

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 ($C=C$, $C\equiv C$), 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: $\text{C}=\text{C}$, $\text{N}\equiv\text{N}$, $\text{O}=\text{O}$)
- Non-availability of d-orbitals (only s and p orbitals used)
- Formation of π -bonds ($\text{C}=\text{C}$, $\text{C}\equiv\text{C}$, $\text{N}\equiv\text{N}$)

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
$\text{XeF}_2, \text{XeF}_4$	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)

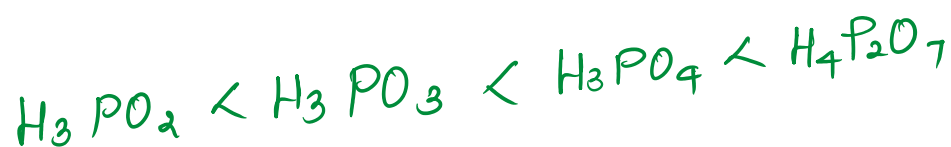
✎ Which of the following statements is correct regarding the anomalous behavior of nitrogen in Group 15?

- (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) $\text{H}_4\text{P}_2\text{O}_7$



3. (JEE Main 2022)

✎ Which of the following statements is correct regarding fluorine?

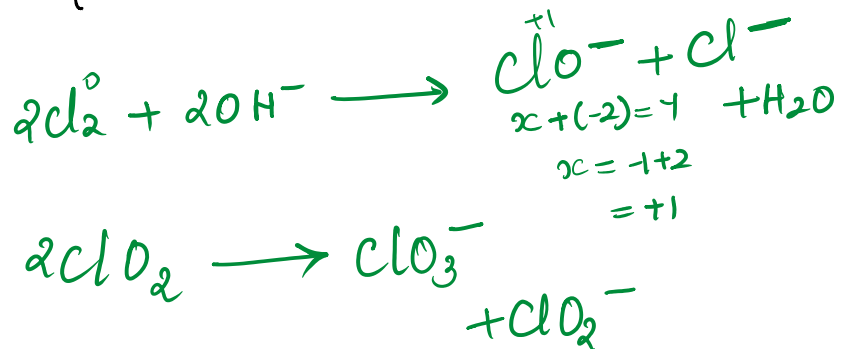
- (A) It can show positive oxidation states (-1)
- (B) It has the highest electron affinity among all halogens

- (C) It doesn't form 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^-



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) $\text{He} < \text{Ne} < \text{Ar} < \text{Kr} < \text{Xe}$

(B) $\text{He} > \text{Ne} > \text{Ar} > \text{Kr} > \text{Xe}$

✓ (C) $\text{He} < \text{Ne} < \text{Kr} < \text{Ar} < \text{Xe}$

(D) $\text{He} > \text{Xe} > \text{Kr} > \text{Ar} > \text{Ne}$

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) ~~OF_2~~