ATOMIC ENERGY CENTRAL SCHOOL-3

TARAPUR

HANDOUT-MODULE- 1/1

SUBJECT: CHEMISTRY CLASS: XII

LESSON : GROUP -15 ELEMENTS

UNIT: p-BLOCK ELEMENTS.

Introduction: p- block elements - Elements from group-13 to group-18, in which differentiating or last electron enter in p- sub shell of the atom are called as p- block elements. (except, He).

The He is an inert gas resembles other members of Group- 18, therefore studied in p-block.

Characteristics of p- block elements :

1. There general electronic configuration is ns^2np^{1-6}.

2. These may be metal, non-metal and metalloids.

3. These generally forms covalent compounds.

Group-15 Elements :

N
P
As
Sb
Bi

- These elements are called as pnictogens .
- Nitrogen family elements consists of atoms having 5 electrons in their outer energy level. Two of the electrons are in the *s* subshell, with 3 unpaired electrons in the *p* subshell.
- As you move down the nitrogen family: atomic radius increases, ionic radius increases, ionization energy decreases, and electronegativity decreases.
- Nitrogen family elements often form covalent compounds, usually with the oxidation numbers +3 or +5.
- Nitrogen and phosphorus are nonmetals. Arsenic and antimony are metalloids. Bismuth is a metal.
- Except for nitrogen, the elements are solid at room temperature.
- Element density increases moving down the family.
- Except for nitrogen and bismuth, the elements exist in two or more allotropic forms.
- Nitrogen family elements display a wide range of physical and chemical properties. Their compounds may be transparent, either diamagnetic or paramagnetic at room temperature, and may conduct electricity when heated. Because the atoms form double or triple bonds, the compounds tend to be stable and potentially toxic.

- Molecular nitrogen comprises 78% by volume of the atmosphere.
- As, Sb, and Bi are found mainly as sulphide minerals.
- The general electronic of this group is $ns^2np_x^1np_y^1np_z^1$, the s-orbital in these elements is completely filled and p-subshell is half –filled ,making their electronic configuration extra stable.
- Due to stable electronic configuration the ionization enthalpy of these elements is higher than 14 and 16 groups.
- Nitrogen is diatomic gas while other elements of this group are polyatomic.
- Due to absence of d-orbital it does not form pentahalides but other elements of this group can form penathalides.
- Pentahalides are more covalent than trihalide because in place of donation of 5electrons sharing of 5e is ease process.
- BiH_3 is the strongest reducing agent amongst all the hydrides of this group because on moving down in group the E-H bond length goes on increasing & bond strength decreases therefore Bi-H bond is a weaker bond.

- Dinitrogen is gas at room temperature because weak van der Waals forces are present between the molecules of dinitrogen. It is inert at room temperature because of the high bond enthalpy of three N-N bonds.
- The well known hydride of nitrogen is ammonia (NH_3) , on a large scale, ammonia is manufactured by haber's process :
  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta H^0 = -46.1 \text{ kJ mol}^{-1}$.
  According to Le Chatelier's principal, high pressure and low temperature are the optimum conditions to maximize the yield of ammonia.
- NO_2 is an oxide of nitrogen , is a brown gas & acidic in nature, it is odd electron species therefore dimerises.
- Nitrogen forms oxoacids such as $H_2N_2O_2$ (hyponitrous acid), HNO_2(nitrous acid) and HNO_3(nitric acid). Amongst them HNO_3 is most important. On a large scale it is mainly prepared by Ostwald's process. This method is based upon catalytic oxidation of NH_3 by atmospheric oxygen to NO, NO further oxidize to NO_2 this reacts with water to give HNO_3.

$3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$