

P - Block Elements

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P-Block Elements

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chapter No. 4 P-Block elements.

Introduction \Rightarrow In the elements addⁿ of electrons takes place successively in p-orbital of the atom, they are known as p-block elements. The elements of group IIIA, IVA, VA, VIA & VIIA have in their outermost shell 3, 4, 5, 6 & 7 electrons respectively.

\Rightarrow Two of these electrons, in each case are present in s-orbital which is complete. The remaining 1, 2, 3, 4 & 5 electrons are present in p-orbital.

\Rightarrow As the properties of these elements depends upon the electrons present in p-orbitals, the elements of group IIIA to VIIA are called p-block elements.

* III A Group elements

The elements Boron, Aluminium, Gallium, Indium & Thallium belong to IIIA group of the periodic table.

\rightarrow Boron is the first element of this group, so this group is called a Boron family.

Boron is electronegative in nature, hence it is non-metallic in character. But other elements Al, Ga, In, Tl, are metallic character. The non-metallic character of Boron is mainly due to small size. Since the size of boron atom is small, ionisation energy is very high, reduction property decreases. Hence its metallic character is reduced. Therefore, compounds of boron are covalent in nature.

\rightarrow Only Boron forms allotropy, means B-B-B bonding is observed other elements do not give allotropy.

At. No.	Element	Electronic configuration.
5	Boron	$2[\text{He}] 2s^2 2p^1$
13	Aluminium	$10[\text{Ne}] 3s^2 3p^1$
31	Gallium	$18[\text{Ar}] 3d^{10} 4s^2 4p^1$
49	Indium	$26[\text{Kr}] 4d^{10} 5s^2 5p^1$
81	Thallium	$54[\text{Xe}] 4f^{14} 5d^{10} 6s^2 6p^1$

Properties:

→ So from electronic configuration, these elements have a three electrons in the outer most shell, so general outer ele. configuration is $ns^2 np^1$. So only one electron is present at outer most shell.

* Properties of Boron group Elements: ⇒

① Size of Atoms and ions ⇒ If we move from top to bottom in the gr. i.e. B to Tl. Atomic & ionic radii increase, this is because of the addⁿ of the ele. goes to new shell at each step. However, this increase is not regular in nature, In that B to Al increase atomic & ionic radii values is very large, but from Al to Tl the increase is small. This is due to the screening effect.

& when Al to Ga is considered, that time is considered in that case f & d orbital electrons shows the screen in betⁿ outer most ele. & nuclear charge.

② Ionisation potential ⇒

Ionisation energy from top to bottom decreases. from B to Tl.

Boron shows high ionisation energy, because it is not forms ions, so required energy is high.

③ Electronegativity ⇒ It is a measure of the power of an atom to attract electrons towards itself in the state of molecule.

Electronegativity values decrease down the group. But decrease not in regular order.

Boron shows the highest electronegativity in Boron family.

④ oxid. state \Rightarrow

All the elements having a three ele. in outermost shell. hence they exhibits a +3 oxidation state. So Boron family having a +3 oxidation state.

\rightarrow Some of the elements shows lower valency state as well.

there is an increasing tendency to form univalent compound from top to bottom in boron family.

\rightarrow In Ga & In +I o. state is less stable than +III o. state.

\rightarrow Tl are more stable than Tl (III) comp.

This is because: the atoms having ele. configuration $s^2 p^1$. monovalency is explained by the s-electrons in the outer shell remaining paired, & not participating in bonding.

This is called "inert pair effect".

\rightarrow Inert pair effect is not restricted for only Boron family but other p-block elements also show.

⑤ Metallic character \Rightarrow

The metallic character (or) electropositive character of the element increases from B to Tl. Thus, B is non-metal, this is due to its small size & high nuclear charge.

The other members are metallic in nature. They are good conductor of electricity.

* Diagonal relationship of Boron & Silicon \Rightarrow

\rightarrow Due to small size of Boron, & non-metallic in character it shows many diff. in IIIA elements. but it resembles with silicon which is placed diagonally next gr. secondly in periodic table.

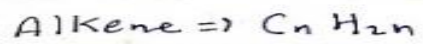
This because of similar polarising power & close charge to radius ratio for these two elements.

Diagonal Relationship of B with Si :

Boron resembles Silicon in following respects.

- ① H_3BO_3 & H_4SiO_4 are weakly acidic.
- ② The hydrides of B & Si (B_2H_6 , B_4H_{10} , Si_2H_6 & Si_4H_{10}) are volatile, spontaneously inflammable & easily hydrolysed.
- ③ The boron halides like silicon halides are partially hydrolysed in water.
 $BF_3 + 3H_2O \rightarrow H_2BO_3 + 3HF$
 $SiF_4 + 4H_2O \rightarrow H_4SiO_4 + 4HF$
- ④ B_2O_3 & SiO_2 are similar in their acidic nature. They readily dissolve metallic oxides, on fusion giving rise to borates & silicates.
 $B_2O_3 + 2NaOH \rightarrow 2NaBO_2 + H_2O$
Sod. metaborate
 $SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$
Sod. meta silicate.
- ⑤ Non-metallic character, both of these boron & silicon show high melting points, high ionisation energies & bad conductors of electricity.
- ⑥ Occurrence \rightarrow Neither boron nor silicon occurred in free nature. Both occur in combined state.

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Boron Hydrides \rightarrow

gr III ele do not react with hydrogen but Boron gives some coord. with hydrogen so these B & H combined molecules are Boron hydrides it is sometimes called Borane.
 \rightarrow They are two types.

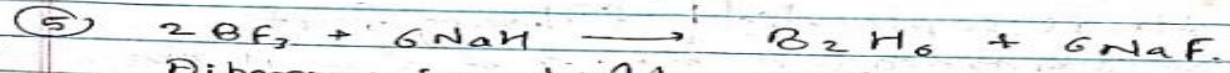
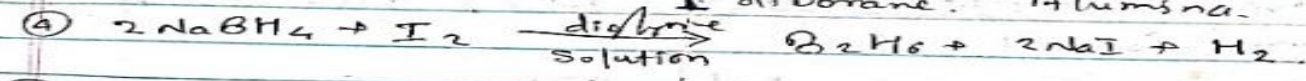
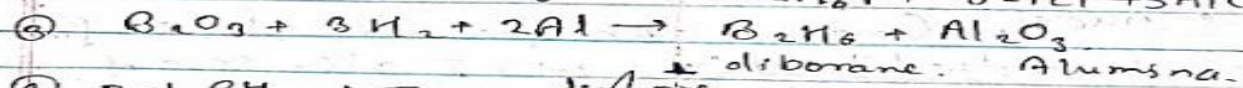
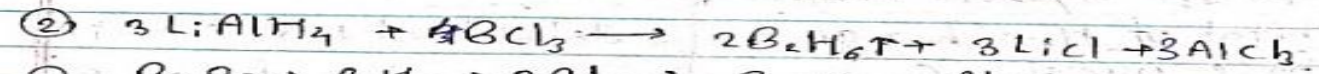
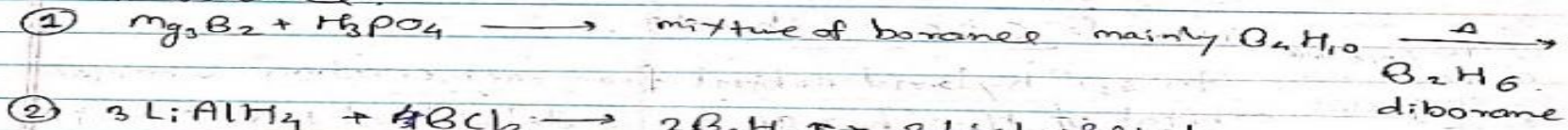
(1) $B_n H_{n+4} \rightarrow$ Nido boranes eg. $B_2 H_6$ - diborane, $B_5 H_{10}$ - pentaborane, $B_8 H_{12}$ - octaborane.

(2) $B_n H_{n+6} \rightarrow$ Arachno boranes, a less stable series.
eg. $B_4 H_{10}$, $B_5 H_{11}$, $B_6 H_{12}$.

(3) $B_n H_{n+2} \rightarrow$ Close boranes, eg. $B_2 H_6^{2-}$, $B_{10} H_{12}$, $B_{12} H_{14}$.

\rightarrow In that Borane diborane is the simplest & most studied hydride. It is used in preparation of higher boranes & in organic chemistry.

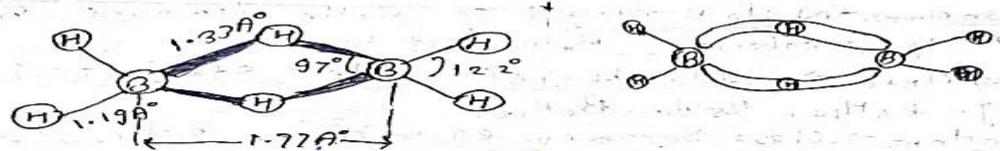
\rightarrow It is prepared by reduction of methals, where Mg & B to give magnesium boride ($Mg_3 B_2$) & then treated it with orthophosphoric acid. This reaction gives mixture of Borane.



Diborane is highly reactive, it catches fire spontaneously in air & explodes with oxygen.
Diborane is colourless gas.

* Structure of diborane \Rightarrow

- \rightarrow In Diborane, B atom is electron deficient nature. its octet is incomplete.
- \rightarrow In that case hydrogen bridge str were proposed.



\rightarrow In B_2H_6 there are 12 valency ele, three from each B. & 6 from H atom. B-H₂ bonds are normal covalent bond, termed as two centre two electron bonds.

\rightarrow The two bridges involve only one from B atom & one from each H-atom. (total 4). This is two centre two ele. (3c-2e) bonds.

6 - non
4s } metalloid
3p }
10 } metal
12 }

An sp^3 hybrid orbital from each B-atom overlaps with orbital of H. This gives a delocalised MO covering all three nuclei. Contains one pair of ele. & forms one of bridged bond (2c-2e) & also second 3c-2e bond formed.

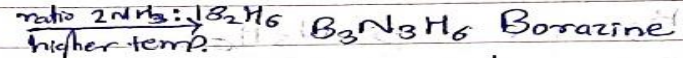
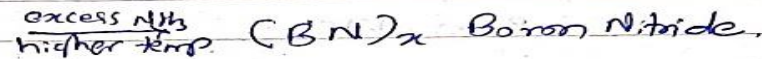
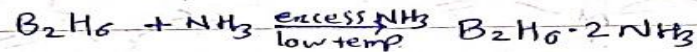
This str. is supported by following facts:

- Heat capacity measured rotation of four H observed only. So it is terminal.
- NMR & Raman spectra 4 hydrogens are equivalent & other 2 hydrogens are another type.
- Diborane cannot be methylated beyond $Me_4B_2H_2$. These hydrogens not methylated having diff. environment. means bridged.

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* Reactⁿ with Ammonia: →

All Boranes acts as Lewis acids & can accept lone pair electrons. They also react with ammonia but products depend upon the conditions.



The compound $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$ is ionic and comprises $[\text{H}_3\text{N} \rightarrow \text{BH}_2 \leftarrow \text{NH}_3]^+$ and $[\text{BH}_2]^-$ ions. On heating it forms borazine.

(A) Boron Nitrides $(\text{BN})_x$ →

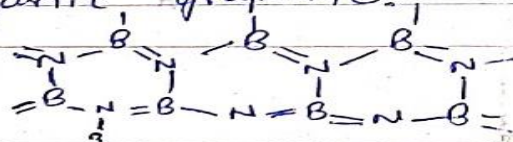
→ Boron nitride is a white slippery solid.

→ In which, B & N atoms forms bond, B & N are undergo sp^2 hybridisation, its geometry is plane triangular str. with bond angle 120° .

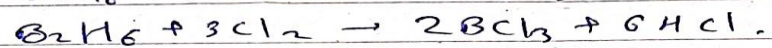
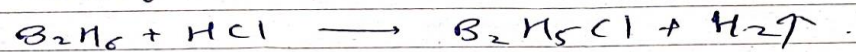
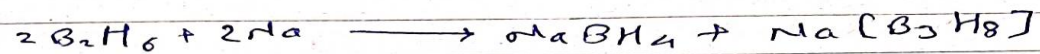
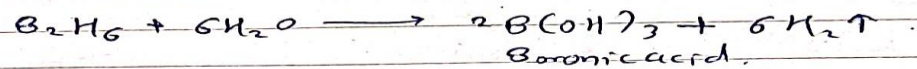
→ The lone pair of N & in 2p orbital forms π bond with vacant 2p orbital of Boron.

→ So, the str. of Boron nitride is isoelectronic with Co-hexagonal structure in graphite.

Due to this reason Boron nitride $(\text{BN})_x$ is called as Inorganic graphite.



Some other reactions of boranes are as follows;



Chemistry of Group IV A :

* Chemistry of group IV A elements :->

-> In this gr C, Si, Ge, Sn, Pb are present. These are called as carbon family elements.

-> Four outer most electrons present.

-> C & Si are non-metals, Ge has both metallic & non-metallic properties i.e. metalloid while remaining two elements, tin & lead are metals.

-> Metallic character increases from top to bottom.

Occurrence :->

-> Carbon is the only element in the gr. occurs in free state e.g. it occurs in the form of diamond, graphite, coal.

-> Silicon is found in the form of silicates (or) silica.

-> Germanium is rare element. It is occurs with zinc ore.

-> Tin occurs as SnO₂ & Lead is found in black mineral calena (PbS).

Electronic configuration :-> Ele. configuration of gr. IV A

At. No.	Element	Electronic configuration
6	C (Carbon)	[He] 2s ² 2p ²
14	Si (Silicon)	[Ne] 3s ² 3p ²
32	Ge (Germanium)	[Ar] 3d ¹⁰ 4s ² 4p ²
50	Sn (Stannous)	[Kr] 4d ¹⁰ 5s ² 5p ²
82	Pb (Plumbous)	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ²

-> Four e. in their outer most shell.

-> General outer e. configuration of this gr. is ns² np².

General Properties of Carbon gr. elements. →

(i) size of atoms & ions: → In the IV A group, it increases more from top to bottom. i.e. C to Pb the atomic & ionic size increases. Because of the addition of electrons in new shell at each step. But increase not regularly. C to Si largely increase, but from Si to Pb very slightly increased. This is due to inert pair effect. & not given the shielding effect for d & f electrons.

(ii) Ionisation energy: → Ionisation energy decreases from C to Pb. but having some irregularities because of effect of d orbital electrons.

→ I.E. required to form M^{4+} ions is comparatively very high I.E.

→ comparatively B or C or elements having a high I.E. This is due to the small size of elements.

(iii) Electronegativity: → Most electronegative element of this IV A group is Carbon. Electronegativity decreases as we go from top to bottom in carbon family gr. But this decrease is not regular. This is due to the filling of d & f orbitals.

(iv) Oxid. State: →

→ general outer ele. confi. is $ns^2 np^2$.

→ There are four ele. in valence shell. They can form an inert gas configuration in two ways
① by gaining four electrons ② by losing four electrons.

→ when carbon atom gains four ele. carbide ions C^{4-} ions formed for eg. B_2C_3 , Al_4C_3 . But carbon not loses all four ele. because of very large amount of energy required.

→ Generally all ele. of gr. show four valency.

→ Ge, Sn & Pb show (+4) oxidation state.

⑤ Metallic character :-

- As we go from top to bottom in gr. IVA metallic character increases, as increase in atomic size.
- Carbon is non-metallic, Si & Ge is metalloids.
- Tin & lead are metals.

⑥ Allotropy of Elements :-

→ Carbon occurs in a large number of allotropic forms; these include diamond, α & β -Graphite & fullerene.

Diamond :- Diamond is unreactive & graphite is quite reactive. In diamond each carbon is in sp^3 -hybridised state i.e. each carbon atom is tetrahedrally surrounded by other four carbon atoms.

→ Due to these dimensional str. is formed. The bond bet. two carbon atoms is very strong & stable. Therefore, diamond is very hard. It has high melting point ($3550^\circ C$). The density is very high. It is non-conductor of heat & electricity. As it is hard it is used as abrasive.

Graphite :-

In graphite each carbon is sp^2 hybridised state. i.e. each carbon is joined by three carbon atoms. → they are in one plane. Thus two dimensional layer str. results.

The distance bet. two layers is about 335 \AA .

The parallel layers having Vander waal's force.

→ Therefore graphite is soft, density is low,

→ Thus it having one unshared p-ele.

So, delocalised π -bond formed. Hence graphite is good conductor of heat & electricity.

→ As it is soft so used for lubricating purpose.



CDM

Fullerene: \Rightarrow When an electric spark is struck betⁿ graphite electrodes, soot is formed. The soot is mainly carbon black. But it contains significant amount of C_{60} carbon cluster compounds. It is called buckminster Fullerene. Smaller amount of other fullerenes C_{32} , C_{50} , C_{70} , C_{76} & C_{84} may be produced.

- \rightarrow This isomer of carbon differs from diamond & graphite.
- \rightarrow The C_{60} molecule looks like soccer ball & sometimes called as "a bulky ball"
- \rightarrow It having a fine & six membered ring.
- \rightarrow Fullerenes are covalent, hence they are soluble in organic solvents.

* Hydrides of gr. IV A elements: \rightarrow

\rightarrow Hydride formatⁿ capacity decrease as we go from C to Pb.

\rightarrow They form a covalent hydrides & a stable hydride

C \rightarrow Carbon forms number of hydrides. Known as alkanes
 formula is C_nH_{2n+2} ; Alkene C_nH_{2n} & Alkyne C_nH_{2n-2}
 & number of Aromatic comp. e.g Benzene, xylene etc

Si \rightarrow Si forms limited number of hydrides because of Si-Si bond is less stable. The hydrides of silicon are known as silanes formula is Si_nH_{2n+2} .

They are prepared as follows;



Ge \rightarrow Hydrides of germanium called as germanes.

GeH_4 germane, Ge_2H_6 digermane, Ge_3H_8 trigermane etc

They are prepared by the addⁿ of $NaBH_4$ to GeO_2 in acid solⁿ

Sn \rightarrow Hydrides of tin is called as stannane SnH_4 ,

distannane Sn_2H_6 . Tin only forms these type of two

hydrides. Stannane is prepared by the reduction

of $SnCl_4$ with $LiAlH_4$ in ether at low temp. $-30^\circ C$

* In that hydrides of gr. IV A stability decrease from C to Pb, & reducing agent capacity increase.

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* Oxides of IV A :-

→ The elements of gr IV A form monoxide of the formula MO.

& dioxide of the formula MO₂ but only lead forms mixed oxide of these both Pb₃O₄, i.e. 2PbO · PbO₂.

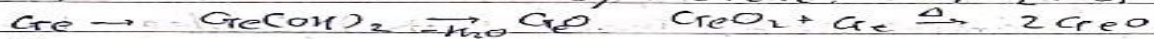
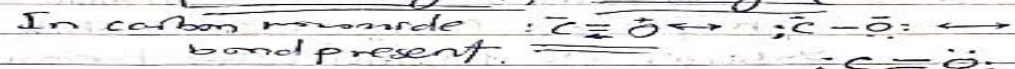
Monoxides :-

C → carbon monoxide is formed when carbon is burned at limited supply of oxygen.



It is colourless, odourless, toxic gas. Toxicity is observed due to its ability to form complex with Fe in which Haemoglobin in blood

Carbon monoxide is used for producer gas, water gas like these types of fuels.



Among the monoxides CO is neutral & SiO is basic & SnO & PbO are amphoteric in nature.

Dioxides :-

C → carbon burning in excess air. $C + O_2 \rightarrow CO_2$

it can be prepared in laboratory when dil. HCl treated with marble. $CaCO_3$. $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$.

It is colourless gas, faint pungent odour & slight acidic taste.

→ solid carbon dioxide is called as dry ice. it is soft, white, snow-like substance with m.p. $-56.6^\circ C$

Solid carbon dioxide is used as a refrigerant under the commercial name drisold. It is used as a substitute of ice in cold drinks & in preparation of ice-cream. Mixed with ether or acetone it provides

freezing mixture with exceedingly low temp.

It is used in the transport of perishable food-stuffs.

It provides cold as well as inert atmosphere. Both these factors help in killing the undesirable bacteria which otherwise spoil the food.

→ It is also used in hospitals for surgical operations of some

→ Artificial rain making has also been accomplished by spraying small pellets of dry ice from aeroplanes over clouds to produce rain.

Chemistry of Group V A Elements:

student _____

* chemistry of V-A group elements :-
The elements Nitrogen (N) phosphorous (P) Arsenic (As), Antimony (Sb) & Bismuth (Bi) constitute gr V of the periodic table.
→ out of N - is most abundant uncombined element available. It is 78.1% present in atmospheric volume. It is combined form present of all human life, 15% weight of proteins is made from Nitrogen.
→ N & P - are non-metals, As & Sb - are metalloids & Bi - are typical metal.
→ occurrence → Nitrogen is a diatomic gas, P - is occurs as calcium phosphate $(Ca_3(PO_4)_2)$

Electronic configuration :-

Element	At. No.	Electronic configuration
N (Nitrogen)	7	$[He] 2s^2 2p^3$
P (Phosphorous)	15	$[Ne] 3s^2 3p^3$
As (Arsenic)	33	$[Ar] 3d^{10} 4s^2 4p^3$
Sb (Stibnium)	51	$[Kr] 4d^{10} 5s^2 5p^3$
Bi (Bismuth)	83	$[Xe] 4f^{14} 5d^{10} 6s^2 6p^3$

Elements of gr V A having five electrons in their outer shell, outer electronic configuration $ns^2 np^3$

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* Group VA elements :-

Hydrides → Properties →

Boiling point :- B.pt. of trihydrides of gr VA elements given below:

	NH_3	PH_3	AsH_3	SbH_3	BiH_3
	-34.5°C	-87.5°C	-62.4°C	-18.4°C	$+16.8^\circ\text{C}$

Except ammonia, boiling pt. increases as we move down group. The abnormally high boiling pt. of ammonia is due to the presence of hydrogen bonding.

Basic character :-

All hydrides have one lone pair of electrons on the central atom, so they behave as Lewis base.

When we go down the gr. V, from N to Bi; basic character of hydride decreases. This is because of size of atom so lone pair diffuses over larger volume.

Thermal stability :-

Stability of hydride of group V elements decrease as we move from NH_3 to BiH_3 . This is because: the size of the central atom increases & its tendency to form stable covalent bond with comparatively small hydrogen atom decrease.

Reducing character → In gr. VA reducing characteristic is increases as we move down the group. Thus, ammonia being stable, is not a good reducing agent, but other hydrides being unstable act as good reducing agents.

Oxides of gr. VA (or) 15 elements :-

→ All elements form trioxide (R_2O_3) & pentoxide (R_2O_5)

Trioxides :- Trioxide of N, P, As are acidic. The oxide of Sb is amphoteric while that of Bi is basic in nature.

Pentoxides → Pentoxide is acidic in every case but the acidity decreases with increasing atomic weight. Thus N_2O_5 is the strongest acidic oxide while Bi_2O_5 is weakest.

Oxoacids → All elements of gr VA form oxoacids.

But oxoacid formation capacity & stability decrease as we move from N to Bi.

N → N forms larger no. of oxoacids such as $\text{H}_2\text{N}_2\text{O}_2$, H_2NO_2 , HNO_2 , HNO_3 , HNO_4 , etc.

P - phosphorus forms oxoacids, having oxidⁿ. state +III & +V.

+III o. state acids are, H_3PO_2 , H_3PO_3 , $H_4P_2O_6$ etc. which are become reducing agent means only reduction reacⁿ observed by using these acids.

+V o. state acids are, $H_4P_2O_7$, HPO_3 , H_4PO_5 & $H_4P_5O_8$ etc. which are become oxidising agent, means only oxidation reacⁿ observed by using these acids.

As → Arsenic forms only two oxoacids H_3AsO_3 & H_3AsO_4

Sb → Antimony forms only one oxoacid, H_2SbO_3 which is unstable & exists only in solution.

Bi → gives one oxoacid, H_3BiO_3

Halides of gr. V A elements :-

All elements of gr. V A forms trihalides general formula is MX_3

- Trihalides of gr. V are mostly covalent & partly ionic

→ Ionic character increases as we go down the group

- generally chlorides of gr. V elements, when show hydrolysis reacⁿ that time different trihalide give different product depending upon trihalide NH_3 give $HOCl$ & NH_3

$PCl_3 + 3H_2O \rightarrow 3HCl + H_3PO_3$ similarly As. Trihalides have

& $SbCl_3 + H_2O \rightarrow SbOCl + 2HCl$ similarly Bi. Pyramidal shape.

Pentahalides :- where P, As, Sb & Bi give pentahalides.

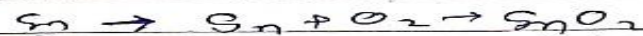
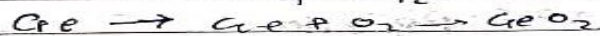
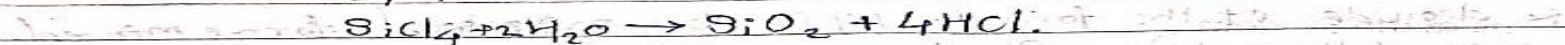
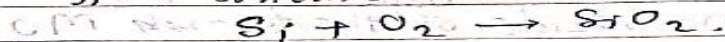
→ N - cannot form pentahalide because N - not have d-orbital in its outermost shell so can not expand its octet.

⇒ Bi - can not form pentahalide because its lower +3 o. state is more stable than +5 o. state because inert pair eff

→ Pentahalides have trigonal bipyramidal shape

→ pentahalides are less stable trihalides

Si → Silicon dioxide is called as silica.



Pb → PbO_2 gives from electrostatic oxidation.

→ In that dioxide, acidic character of dioxide decreases & basic character increases as we go down the group.

gr. V → Hydrides: → general formula MH_3 . → NH_3 ammonia, PH_3

phosphine, AsH_3 arsine, SbH_3 stibine & BiH_3 bismuthine

& larger no. of hydrides are formula M_2H_4 i.e. N_2H_4 hydrazine

P_2H_4 diphosphine & As_2H_4 (diarsine). N also

forms HN_3 hydrazoic acid. These all trihydrides have

sp^3 -hybridisation & pyramidal structure.

Bond angle → is decreased. NH_3 107.3° PH_3 93.6° AsH_3 91.8° SbH_3 91.3°

Boiling pt. → except NH_3 → Bpt. increases as we go down the gr. abnormal Bpt. because of hydrogen bonding

NH_3 -34.5°C PH_3 -87.5°C AsH_3 -62.4°C SbH_3 -18.4°C BiH_3 $+16.8^\circ\text{C}$

Basic character → All hydrides having a lone pair so these are Lewis bases. basic character is decreased as we go down the N to Bi because of size

Reducing character → Reducing character is increased as we go down N to Bi.

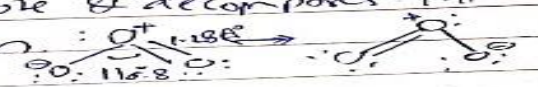

Halides → N & Bi not forms penta halides
→ +3 o. state stable than +5 o. state.
↳ d-orbital not.

Group VII A Elements:

Chalcos \Rightarrow ~~ore~~ ore
 gen \Rightarrow formation So, chalcogens.

- * VIA group elements \rightarrow O, S, Se, Te are non-metals, called as chalcogens & last Po-element is metallic. \rightarrow Oxygen is most abundant element. earth crust is made up of about 46.6%, it is essential for respiration & combustion process. It is essential for all living organisms.
- \rightarrow sulphur occurs in combination form with metals such as sulphides.
 - \rightarrow the sources are crude oil, natural gas, from which it is extracted as H_2S . Te, Se & Po are rare.
 - \rightarrow In all elements outer shell electrons are six. So, ele. conf. is $ns^2 np^4$

* Properties of VIA gr. :-

- (1) size of atom & ion \rightarrow From top to bottom increases, but not uniform. O to S - large size, but S to Se is small increase. because of shielding effect.
- (2) Ionisation energy :- From top to bottom decreases. O to S I.E. diff. is large. but S to Te diff. is lesser.
- (3) Electronegativity \rightarrow decrease down to gr. O - is highest electr. negativity. in gr. VIA.
- (4) oxidation state \rightarrow $ns^2 np^4$ ele. conf. So, oxide state got when absorb two electrons, so gives divalent anion such as O^{2-} & S^{2-} . In that elements, two unpaired ele so +II O. state is common, & also observed +IV & +VI are also possible when the paired p & s electrons are unpaired respectively.
- (5) Reactivity :- all elements reactive, but reactivity decreases in gr. VIA.
- (6) Allotropy :- O_2 & O_3 allotropic forms. S, Se, Te & Po form more complicated Os, like as S_8
 $O_2 \rightarrow$ is paramagnetic $\ddot{O}=\ddot{O}$. $O_3 \rightarrow$ unstable & decomposes into O_2
 Str. of O_3 is V-shaped. sp^2 -hybridisation. 
 $S_8 \rightarrow$ 

* Oxides :- classification on the basis of ΔG & chemical property.

(a) Normal oxides :- general formula M_xO_y .

oxidation no. of O - is (-2) e.g. H_2O , MgO & Al_2O_3 ,
& any $M-O$ bond.

(b) Peroxides :- O state is (-1), M_xO_2 e.g. H_2O_2 ,
It having $-O-O-$ bond.

(c) suboxides :- this type of oxide contains less oxygen
than would be expected for an $O=C=C=C=O$.

(d) Basic oxides :- metallic oxides are generally basic.
They are ionic & contains O^{2-} ion, for ex.
 Na_2O , MgO , CaO .

(e) Amphoteric oxides :- e.g. BeO , Al_2O_3 , Cr_2O_3 , SnO
 PbO & ZnO .

(f) Acidic oxides :- Non-metallic oxides, covalent bond
 B_2O_3 , N_2O_5 , CO_2 , P_2O_5 , SO_3 etc.

(g) Neutral oxides :- few oxides have no acidic &
no basic properties for ex. N_2O , NO , CO .

Elements of Group VII:

* Elements of gr. VII \rightarrow

\rightarrow In that F, Cl, Br, I & At (Asterisk line) fairly abundant in nature

- It is observed in a combined forms of earth crust.

Out of halogens only At is a radioactive.

\rightarrow F, Cl, Br & I have closely related properties & are known collectively as Halogens.

Sea salts, general = born because the salts of first three occurs in sea water.

• Electronic configuration \rightarrow

Element	At. No.	Electronic configuration
F	9	$[\text{He}] 2s^2 2p^5$
Cl	17	$[\text{Ne}] 3s^2 3p^5$
Br	35	$[\text{Ar}] 3d^{10} 4s^2 4p^5$
I	53	$[\text{Kr}] 4d^{10} 5s^2 5p^5$
At	85	$[\text{Xe}] 4f^{14} 5d^{10} 6s^2 6p^5$

General electronic configuration is $ns^2 np^5$. So only one ele. require to get inert gas configuration & becomes stable. Hence amongst elements in periodic table halogens are reactive elements in inorganic chemistry.

GENERAL PROPERTIES:

→ General properties :-

- (i) At. & ionic radii - increased when we go down the group.
- (ii) Ionisation energy in I.E. is very high for halogens, because of very small tendency to lose electrons, but values are decreased as we go down the group.
- (iii) Electronegativity: → Halogens have high electronegativity, in that F. is highest electronegativity which is $\frac{4}{4}$. But when we go down the group, electronegativity is decreased.
- (iv) Non-metallic character: → Considering the high electronegativity, all halogens are non-metallic in nature & the character is decreased when we go from top to bottom, i.e. Iodine shows distinctly metalloidal character.
- (v) Colour: → All halogens are coloured; because of absorption of light, an electron goes in excited state in outer shell, so they radiate light when come in ground state or lower state.
F → absorbs violet light & emits yellow.
Cl → emits greenish yellow.
Br → red colour.
I → absorbs yellow & green radiations & emits violet.
- (vi) Electron affinity: → They have high electron affinity, $F < Cl > Br > I$, generally decreased E.A.
- (vii) Oxidation State: → They have +1, -1 & 0 state. F is most electronegative so exhibits -1 o. state. Other halogens exhibit higher positive o. state +3, +4, +5, +6 & +7.

* Compounds of VII A elements:-

- hydrides → HF, HCl, HBr, HI, acids.
- oxides Cl_2O , F_2O , Br_2O , I_2O .
- oxy acids $HClO_4$.

INTERHALOGEN COMPOUNDS:

* Interhalogen Compounds :-

Each halogen combines with every other halogen to form compounds amongst themselves. These are known as interhalogens or interhalogen compounds.

For writing & naming the interhalogen compounds, the less electronegative halogen is ~~written~~ first.

→ They are divided into two categories;

- ① Neutral molecules containing two or more halogen atoms such as ICl , ClF_3 , IF_5 , IF_7 , etc.
- ② Negatively charged interhalogen anions such as ICl_2^- & ICl_4^- & positively charged interhalogen cations such as ICl_2^+ & IF_4^+ .

Types of interhalogens :-

XY	XY_3	XY_5	XY_7
ClF	ClF_3		
BrF	BrF_3	BrF_5	
IF		IF_5	IF_7
BrCl			
ICl	ICl_3		
IF_3			

THE END