



## Hydrogen

## Position of hydrogen in the periodic table

Hydrogen is the first element in the periodic table. Hydrogen is placed in no specific group due to its property of giving electron (When  $H^-$  is formed) and also losing electron (When  $H^+$  is formed).

## Preparation of Dihydrogen:

(i) By action of water with metals

$$2M + 2H_2O \rightarrow 2MOH + H_2$$

$$[M = Na, K \text{ etc.}]$$

(ii) By the reaction of water on alkali and alkaline earth metals hydrides

$$NaH + H_2O \rightarrow NaOH + H_2$$

$$CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$$

(iii) By action of metal with acids:

$$Fe + 2HCl \rightarrow FeCl_2 + H_2$$

(vi) Laboratory method:

$$Zn + \text{dil. } H_2SO_4 \rightarrow ZnSO_4 + H_2$$

(vii) *Preparation of pure hydrogen*: (i) The action of pure dil.  $H_2SO_4$  on pure magnesium ribbon.

$$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$





(ii) **Bosch process:** 
$$C + H_2O \xrightarrow{1270 \text{ K}} CO + H_2$$
Water gas

$$H_2 + CO + H_2O \xrightarrow{773 K} CO_2 + 2H_2$$

(iii) Lane's process:

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Physical properties of dihydrogen: It is a colourless, tasteless and odourless gas.

(i) Action with metals: To forms corresponding hydrides.

$$2Na + H_2 \xrightarrow{Heat} 2NaH$$
,  $Ca + H_2 \xrightarrow{Heat} CaH_2$ .

(ii) Reaction with Non-metals  $2H_2 + O_2 \xrightarrow{970 \text{ K}} 2H_2O$ 

$$N_2 + 3H_2 \xrightarrow{Fe, Mo} 2NH_3$$

$$H_2 + F_2 \xrightarrow{Dark} 2HF$$

$$H_2 + Cl_2 \xrightarrow{Sunlight} 2HCl$$

$$H_2 + Br_2 \rightarrow 2HBr$$

$$H_2 + I_2 \xrightarrow{673 \text{ K}} 2HI$$

The reactivity of halogen towards dihydrogen decreases as,

$$F_2 > C l_2 > B r_2 > I_2$$

(iii) *Reaction with unsaturated hydrocarbons*:  $H_2$  reacts with unsaturated hydrocarbons such as ethylene and acetylene to give saturated hydrocarbons.

$$H_2C = CH_2 + H_2 \xrightarrow{Ni \text{ or Pt or Pd}} CH_3 - CH_3 \quad HC \equiv CH + 2H_2 \xrightarrow{Ni \text{ or Pt or Pd}} CH_3 - CH_3$$
Ethane

Acetylene

Acetylene

## **Uses of Dihydrogen**

- (i) As a reducing agent
- (ii) In the hydrogenation of vegetable oils
- (iii) As a rocket fuel in the form of liquid  $H_2$







(iv) In the manufacture of synthetic petrol