

Hydrogen

Hydrogen is represented by the symbol H and has an electron configuration $1s^1$.

Appearance

Hydrogen is a colourless, odourless, tasteless gas.

General Reactivity

Hydrogen forms more compounds than any other element. The great majority of these compounds are covalent, but the cation H^+ is also very important chemically because of its role in acid-base reactions. Hydrogen is also a powerful reducing agent.

Occurrence and Extraction

Hydrogen is the most abundant element in the universe. There is very little free hydrogen in the earth's atmosphere, but large quantities are found in the combined state as water and organic compounds. Most hydrogen is manufactured from natural gas, which is composed largely of methane.

Physical Properties

Hydrogen is a diatomic gas which has the lowest density of all gases at room temperature and pressure. It is flammable. The splint test is used in the laboratory as a quick test for hydrogen; a test-tube containing a mixture of hydrogen and air gives a loud 'pop' when a flame is applied.

There are three isotopes of hydrogen:

protium - mass number 1

deuterium - mass number 2

tritium - mass number 3

Chemical Properties

Hydrogen is covalently bonded in almost all its compounds. This is mainly because its ionisation energy is very high, so the formation of H^+ is not favoured. Also, H^+ is a proton and so is extremely small, and this small size gives it exceptionally strong polarising power. Important compounds containing hydrogen are discussed under the other element(s) concerned.

The cation H^+ acts as an extremely strong Lewis acid in water and attaches strongly to a water molecule forming H_3O^+ . This ion plays a central role in the mechanism of acidbase reactions.

The most common oxidation number of hydrogen in its compounds is +1, eg: HCl, H_2O , but in compounds containing the hydride ion H^- it has an oxidation number of -1.

Industrial Information

The controlled reaction between hydrogen and oxygen is used to power space vehicles.

Hydrogen is also used to reduce nitrogen gas to ammonia in the Haber-Bosch synthesis (see Group 15). This is the principal method by which atmospheric nitrogen is brought into the food chain.

Further Information

For further information look up the hydrogen entry.

Data

Ionisation Energy/kJ mol⁻¹ 1312

Radius of H⁺ ion/m 10⁻¹⁵