

Hydrogen

H

General Information

Discovery

Hydrogen was first recognized as an element by Cavendish in 1766, and named by Lavoisier.

Appearance

Hydrogen is a colourless gas.

Source

Hydrogen is found in the sun and most of the stars, and is easily the most abundant element in the universe. The planet Jupiter is composed mostly of hydrogen, and there is a theory that in the interior of the planet the pressure is so great that metallic hydrogen is formed from solid molecular hydrogen. On this planet, hydrogen is found in the greatest quantities in water, but is present in the atmosphere only in small amounts - less than 1 part per million by volume.

Hydrogen is prepared commercially by several methods; electrolysis of water, decomposition of hydrocarbons, displacement from acids by certain metals, action of steam on heated carbon, and action of sodium or potassium hydroxide on aluminium.

Uses

Large quantities are used in the Haber Process (the production of ammonia for agricultural use) and for the hydrogenation of oils to form fats. It has several other uses, including welding and the reduction of metallic ores, and liquid hydrogen is important in cryogenics and superconductivity studies as its melting point is just above absolute zero.

Biological Role

Hydrogen is the basis of all life, as part of the DNA molecule.

General Information

There are three isotopes of hydrogen - protium, deuterium and tritium. Protium is the ordinary isotope, with an atomic mass of 1. Deuterium, atomic mass 2, was discovered in 1932 and tritium, atomic mass 3, in 1934. Tritium is unstable, with a half-life of about 12.5 years, and is used in nuclear reactors, hydrogen bombs, luminous paints and as a tracer. Protium is the most abundant isotope, and tritium the least abundant.

It would be possible to base the entire economy of the Earth on solar and nuclear generated hydrogen, an advantage as hydrogen itself is non-polluting, but the high cost of hydrogen compared with current hydrocarbon fuels makes this unrealistic at present.

Physical Information

Atomic Number	1
Relative Atomic Mass ($^{12}\text{C}=12.000$)	1.008
Melting Point/K	14
Boiling Point/K	20.3
Density/kg m ⁻³	0.090 (gas, 273K)
Ground State Electron Configuration	1s ¹
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	-72.8

Key Isotopes

Nuclide	¹ H	² H	³ H
Atomic mass	1.008	2.014	3.016
Natural abundance	99.99%	0.015%	0%
Half-life	stable	stable	12.262 yrs

Ionisation Energies/kJ mol⁻¹

M - M ⁺	1312
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Other Information

Enthalpy of Fusion/kJ mol⁻¹ 0.12

Enthalpy of Vaporisation/kJ mol⁻¹ 0.46

Oxidation States

Main H⁺¹

Others H⁰, H⁻¹

Covalent Bonds/kJ mol⁻¹

H - H 453.6

H - F 566

H - Cl 431

H - Br 366

H - I 299