15	16	17
N	O	F
P	S	Cl
As	Se	Br
Sb	Te	I
Bi	Po	At
–	Uuh	–

p-BLOCK ELEMENTS

6.1) GROUP 15

[NITROGEN FAMILY]

IMPORTANT POINTS

1. In this chapter, we study, Physical and Chemical properties and Reactions of certain compounds and some Preparation methods of P- block elements.

---

2. **Elements of Group 15 (VA) [Nitrogen family]:** Nitrogen N, Phosphorus P, Arsenic As, Antimony Sb, Bismuth (Bi).

N, P are non metals, As, Sb are Semi Metals and Bi is metal.

---

3. **Properties of N - family :**

i) General **electronic configuration** of N-family is **$ns^2\ np^3$**.

ii) General **oxidation states:** –3, +3 and +5; Oxidation states of N vary from –3 to +5

iii) Nitrogen forms a **diatomic** molecule (N_2) and the other elements form **tetraatomic** molecules.

iv) Group 15 elements exhibit **allotropy,** catenation except Bi

v) Group 15 elements, form **volatile hydrides** with **pyramidal structures** of the form EH_3

vi) **'Basic nature'** of hydrides decreases down the group.

vii) **Oxides:** The VA elements form two series of **oxides:**

a) Trioxides (E_2O_3 or E_4O_6)

b) Pentoxides (E_2O_5 or E_4O_{10}).

- N_2 forms several oxides like N_2O, NO, N_2O_3, N_2O_4 ,N_2O_5.

viii) The **acidic nature** of the oxides decreases down the group.

ix) **Halides:** Nitrogen family forms 2 series of halides (X=F, C*l*, Br, I):

a) Tri halides(EX_3)

b) Pentahalides(EX_5) [except N]

All of the halides hydrolyse.

x) **Oxy acids:** Non-metals (N, P) of VA group form 2 series of **oxy acids**

a) –ous series b) –ic series

Oxyacids of nitrogen: Nitrous acid (HNO_2), Hyponitrous acid ($H_2N_2O_2$), Nitric acid (HNO_3), Pernitric acid(HNO_4).

Oxyacids of Phosphorus:

Hypophosphorous acid (H_3PO_2),
Phosphorous acid (H_3PO_3),
Pyrophosphorous acid ($H_4P_2O_5$),
Orthophosphoric acid (H_3PO_4),
Metaphosphoric acid (HPO_3),
Hypophosphoric acid ($H_4P_2O_6$),
Pyrophosphoric acid ($H_4P_2O_7$),
Peroxy phosphoric acid (H_3PO_5).

- In each oxo acid series, the acidic nature decreases down the group.

---

4. **Nitric acid(HNO_3)** is manufactured by

a) **Ostwald's process**

b) **Birkland – Eyde process**.

Ammonia (NH_3) is manufactured by

a) **Haber process**

b) **Cyanamide process**.

GROUP 15
CHEM BEATS!


N-Cycle


P-Teeth

As - Doping Agent


Sb - Kazal Pencil


Bi -Bullet Shots

GROUP-15

- **N (7) NITROGEN [**Miss. Nature Queen**] :** N occupies 78% in Atm, Four Core organics [O, C, H, N]
- **P (15) PHOSPHORUS[** Miss. Smiley **] :** P glorifies the shining of our Teeth, Highly reactive.
- **As (33) ARSENIC [** Mr.&Ms. Poison **] :** As Doping agent in Semiconductors, killed(?) Nepolean.
- **Sb (51) ANTIMONY [** Mr & Ms. Kazal **] :** Sb - కాటుక కళ్ళ కాజల్. You know: Sb stands for Stibium.
- **Bi (83) BISMUTH [**Mr. Bullet**]** **:** Bi makes Bullets, relieves Stomach-ache.

☞ Metal Elements posess Male like Properties. For Metals(Male) Prefix Mr. is used here.

☞ Non-Metal Elements posess Female like Properties. For Non-Metals(Female) Prefix Ms. is used.

☞ Semi Metal Elements posess both Male & Female like Properties. For Semi Metals Prefix Mr. & Ms. is used.

☞ Group Leading Elements are assigned Queen/ King Status.

☞ Silly Nick Names for Elements are Simply Coined basing on some of their Interesting Properties.

15	16	17
N	O	F
P	S	Cl
As	Se	Br
Sb	Te	I
Bi	Po	At
–	Uuh	–

p-BLOCK ELEMENTS

6.2) GROUP 16

[OXYGEN FAMILY]

IMPORTANT POINTS

1.1 Elements of group 16 (VIA)[Oxygen family]: Oxygen (O), Sulphur (S), Selenium (Se), Tellurium (Te), Polonium (Po).

1.2 In this Chapter, we study (i) Physical states of O, S– Structure, allotropy (ii) Hydrides, Oxides, Halides (iii) Oxy acids , Chalcogens– Structures (iv) Preparation, properties and uses of Ozone O_3, Sodium thiosulphate, Sulphuric acid.

---

2. Properties of Oxygen family:

Oxygen and sulphur elements are abundant in the earth's crust.

i) General electronic configuration is $ns^2 np^4$.

ii) The common oxidation state is –2 . Except Oxygen other elements show +4 and +6 states

iii) Only oxygen is in gaseous state and all others are in solid state and have complex physical states.

iv) Ionization energy, electronegativity decrease from top to bottom.

v) Density, melting point, boiling point and metallic character increase from top to bottom.

vi) G-16 elements exhibit allotropy except Te.

vii) G-16 elements form hydrides of type H_2M

viii)The hydrides of this group are all highly volatile, except H_2O.

ix)The order of stability of the hydrides: $H_2O > H_2S > H_2Se > H_2Te > H_2PO$ These are all bent molecules

x) All the elements of this group form dioxides (MO_2) and trioxides (MO_3).

• Sulphur forms SO_2 and SO_3.

xi) SO_2 acts as reducing agent and shape is angular.

xii) SO_3 acts as oxidising agent and shape is trigonal planar.

xiii)The elements of VIA group form halides with general formulae M_2X_2, MX_2, MX_4 and MX_6. i.e, Monohalides, dihalides, tetrahalides, hexafluorides

• Oxygen difluoride is a V-shaped molecule.

• Dioxygen difluoride has an open-book structure.

xiv) **The oxoacids of sulphur:**

i) Sulphurous acid series

ii) Sulphuric acid series

iii) Thionic acid series

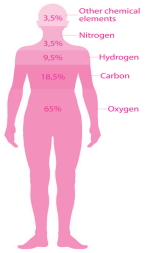
iv) Peroxoacid series.

3.1. Ozone is obtained by subjecting pure dry cold oxygen gas to silent electric discharge.

3.2. Hypo (Sodium thiosulphate) is prepared by boiling sodium sulphite solution with sulphur.

3.3. H_2SO_4 is manufactured by **contact process**.

GROUP 16
CHEM BEATS!



Oxy-Body

S-Matchstick Head

Se - Laser Printer

Te - DVD

Po- Anti Static Brush

OXYGEN FAMILY

- **O(8) OXYGEN [** Miss. O' Baby Queen **]** : O-65% in our body,highly reactive,3rd Most Abundant [H,He,O]
- **S(16) SULPHUR [**Miss. Sweet 16 **]** : S Mineral Makes Proteins, Kills Bacteria, Refines Ores,....
- **Se(34) SELENIUM [**Ms. Copy cat **]** : Se- Boosts Immune System and Metabolism,....
- **Te (52)TELLURIUM [**Mr & Ms. DVD **]** : Te- Vulcanises Rubber, Doping Agent,....
- **Po (84) POLONIUM [**Mr. Solo Static **]** : Po-First discovered Radioactive Element,....

Chalco అంటే **Ore.....Ores** ఎక్కువగా ఉండే గ్రూప్ **G-16.**

తెలుగులో **G-16** ను 'ఓర్ల గ్రూపు' అనొచ్చు!

G-16 is a Female Dominating Group

15	16	17
N	O	F
P	S	Cl
As	Se	Br
Sb	Te	I
Bi	Po	At
–	Uuh	–

p-BLOCK ELEMENTS

6.3) GROUP 17

[HALOGEN FAMILY]

IMPORTANT POINTS

1.1 Elements of Group 17(VIIA):
[Group of Halogens]: Fluorine(F), Chlorine (Cl), Bromine (Br), Iodine (I), Astatine (At).

1.2 In this Chapter, we study
(i) Halogens-Physical states, Properties
(ii) Oxy acids of Chlorine
(iii) Preparation, properties and uses of F, C*l*, Bleaching powder

---

2. Properties of Group 17 elements:
F_2, Cl_2, Br_2 and I_2 are called **halogens**

i) General electronic configuration is ns^2np^5

ii) With this configuration they exhibit –1, +1 **oxidation** states. Cl_2, Br_2, I_2 show +3, +5 and +7 states

iii) Physical states change from gas to solid due to increase of Vander Waal's forces.

- Accordingly the melting points ; boiling points increase.
- The highest electron affinity is shown by chlorine.
- The bond energies fall from Cl_2 to I_2.
- In this group, ionisation energies gradually decrease from top to bottom.
- In this group, electronegativity and electron affinity values decrease from top to bottom.

iv) All of them are reactive elements and so they occur in the combined state only.

- The chemical reactivity of halogens with different reactants is: $F_2 >> Cl_2 > Br_2 > I_2$.

v) The structures of HClO, $HClO_2$, $HClO_3$ and $HClO_4$ have sp^3 hybridized chlorine.

vi) Chlorine forms many **oxides:** Chlorine monoxide (Cl_2O), chlorine dioxide (ClO_2), chlorine hexoxide (Cl_2O_6) and chlorine heptoxide (Cl_2O_7).

vii) Halogens react with each other forming binary compounds known as inter halogen compounds. **Ex :** C*l*F, C*l*F_3, IF_7 etc.

viii) Halogens exhibit **colour** due to absorption of light in the visible region.

xi) **Minerals of Fluorine:**
Fluorspar (CaF_2),
Cryolyte (Na_3AlF_6),
Fluoroapatite [$3Ca_3(PO_4)_2.CaF_2$]

3.1 Fluorine is produced on large-scale by **Whytlaw Gray's method**.

3.2 Industrially **chlorine** is prepared by using **Nelson cell method.**

3.3 Bleaching powder can be prepared by passing dry chlorine over dry slaked lime.

3.4 The recent method of its preparation is **Bechmann's method.**

GROUP 17
CHEM BEATS!

F-Toothpaste


Cl - Chlorinated Pool


Br-Liquid Bottle


I-Tincture

At- Anti Cancer Medicine

G-17 is Known as HIGHLY ACTIVE & REACTIVE GROUP

- **F (9) FLUORINE** [Miss. Fast Action Queen] : F-Most Electro –ve, Very reactive, Highest I.E and E.N,....
- ***Cl* (17) CHLORINE** [Miss. Clean] : *Cl* -Highest E.A, Kills bacteria, makes PVC,....
- **Br(35) BROMINE** [Ms. Liquid] : Br-Only Non-Metal in Liquid State, flame Retardant,.....
- **I (53) IODINE** [Ms. I] : I- Tincture is an anti-septic, repairs skin cuts, scars,....
- **At (85) ASTATINE** [Mr & Ms. Question Mark] : At-Rarest element on earth, available only 31g on the earth.

Halogen Means Salt Generation. G-17 తెలుగులో 'ఉప్పు వారి ఫ్యామిలీ'.

G-17 అంటే అత్యధిక సంఖ్యలో **4 Non- Metals** కలిగిన **complete Female dominating Group.**

G-17 ఒక్క **Male Metal** కూడా లేదు మరి. మరీ అన్యాయం కదా!

BULLET TIP: Names of All G-17 Elements end with INE.

18
He
Ne
Ar
Kr
Xe
Rn

p-BLOCK ELEMENTS

6.4) GROUP 18

[NOBLE GASES]

IMPORTANT POINTS

1.1 Elements of group 18 (zero group) are
Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe) and Radon (Rn) .

1.2 All these elements are known as inert gases or noble gases or rare gases.

2.1 The general outer electronic configuration of inert gases is $ns^2\ np^6$.

2.2 This electronic configuration is very stable.
All the other elements try to attain this configuration.

2.3 All inert gases are monoatomic, colourless, odourless.

2.4 All the noble gases (except Radon) occur in the Universe in free state.
All these elements are present in the Earth's atmosphere.

2.5 Noble gases are separated by Dewar's adsorption method using coconut charcoal.

2.6 Noble gases are chemically inactive due to
(i) Stable configuration (ii) High ionisation energy (iii) Zero electron affinity values.

2.7 Density, boiling point of these elements gradually increase with increase of size.

2.8 Ionisation potential values decreases from helium to xenon, as the atomic size increases.

2.9 Noble gases are used in coloured advertising signals, which are visible through mist and fog.

3.1 Helium is light and non-inflammable gas.

3.2 He is used for filling balloons ,airships and 'to maintain very low temperature'.

3.3 A mixture of 85% He & 15% H_2 is used in 'inflating tyres'.

3.4 A mixture of He & O_2 is used 'for respiration' by **sea divers.**

4.1 Neon is used in discharge tubes .Ex: 'Neon lamps' are used in 'street lights'.

4.2 Neon is used in signal lights, for aeroplane pilots.

5.1 Argon is the most available noble gas in air

5.2 Argon is used in filling electric bulbs.

6.1 Krypton is used in minor cap lamps.

6.2 Kr- 85 is used for measurement of thickness of metal sheets & joints.

7.1 Xenon is known to form 'stable fluorides'.

7.2 Fluorides of xenon are XeF_2(linear), XeF_4 (square planar) and XeF_6(Distorted octahedral).

7.3 Oxides of xenon are XeO_3 (Pyramidal), XeO_4(Tetrahedral) and $XeOF_4$(Square pyramidal)

7.4 Xenon is used in photography 'flash bulbs'.

8. Radon is used in radio therapy (the preparation of ointments) for the treatment of cancer.