

CONCEPT MAP

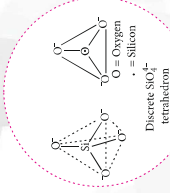
THE p-BLOCK ELEMENTS (Group 14)



Group 14 elements show a pronounced discontinuity in their general properties between the first and second row elements followed by a gradual transition towards more metallic character.

Atomic and Physical Properties

- Elements: C, Si, Ge, Sn, Pb
- Electronic configuration: [Noble gas] $ns^2 np^2$
- Oxidation states: +2 and +4
- Atomic radii, metallic character and stability of +2 O.S. : Generally increase down the group.
- Ionisation enthalpy, melting point, boiling point, reducing character and stability of +4 O.S. : Generally decrease down the group.
- IE of Pb is slightly higher than Sn due to lanthanide contraction.
- IE_1 and IE_2 are higher and lower than the corresponding group 13 elements respectively.
- Catenation : Tendency of catenation decreases down the group.
- Allotropy: Except Pb, all others show allotropy.
- Complex formation : Except C, all other form complexes due to presence of vacant d -orbitals.

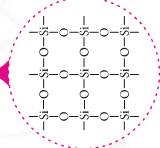


Silicates

- Basic unit is SiO_4^{4-} .
- They exist either as discrete unit or joined together by sharing 1, 2, 3 or 4 oxygen atoms per silicate unit to form different structures like chain, ring, sheet or 3-D network.
- Zeolites are 3-D silicates in which some of the Si atoms are replaced by Al^{3+} ions and to balance the negative charge some cations like Na^+ , K^+ or Ca^{2+} are incorporated. They are used in water softening.

Silicon Dioxide (SiO_2)

- Covalent, three dimensional network solid.
- Almost non-reactive due to high Si - O bond enthalpy.



GROUP 14 : THE CARBON FAMILY

Chemical Properties

- Reactivity towards air:
 - They form oxides of the formula EO and EO_2 on heating with air.
 - Acidic strength of their oxides decreases down the group.
- Reactivity towards water:
 - Only Sn can decompose water.
 - $Pb + 2H_2O \longrightarrow SnO_2 + H_2$
 - Pb is unaffected by water due to formation of protective oxide film.
- Reactivity towards halogens:
 - They form halides of the formula EX_4 and EX_2 .
 - Except C, all react directly with halogens.
 - Except C and Si, all form dihalides.



Anomalous behaviour of C

- The anomalous behavior of C is due to small size, high ionisation energy and absence of d -orbitals.
- C is hardest having highest m.p.t. and b.p.t. amongst the elements of group 14.
- C shows maximum covalency of 4 while rest show maximum covalency of 6.
- C has maximum tendency for catenation and multiple bonding ($p\pi-p\pi$) and shows allotropy.



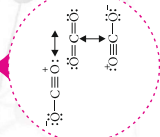
Important Compounds of C and Si

Carbon Monoxide (CO)

- Preparation :
 - $C + H_2O \xrightarrow{\text{Water gas}} CO + H_2$
 - $2C + O_2 \xrightarrow{2773 K} 2CO + 4N_2$ (Producer gas)
- Highly poisonous due to the formation of a complex with haemoglobin (Hb) which is 300 times more stable than O_2 -Hb complex thus, prevents Hb in the RBCs from carrying O_2 round the body.

Carbon Dioxide (CO_2)

- Preparation :
 - $CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$
 - It is consumed during photosynthesis.
 - $6CO_2 + 12H_2O \xrightarrow{h\nu} C_6H_{12}O_6 + 6O_2 + 6H_2O$



Silicones

- Synthetic organosilicon polymers containing repeated R_2SiO units held by Si - O - Si linkage.
- They are water repelling due to non-polar alkyl groups.

