic complex → add 'ate'

$K_4^{+4}[Fe^{+2}(CN^{-1})_6^{6-}]^{-4}$

Potassium hexa cyano ferrate (II)

$[Cu^{+2}(NH_3^0)_4]^{+2}SO_4^{-2}$

Tetra amine copper (II)

Geometry of Complexes:
depends upon:
→ No. of ligands
→ Size of Ligand
→ Charge on CMI (central metal atom).

Coordination Number 2:
geometry → linear
Hybridization → sp
Angle → → 180°
Example → $[Cu(NH_3)_2]^{+2}$, $[Ag(NH_3)_2]^{+1}$

Coordination Number 4:
①: Geometry → Tetrahedral
Hybridization → sp^3
Angle → 109.5°
Example → $[Cu(Cl)_4]^{-2}$, $[Co(Cl)_4]^{-2}$