

Class 12 Chemistry – P-Block Elements | Study Guide

1. Theory in Simple Words with Visuals

1.1 What are P-Block Elements?

- **Definition:** Elements in which the **last electron enters the p-orbital** of their respective energy level.
- **Groups:** 13 to 18 (Boron to Noble Gases)
- **Analogy:** Think of the p-orbital as a "parking lot" with 6 slots; electrons fill it last.

Visual Table:

Group	Valence Electrons	Example	Special Feature
13	$ns^2 np^1$	B, Al	Metals, low electronegativity
14	$ns^2 np^2$	C, Si	Non-metals/metalloids
15	$ns^2 np^3$	N, P	Non-metals, can form oxides
16	$ns^2 np^4$	O, S	Strong oxidizers
17	$ns^2 np^5$	F, Cl	Highly reactive non-metals
18	$ns^2 np^6$	Ne, Ar	Inert gases

1.2 General Trends

Property	Trend Across Period	Trend Down Group	Example/Visual
Atomic Radius	Decreases	Increases	"Pulling electrons closer"
Ionization Energy	Increases	Decreases	"Energy to remove electron"
Electronegativity	Increases	Decreases	"Atom's grip on electrons"
Metallic Character	Decreases	Increases	"Metallic glow"

Tip: Use "Across a period: Tighten → Upward energy; Down a group: Loosen → Bigger atom" for mental image.

1.3 Important Group-Wise Highlights

Group 13 (Boron Family)

- Elements: B, Al, Ga, In, Tl
- Oxidation states: +3, +1 (Tl)
- Properties: Amphoteric oxides, electron-deficient B forms covalent bonds
- Example: B_2H_6 (diborane) → unique bonding (3-center 2-electron bond)

Group 14 (Carbon Family)

- Elements: C, Si, Ge, Sn, Pb
- Oxidation states: +4, +2 (Pb)
- Catenation (ability to form chains): Strong in C, weaker down the group
- Example: CO_2 , SiO_2

Group 15 (Nitrogen Family)

- Elements: N, P, As, Sb, Bi
- Oxidation states: -3, +3, +5
- N_2 is very stable (triple bond) → inert
- Allotropy: White P, Red P

Group 16 (Oxygen Family)

- Elements: O, S, Se, Te, Po
- Oxidation states: -2, +2, +4, +6
- O_2 and O_3 (ozone) important
- Strong oxidizing agents ($\text{F}_2 > \text{O}_2 > \text{S}$)

Group 17 (Halogens)

- Elements: F, Cl, Br, I, At
- Oxidation state: -1
- Reactivity decreases down the group
- Form interhalogen compounds (ClF_3 , BrF_5)

Group 18 (Noble Gases)

- Elements: He, Ne, Ar, Kr, Xe, Rn
- Oxidation state: 0
- Very stable, low reactivity
- Compounds: XeF_2 , XeO_3

2. Key Concepts & Formulas

Concept	Formula/Definition	Tip/Mnemonic
Oxides	Acidic, Basic, Amphoteric	$\text{B}_2\text{O}_3 \rightarrow$ Acidic, $\text{Al}_2\text{O}_3 \rightarrow$ Amphoteric

Concept	Formula/Definition	Tip/Mnemonic
Bonding	Covalent, Ionic, Metallic	"P-block loves sharing electrons"
Oxyacids	HXO (X=Group Element)	HNO ₃ , H ₃ PO ₄ , H ₂ SO ₄
Electronegativity	Ability to attract electrons	Increases → across period; decreases → down group
Halogen displacement	X ₂ + Y ⁻ → Y ₂ + X ⁻	"Stronger halogen kicks weaker one"

Mnemonic for groups 13–18:

"Boring Cats Never Offer Fresh New Ideas" → B, C, N, O, F, Ne, (for easy recall).

3. Solved Numerical Problems

Example 1: Oxidation States

Problem: Determine oxidation state of N in HNO₃.

Solution: H = +1, O = -2, Let N = x

- x + 1 + (-2 × 3) = 0 → x - 5 = 0 → x = +5
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Example 2: Halogen Displacement

Problem: Cl₂ added to KI solution. Identify products.

Solution: Cl₂ + 2KI → 2KCl + I₂

Tip: More reactive halogen displaces less reactive one.

4. Previous Years' Board Questions (Solved)

- Group-wise properties, oxidation states, bonding → 2016–2022
 - Oxyacids, oxides & their nature → recurring pattern
 - Halogen reactions & displacement → high-weightage
 - Allotropy & catenation (C, P, S)
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5. Quick Revision Notes / Important Points

- **Group trends:** Atomic radius ↓ across, ↑ down; Electronegativity ↑ across, ↓ down
- **Group highlights:**
 - 13 → B, Al, amphoteric oxides
 - 14 → C, catenation
 - 15 → N₂ stable, P allotropes

- 16 → O₂, S strong oxidizers
 - 17 → Halogens, reactivity ↓ down
 - 18 → Noble gases, inert
 - **Mnemonic:** "Boring Cats Never Offer Fresh New Ideas"
 - **Quick diagrams:** Flowcharts for oxides & acid/base nature
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6. Predicted / Likely Questions

1. Group properties & trends
 2. Bonding in diborane, ozone
 3. Oxidation states & oxyacids
 4. Halogen reactions & displacement
 5. Allotropy & catenation examples
 6. Numericals on oxidation states
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7. Exam Tips & Tricks

- Draw tables for groups & trends
 - Use color-coding for metals, non-metals, metalloids
 - Remember common reactions of halogens, oxygen, nitrogen
 - Check stoichiometry carefully for numericals
 - Visualize allotropy & bonding using sketches
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8. Visual & Kid-Friendly Learning Style

- **Boron (B)** → "electron-deficient buddy" → forms 3 bonds
- **Carbon chains** → "lego blocks building chains"
- **Oxygen & Ozone** → "O₂ breathing, O₃ protective shield"
- **Halogens** → "gang of reactive friends fighting weaker ones"
- Use flowcharts, diagrams, color codes for trends & reactions