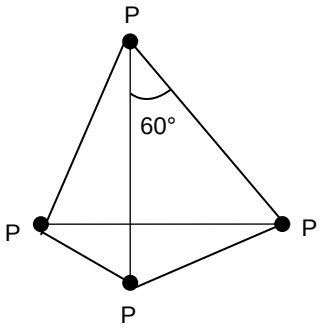
Introduction

- VA group elements are Nitrogen (N) (7), Phosphorus (P) (15), Arsenic (As) (33), Antimony (Sb) (51), Bismuth (Bi) (83).
- These elements are called as pnicogens.
- Their compounds are called pnictides.
- 78% of Atmosphere posses Nitrogen.
- It is also available in the form of nitrate salts in earth's crust.
  Eg : Salt petre KNO_3, Chile salt petre $NaNO_3$ etc,.
- Most abundant element of this group in earths crust is P.
- The important minerals of phosphorus are phosphate rocks, fluorapatite [$3Ca_3(PO_4)_2$, CaF_2], phosphorite [$Ca_3(PO_4)_2$] etc,.
- These are p–Block elements with $ns^2\ np^3$ configuration.
- As the P – orbitals in the outermost shells are half-filled these elements are stable.
- Nitrogen is a gas, P, As, Sb and Bi are solids.
- Nitrogen and Phosphorus are non – metals, Arsenic and antimony are metalloids and Bismuth is a metal.
- Nitrogen exists as triple bonded diatomic gaseous molecule. Bismuth is a metal (monoatomic).
- P, As and Sb exists as tetratomic, tetrahedral molecules.
- The existence of Nitrogen as diatomic molecule is due to existence of p□ - P□ multiple bonds.
- The bond dissociation energy of Nitrogen is 945.4kJ. (225 kcal/mole)
- p□ - P□ multiple bonds are not possible in other elements due to repulsion between non – bonded electrons of the inner core.
- Phosphorus form layered structures with a co-ordination number of 3.
- P_4 has a regular tetrahedral structure having one P atom at each vertex of the tetrahedron. The bond angle $\angle PPP$ is 60°.



- *Atomic size increases from Nitrogen to Bismuth, less increase from As to Bi is because of less shielding effect of (n-1) d electrons.*
- *Due to smaller size of nitrogen it's electronegative value is high.*

- Electronegativity decreases from nitrogen to Bismuth.
- B.P. increases from Nitrogen to Bismuth.
- M.P. increases from Nitrogen to Arsenic and then decreases.
- Low M.P of nitrogen is due to its diatomic discrete gaseous molecules.
- Due to large size and metallic character the M.P. of antimony and Bismuth decreases.
- Nitrogen in solid state exists in cubic crystalline structure (- nitrogen) and hexagonal crystalline structure (- nitrogen).
- Phosphorous exists in white, red, scarlet, violet, - black, - black etc. forms.
- Nitrogen can form a chain of two atoms (NH_2–NH_2) and a chain of three atom ($N_3^{(-)}$).
- Less catenation capacity for Nitrogen is due to less dissociation energy of N – N bond.
- Phosphorus forms (P_2H_4).
- The general oxidation states of these elements are +3 and +5 and –3 (except Bi).
- Stability of + 3 form increases from nitrogen to bismuth and + 5 decreases due to inert pair effect.
- Nitrogen show various oxidation states because of small size and high electronegativity. It shows

  – 3 in Li_3N, Mg_3N_2, Ca_3N_2 etc.

  – 2 in N_2H_4

  – 1 in NH_2OH

  $-\frac{1}{3}$ in N_3H

  0 in N_2

  + 1 in N_2O

  + 2 in NO

  + 3 in N_2O_3

  + 4 in NO_2

  + 5 in N_2O_5
- Phosphorous show – 3 in Zn_3P_2, Ca_3P_2.
- Nitrogen can show maximum covalency of 4 (NH_4^+).
- Remaining elements shows covalency of 5 and a maximum of 6 as in $AsF_6^{(-)}$, $PCl_6^{(-)}$.
- Phosphorous is reactive due to the presence of single P – P covalent bonds.