HYDROGEN

(i) Molecular hydrogen

Ordinary hydrogen gas consists of di-atomic molecules in which two H-atoms unite together by covalent bond. This is known as **molecular hydrogen.**

Stability of molecular hydrogen

H-H bond energy is very high i.e, 104 Kcal per mole .Due to high bond energy ,molecule of hydrogen is very stable .**It does not react under ordinary conditions** .Only those reactions are possible in which at least 104 Kcal per mole of energy is available.

(ii) Atomic hydrogen

Hydrogen obtained by the dissociation of molecular hydrogen is called atomic hydrogen.

Atomic hydrogen is very energetic and very reactive .It has a very short life and spontaneously combine to form molecular hydrogen.

PREPARATION OF ATOMIC HYDROGEN

(i) **By thermal dissociation**
When molecular hydrogen is heated at 5000C,it dissociates into atomic hydrogen. (This is a theoretical approach)

H_2 è **2H**

(ii) **By electric discharge**
At o.1 mm Hg to 1.00 mm Hg pressure

H_2 è **2H**

REACTIONS OF ATOMIC HYDROGEN

Being very energetic ,atomic hydrogen reacts with different substances under ordinary conditions.

(i) **With Oxygen**

$2H + O_2$ è H_2O_2 (Hydrogen per oxide)

ATOMIC HYDROGEN TORCH

Atomic hydrogen torch is a system used to obtain a flame of 5000C. Atomic hydrogen when combined, a high temperature flame is obtained which is used to weld Al-alloys and different types of steel.

DETAILS

When molecular hydrogen is passed through an electric discharge, which is set up between two electrodes, it dissociates into atomic hydrogen. Being a short-lived atom it recombines into molecular hydrogen. Consequently a flame of about 4000C to 5000C is produced which is sufficient for welding.

$H + H$ è H_2 + Heat (104 Kcal per mole)

(iii) **NASCENT HYDROGEN**

Hydrogen gas liberated during a **chemical reaction** is **always in atomic state,** which is known as **nascent hydrogen.**

•If a substance **capable to react is present** then it will react with it, **otherwise it recombines into molecular hydrogen in 0,3seconds,** that may not seem long but is sufficient time for the making of other molecules.

Why, when so much energy would be released, do the atoms not recombine more rapidly? The answer is that the excited state dihydrogen molecule produced is so simple that it has no ready mechanism to get rid of the extra energy other than by dissociating again. E.g. it will be symmetrical and without an electric dipole moment, which prevents it from radiating the energy. A "third body" collision is required, such as with a third hydrogen atom, a hydrogen molecule or the walls of an electrode, to take away the excess energy.

It is even possible to **extend the lifetime** of hydrogen atoms by **magnetic separation.** When hydrogen molecules are dissociated the spins of the electrons are not changed so half the atoms produced have their spins "up" and the other half have them "down". Passing them through a **strong magnetic field** splits them into two beams. Once separated in this way there are no atoms of opposite spin for them to recombine with, and the rate of inversion is very slow unless catalysed by the presence of a paramagneticsubstance such as NO or a transition metal. Single spin atomic hydrogen can be stored for **several days and even liquified.**