BORON FAMILY

5	13	31	49	81	113
B	Al	Ga	In	Tl	Uut
Boron	Aluminium	Gallium	Indium	Thallium	Ununtrium unknown

ELECTRONIC CONFIGURATION

ns^2np^1

Valence electrons = 3

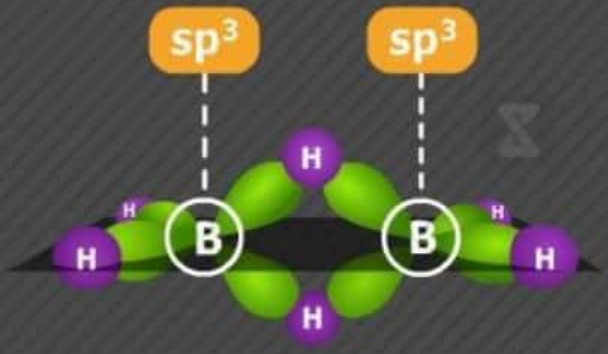
PHYSICAL STATE

Boron is a non metal. Aluminium, Indium, Gallium are metalloids.

31 Ga Gallium

Gallium has the **second lowest melting point** after mercury. It remains in liquid phase even at high temperatures.

DIBORONE (B_2H_6)



AMPHOTERIC

$Al(OH)_3$ is amphoteric

Al - O - H

Strength between Al - O and O - H is same.

Bond strenght Al – O = Bond strenght O – H

BH_3 is an electron deficient molecule. It has six electrons and a vacant orbital. So, it is used as an electrophile in organic reactions.

Aluminium is used in tins, aeroplanes and even in Iphone

Borax ($Na_2B_4O_7$) is used for cleaning and washing purposes.

Aluminium was classified as precious metal during 19th century. **Napoleon III** gave aluminium cutlery to his most valuable guests, all other guests had to eat with gold cutlery.

Indium is used in display screens of television and mobiles.

Thallium is used as rat poison.

CARBON

Part-I

FAMILY

6	14	32	50	82
C	Si	Ge	Sn	Pb
12.0107	28.09	72.81	118.71	207.2

DO you know?

- Carbon is a non-metal
- Silicon and germanium are metalloid
- Lead and tin are metal

Carbon has three main solid state allotropes: Graphite, Diamond and Fullerenes (the most commonly known of which, buckminster fullerene, is also known as a "bucky-ball").

Germanium

Germanium is a rare element used in the manufacturing of **semi-conductor** devices. The physical and chemical properties of germanium are very similar to those of silicon. Germanium is **grey-white** in color and forms crystal structures.

Silicon

Silicon is the second most common element in the earth's crust (after oxygen) and it is the backbone of the mineral world. Silicon is used extensively as a semiconductor in **solid-state** devices in the computer and microelectronics industries.

Tin

Tin is **malleable**, **ductile**, and **crystalline**. It is a superconductor at low temperatures. Tin reacts with bases, acid salts and strong acids. Tin chlorides are good reducing agents and often used to reduce iron ores. Tin fluoride is often the anticavity **"fluoride"** additive in toothpastes.

Lead

It is a soft, malleable metal with a low **melting point**. Lead is toxic to humans, especially children. Even low levels of exposure can cause nervous system damage and can prevent proper production of **haemoglobin**. Its oxides have many industrial uses as oxidizing agents, such as cathodes in lead-acid storage cells.

Point to Remember

Carbon has the highest melting/sublimation point of the elements. The melting point of diamond is **3550°C**, with the sublimation point of carbon is around **3800°C**

CARBON FAMILY

Part-II

6	14	32	50	82
C	Si	Ge	Sn	Pb
Carbon	Silicon	Germanium	Tin	Lead

ELECTRONIC CONFIGURATION

ns^2np^2

Valence Electrons = 4

REACTIVITY

The carbon family elements tend to be fairly unreactive. the elements tend to form covalent compounds, though tin and lead also form ionic compounds.

CARBIDES

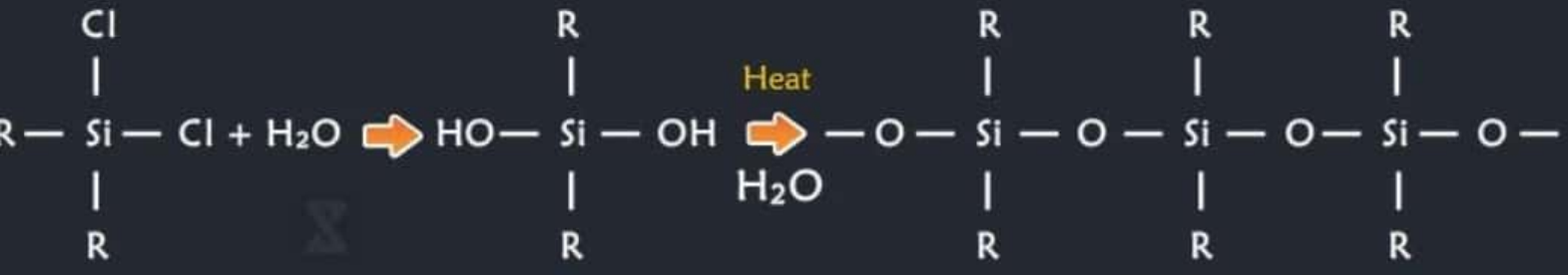
Carbon combines with other elements and forms carbides Al_4C_3, Be_2C, SiC and B_4C are considered as the hardest compounds.

DON'T STORE JUICES IN TIN CONTAINERS

Generally juices have metallic taste if we store them in tin containers. Juices are mostly acidic and they react with tin. Tin reduces the acid by absorbing oxygen.

SILICONES

Silicones are organo silicon polymers and are formed by hydrolysis of R_2SiCl_2



CARBON-GODLY ELEMENT

Every human being and everything around us consists of carbon.

TIN-CANS

Initially we used Tin in making cans, later it was replaced by Aluminium.

SILICON

Silicon is used in semiconductor devices, which are used in modern day computers.

LEAD PENCILS

Lead Pencils which we use do not contain Lead. It contains Graphite (an allotrope of carbon).

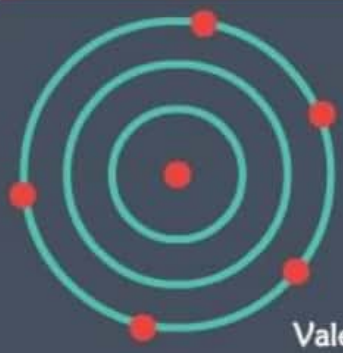
NON STICK PAN

Nonstick pan has a Teflon layer on its surface. Teflon(-CF_2-CF_2-)

NITROGEN FAMILY

7	15	33	51	83
N	P	As	Sb	Bi
Nitrogen	Phosphorus	Arsenic	Antimony	Bismuth

ELECTRONIC CONFIGURATION



ns^2np^3

Valence Electron =5

BORAZONE

Borazone(cBN) has graphite like structure and it is harder than diamond. So, it is used for cutting the diamond.

Half life of Bismuth is very high. If 100 gm of Bismuth had been present at the begining of universe, 14 billion years ago. About 99.9999 gm would be left today.

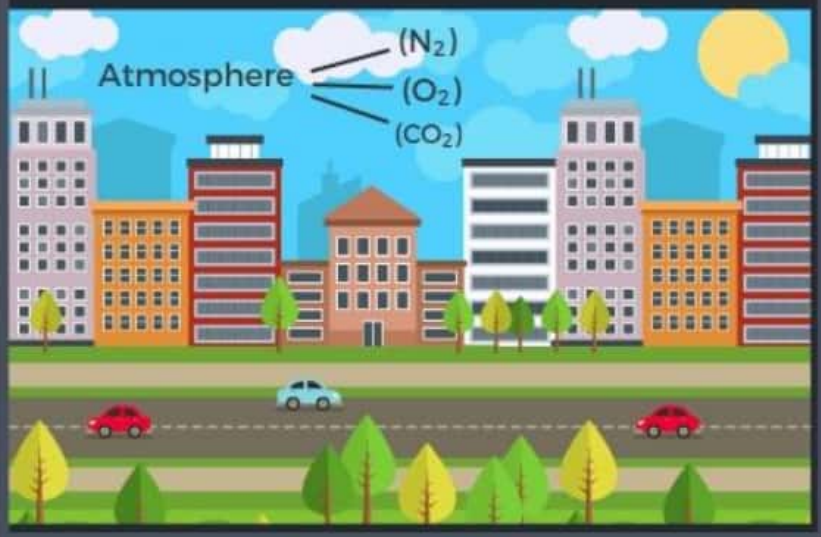
INERT NATURE OF N_2 ($N \equiv N$)

Triple bond exists between Nitrogen, which is very hard to break. It reacts only when suitable conditions are met for reaction.

TEST OF PROTIENS

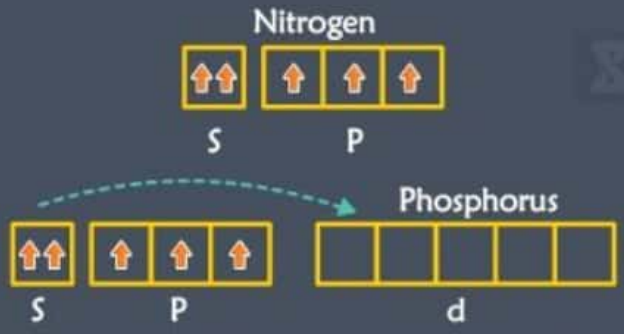
Nitric acid attacks the protien and forms Xanthoprotien which is yellow is colour.

EARTH ATMOSPHERE CONTAINS 71% NITROGEN



PENTAHALIDES

Nitrogen does not show pentahalides because of the absence of d-orbitals. Phosphorous shows pentahalides by exciting s electrons into d-orbitals.



USES

TNT

Tri Nitro Toulene is used in explosives.

Arsenic is a poisonous gas therefore, it is used as pesticides for trees.

Red phosphorus is used in matchbox.

P_2O_5 is used as a drying agent, but it is corrosive to use outside the labs.

CHALCOGENS

8	16	34	52	84	116
O	S	Se	Te	Po	Lv
Oxygen	Sulphur	Selenium	Tellurium	Polonium	Livermorium

ELECTRONIC CONFIGURATION

$ns^2\ np^4$

Valence Electrons = 6

TAILING OF MERCURY

Mercury loses its miniscus and sticks to the glass due to formation of mercurous oxide.

$2Hg + O_3 \rightarrow O_2 + Hg_2O$

Ozone — Mercurious oxide

POLONIUM

Radioactive and deadly. It is rumoured that Yasar Arafat died due to poisoning of Polonium.

OZONE LAYER (O_3)

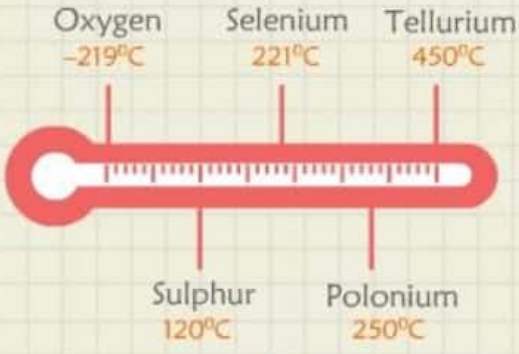
Ozone layer is filled with ozone molecules.

Ozone is the **BEST OXIDISING AGENT**

CAREFUL WITH H_2SO_4

H_2SO_4 is the strongest and most corrosive acid. It can cause serious burns on the skin.

MELTING POINT



REACTION WITH HYDROGEN

Hydrogen with Oxygen forms water (H_2O)
Hydrogen with sulphur forms H_2S which gives foul smell.

TELLURIUM

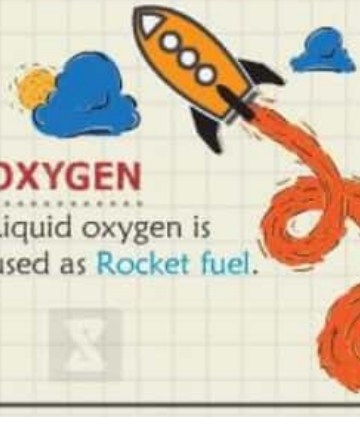
Tellurium is used in CD's and Blue-ray discs.

SULPHUR

Sulphur is used in making Gun powder.

SELENIUM

Selenium is used in Glass making.



OXYGEN

Liquid oxygen is used as Rocket fuel.

HALOGENS

1 Physical State

Gas	Liquid	Solid
F, Cl	Br	I, As

2 ELECTRONIC CONFIGURATION

They have seven valence electrons

GENERAL CONFIGURATION
$ns^2\ np^5$

3 REACTIVITY

Reactivity decreases down the group as it is harder to add electrons.

F is the most reactive

4 ACIDITY

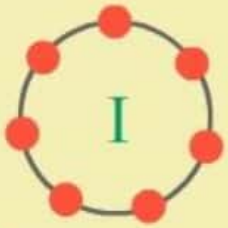
Acidity decreases down the group

HF is the strongest acid which can dissolve glass also.

5 INTER HALOGEN

Halogens combine with each other to forms series of compounds like

$AX\ AX_3\ AX_5\ AX_7$



Large molecules can accomodate more halogens like in IF7

Small fluorine can't accomodate many halogens like in FCl F Cl

6 CHLORINE IN WAR FARE

Germany used chlorine in world war- I against France.

Chlorine gas destroys respiratory organs.

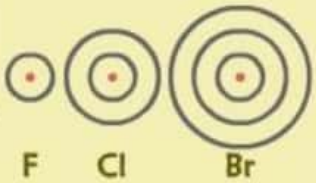
7 VARIABLE OXIDATION STATES

Halogens exhibits variable oxidation states. starting from –1 to 7.

Fluorine can't show positive oxidation state.

8 ELECTRONEGATIVITY

Atomic size increases down the group, therefore electronegativity decreases down the group.



9 USES

Fluorine is used in Tooth Paste

Chlorine is used as a Bleaching Agent

Iodine is used in Disinfectants

Bromine is used for developing Photographic films

NOBLE GASES

2	10	18	36	54	86
He	Ne	Ar	Kr	Xe	Rn
4.0026	20.179	39.948	83.80	131.293	222.017
Helium	Neon	Argon	Krypton	Xenon	Radon

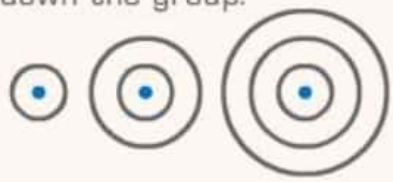
Also known as inert gases as their atoms don't combine with other atoms in chemical reaction

First Noble Gas Compound - Xenon

Bartlett surprised every one by synthesiting $XePtF_6$

Atomic Size

Size increases as you go down the group.



He Xe Kr

Helium

Helium is used in ballons. Initially hydrogen was used which is much lighter than Helium but due to its flammability, we shifted to Helium.

Krypton

Light bulb containing krypton gas can produce a bright white light useful for photo-graphy and runaway lights.

Electronic Configuration

These elements have 8 electrons in valence orbital which is considerd stable.

Exception : Helium has two valence electrons

General electronic configuration

$ns^2\ np^6$

Neon Light

Neon Lights which we use in our streets are produced by ionising inert gas by applying voltage.

Argon

Do you know?

There are 22 known isotopes of argon ranging from argon-31 to argon-51 and argon-53.

Radon

Radon is radioactive and can enter homes through basements after radioactive decay of rocks below the earth.

Reactivity of Xenon

1. Xenon acts as fluorinating agent

$$Pt + XeF_4 \rightarrow PtF_4 + Xe$$

2. Xenon acts as fluoride acceptor

$$XeF_4 + MF_5 \rightarrow [XeF_3]^+ [MF_6]^-$$

3. Xenon acts as fluorine donar

$$XeF_4 + MF \rightarrow M^+ + [XeF_4]^-$$