P-BLOCK ELEMENTS

Free

Mnemonics for Quick Learning

- "BAl GaIn Tl" – Group 13
- "Can Silly Germans Snatch Pb?" – Group 14
- "New Pal Asks Some Biryani" – Group 15
- "Oh! SSe TePo" – Group 16
- "Fluffy Cat Brought Ice At night" – Group 17
- "Hi NeAr Kings Xero Run" – Group 18

1. General Electronic Configuration

- Group 13: $ns^2\ np^1$
- Group 14: $ns^2\ np^2$
- Group 15: $ns^2\ np^3$
- Group 16: $ns^2\ np^4$
- Group 17: $ns^2\ np^5$
- Group 18: $ns^2\ np^6$

📌 He (Helium) Exception: $1s^2$ (Full duplet)

2. General Trends in Properties

Property	Across a Period (Left → Right)	Down a Group (Top → Bottom)
Atomic Radius	Decreases	Increases ✓
Ionization Energy	Increases	Decreases

(IE)		
Electronegativity (EN)	Increases	Decreases
Metallic Character	Decreases	Increases
Non-Metallic Character	Increases	Decreases
Electron Affinity (EA)	Becomes more negative (more attraction)	Becomes less negative
Oxidation States	Increases in variation	Stability of higher oxidation states increases
Reactivity	Non-metals more reactive	Metals more reactive

3. Unique Behavior of the First Element in Each Group

Group	First Element	Unique Characteristics
Group 13 (Boron)	B	Non-metal, forms covalent bonds, does not form B^{3+} ions easily.
Group 14 (Carbon)	C	Forms multiple bonds (C=C, C≡C), shows allotropy (diamond, graphite). Catenation.
Group 15 (Nitrogen)	N	Exists as N_2 due to strong triple bond, maximum covalency = 4.
Group 16 (Oxygen)	O	Exists as O_2 molecule, shows high electronegativity, forms multiple bonds.
Group 17 (Fluorine)	F	Highest electronegativity, strongest oxidizing agent,

		only -1 oxidation state.
Group 18 (Helium)	He	Noble gas with only two electrons ($1s^2$), does not form compounds.

4. Key Chemical Properties

(a) Oxidation States

- **Group 13:** +3, (Boron shows only covalent bonding)
- **Group 14:** +4, +2 (Pb^{2+} more stable due to inert pair effect)
- **Group 15:** -3, +3, +5 (Bi^{3+} more stable than Bi^{5+})
- **Group 16:** -2, +4, +6 (Oxygen mainly -2, others show +6)
- **Group 17:** -1, +1, +3, +5, +7 (F only -1, others show multiple)
- **Group 18:** Mostly 0, but heavier elements like Xe form compounds (+2, +4, +6)

(b) Acidic, Basic & Amphoteric Nature of Oxides

- Acidic: **Non-metals** (CO_2, N_2O_5, SO_3, Cl_2O_7)
- Basic: **Metals** (Al_2O_3, PbO)
- Amphoteric: **Intermediate elements** (B_2O_3, Al_2O_3)

(c) Reactivity with Hydrogen (Hydrides)

- Stability decreases down the group ($NH_3 > PH_3 > AsH_3 > SbH_3$)
- Bond angles decrease down the group due to decreasing electronegativity

(d) Reactivity with Halogens

- Forms trihalides & pentahalides (PCl_3, PCl_5, SF_6, IF_7)

- Stability of higher oxidation states increases down the group

(e) Reactivity with Oxygen (Oxides)

- **Basic Oxides:** Formed by metals
- **Acidic Oxides:** Formed by non-metals
- **Amphoteric Oxides:** Have dual nature (Al_2O_3, SnO_2)

5. Anomalous Properties of the First Element

☑ Small size

☑ High electronegativity

☑ Strong bond formation (multiple bonds: C=C, N≡N, O=O)

☑ Non-availability of d-orbitals (only s and p orbitals used)

☑ Formation of π-bonds (C=C, C≡C, N≡N)

6. Important Compounds & Uses

Compound	Uses
NH_3 (Ammonia)	Fertilizers (Urea)
HNO_3 (Nitric Acid)	Explosives, fertilizers
H_2SO_4 (Sulfuric Acid)	Industrial chemical, battery acid
CO_2 (Carbon Dioxide)	Refrigerant (dry ice), fire extinguishers

	extinguishers
SiO_2 (Silica)	Glass, semiconductors
Cl_2 (Chlorine)	Water purification, PVC manufacture
XeF_2, XeF_4	Powerful fluorinating agents

Advanced Concepts

Inert Pair Effect

- **Definition**: Reluctance of ns^2 electrons to participate in bonding
- **Mechanism**:
  - Increased nuclear charge
  - Relativistic effects
  - Energy required to promote electrons becomes significant

Diagonal Relationships

- **Concept**: Similar properties of elements diagonal to each other
- **Examples**:
  - Lithium and Magnesium
  - Beryllium and Aluminum
  - Boron and Silicon

Final Notes

◇ *P-block elements show a transition from metallic to non-metallic nature as we move from left to right.*

◇ *The first elements of each group show anomalous behavior due to their small size, high ionization energy, and absence of d-orbitals.*

◇ Oxidation states and stability vary significantly across the p-block due to the inert pair effect.

1. (JEE Advanced 2019)

📌 Which of the following statements is correct regarding the anomalous behavior of nitrogen in Group 15?

(A) It does not show catenation like phosphorus

(B) It forms pentahalides like other group 15 elements

(C) It has the ability to expand its octet

(D) It shows low electronegativity compared to phosphorus

2. (NEET 2020)

📌 Among the following oxoacids, which one is the strongest acid?

(A) H_3PO_2

(B) H_3PO_3

(C) H_3PO_4

(D) $H_4P_2O_7$

$H_3PO_2 < H_3PO_3 < H_3PO_4 < H_4P_2O_7$

3. (JEE Main 2022)

📌 Which of the following statements is correct regarding fluorine?

(A) It can show positive oxidation states (−1)

(B) It has the highest electron affinity among all halogens

(C) It doesn't forms the strongest hydrogen bond among halogens (HF)

(D) It cannot show disproportionation reactions (-1)

4. (JEE Advanced 2018)

📌 Which of the following species will undergo disproportionation in an aqueous solution?

(A) ClO_4^-

(B) Cl_2

(C) ClO_2

(D) Cl^-

$2Cl_2^0 + 2OH^- \longrightarrow \overset{+1}{Cl}O^- + Cl^- + H_2O$

$x + (-2) = -1$

$x = -1 + 2$

$= +1$

$2ClO_2 \longrightarrow ClO_3^- + ClO_2^-$

5. (NEET 2021)

📌 Which of the following statements is incorrect about noble gases?

(A) They have high ionization enthalpies

(B) Xenon forms stable compounds with fluorine and oxygen

(C) They are monoatomic in nature

(D) They form strong van der Waals forces due to high polarizability

6. (JEE Advanced 2017)

📌 Which one of the following compounds does not exist?

(A) XeO_4

(B) XeF_6

(C) $XeCl_4$

(D) HeF_2

7. (JEE Main 2019)

📌 Which of the following is the correct trend for boiling points of noble gases?

(A) He < Ne < Ar < Kr < Xe

(B) He > Ne > Ar > Kr > Xe

(C) He < Ne < Kr < Ar < Xe

(D) He > Xe > Kr > Ar > Ne

8. (JEE Advanced 2016)

📌 Which of the following compounds is not an example of an interhalogen compound?

(A) ClF_3

(B) BrF_5

(C) ICl

(B) BrF_5

(C) ICl

(D) XeF_2