L.S COLLEGE MUZAFFARPUR

B. R. A. BIHAR UNIVERSITY

Dr. Priyanka

Department of Chemistry

TOPIC:- Group-wise systematic study of p-block elements

Group-13

Chemical properties

Chemical Properties

Boron's chemistry is so different from that of the other elements in this group that it deserves separate discussion. Chemically boron is a non-metal, it has a tendency to form covalent bonds and displays similarities with silicon, which will be discussed later.

All elements except thallium when treated with halogens, oxygen or sulphur form halides (MX_3) oxides (M_2O_3) and sulphides (M_2S_3). Thallium forms TlX, Tl_2O and Tl_2S. Aluminum has a very high affinity for oxygen (enthalpy of formation of Al_2O_3 is – 1676 KJ mol^{-1}) and is used to remove oxygen from other metal oxides. This forms the basis of the Thermite process for extracting many metals from their oxides.

$$3\,MnO_2 + 4Al \longrightarrow 2Al_2O_3 + 3Mn$$

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Boron and aluminium form nitrides by direct combination with nitrogen at very high temperature. They form carbides on heating with carbon.Aluminium carbide (Al_4C_3) on hydrolysis given methane.

$$Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3\,CH_4$$

Boron carbide ($B_{12}C_3$) is a hard, high melting, inert compound used as an abrasive. Boron combines with many metals to form borides e.g. MgB_2, VB, Fe_2B where it displays negative oxidation state. The reactions of the elements with acids differ. Boron reacts only with oxidizing acids to form boric acid

$$2B + 3H_2SO_4 \longrightarrow 2H_3BO_3 + 3SO_2$$

$$B + 3HNO_3 \longrightarrow H_3BO_3 + 3\,NO_2$$

Boric acid is better represented as $B(OH)_3$ and does not contain replaceable hydrogen. The other elements react with dilute mineral acids to evolve hydrogen

$$2M + 6HCl \longrightarrow 2MCl_3 + 3H_2$$

Al is rendered passive with concentrated nitric acid. Boron liberates hydrogen when fused with alkali.

$$2B + 6NaOH \longrightarrow 2Na_3BO_3 + 3H_2$$

Aluminium and gallium dissolve in alkali to form tetrahydroxoaluminate (III) and tetrahydroxogallate (III) respectively.

$$M + 4NaOH \longrightarrow Na[M(OH)_4] + 2H_2$$

Thus, we see that elements of Group 13 are quite reactive. We will now study some important compounds.