

Name: Chandra Shekhar  
College: IIT Gandhinagar  
Subject: Chemistry  
Weightage: Regular  
Title: P-Block Element

## p-Block Elements

### Group 13: Boron Family

Elements: B, Al, Ga, In, Tl

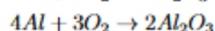
Electronic Configuration:  $ns^2np^1$

#### General Characteristics

- Boron is a non-metal; the rest are metals.
- Melting points show irregular trend due to structural variations. Boron has high melting point because of its giant covalent structure.
- Density increases down the group.
- First ionization energy is lower than group 2, but  $IE_2$  and  $IE_3$  are high.
- Due to poor shielding by d-orbitals, IE of Ga is higher than Al.
- Oxidation state is predominantly +3; heavier elements also show +1 due to inert pair effect.

#### Chemical Properties

- Al shows amphoteric nature (forms both ionic and covalent compounds).
- Reaction with oxygen:



- Reaction with acids and alkalis:



### Group 14: Carbon Family

Elements: C, Si, Ge, Sn, Pb

Electronic Configuration:  $ns^2np^2$

#### General Characteristics

- C and Si are non-metals; Ge is metalloid; Sn and Pb are metals.
- Melting and boiling points decrease down the group.
- Density increases; ionization energy decreases.
- Shows +4 and +2 oxidation states. +2 becomes more stable down the group.

#### Chemical Behavior

- **Catenation:** Maximum in carbon.
- **Allotropy:** Found in all elements.
- **Reaction with  $O_2$ :**
  - $CO_2$ ,  $SiO_2$  are acidic;  $SnO_2$ ,  $PbO_2$  are amphoteric; CO is neutral.
- **Reaction with water:** Sn reacts with steam; others are resistant.
- **Reaction with halogens:** Forms tetra- and di-halides; tetrahalides less stable down the group.

### Group 15: Nitrogen Family

Elements: N, P, As, Sb, Bi

Electronic Configuration:  $ns^2np^3$

#### Physical and Chemical Features

- Ionization energy, electronegativity decrease down the group.
- Melting/boiling points increase except Bi.
- Oxidation states:  $-3, +3, +5$ .
- **Hydrides ( $EH_3$ ):** Basicity and thermal stability decrease from  $NH_3$  to  $BiH_3$ .
- **Oxides:** Varying acid-base nature depending on oxidation state.
- **Halides:** Form  $EX_3, EX_5$ ; pentahalides are more covalent.

### Group 16: Oxygen Family

Elements: O, S, Se, Te, Po

Electronic Configuration:  $ns^2np^4$

#### Properties

- Radii, metallic nature, and melting/boiling points increase down the group.
- Common oxidation states:  $-2, +2, +4, +6$ .

#### Chemical Behavior

- **Hydrides ( $H_2E$ ):** Acidic strength and reducing nature increase down the group.
- **Oxides:**  $EO_2$  and  $EO_3$  are acidic.
- **Halides:** Form  $EX_2, EX_4, EX_6$ .

### Group 17: Halogen Family

Elements: F, Cl, Br, I, At

Electronic Configuration:  $ns^2np^5$

#### Trends

- Atomic size and melting/boiling points increase; ionization energy decreases.
- Fluorine only shows  $-1$  oxidation state; others show  $+1, +3, +5, +7$ .

#### Chemical Properties

- **Hydrides ( $HX$ ):** Acid strength increases; thermal stability decreases down the group.
- **Oxides:** Range from  $+1$  to  $+7$  oxidation states.
- **Oxyacids:** Include  $HOX, HXO_2, HXO_3, HXO_4$ . Strength:  $HClO_4 > HClO_3 > HClO_2 > HOCl$ .
- **Interhalogen Compounds:**

AX	$AX_3$	$AX_5$	$AX_7$
$ClF, BrF$	$ClF_3, BrF_3$	$ClF_5, BrF_5$	$IF_7$

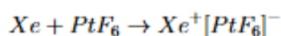
### Group 18: Noble Gases

Elements: He, Ne, Ar, Kr, Xe, Rn

Electronic Configuration:  $ns^2np^6$  (He:  $1s^2$ )

#### Properties

- Radii and boiling points increase down the group.
- Ionization energy decreases; electron affinity nearly zero.
- Mostly inert, but Xe forms compounds:



Fluorides:  $XeF_2, XeF_4, XeF_6$