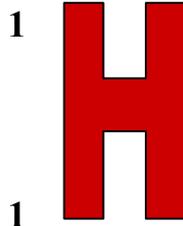


Hydrogen

Frequency in the universe	~ 91%
in the earth crust	0.3%
in the sea water	66%
in the human body	63%



Melting point	-260°C
Boiling point	-253°C
density	0.09g/l
Elektronegativity	2.20
Atomic radius	37.5 pm
Elektron configuration	1s ¹

Hydrogen is the most frequent element in the universe. It is available in large quantities in every fixed star. The reaction to helium produces the energy for the brightness of the fixed stars.

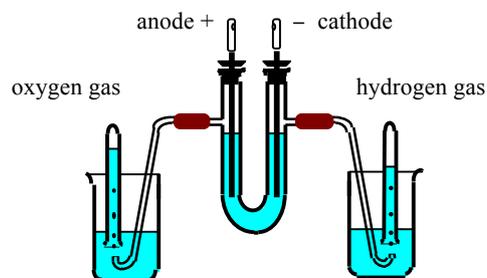
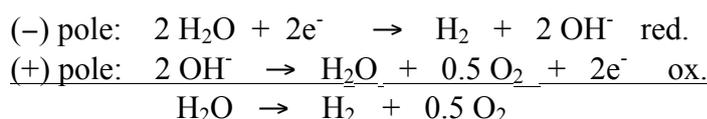
Our sun will live on its hydrogen stock for another 5 billion years.

Gigantic nebulae of atomic hydrogen exist between the stars. Such fogs don't emit light of their own but are made to shine by adjacent fixed stars. The largest planet in our solar system, Jupiter, also consists mainly of hydrogen and helium. Proving the existence of hydrogen is possible due to its typical spectrum. Atomic hydrogen is found in the atmosphere of our earth only as a trace element.

Hydrogen exists mainly bound to other elements. Its most important compounds are water, methane (in natural gas), hydrocarbons (in petroleum), as well as almost all other organic compounds.

How to generate large quantities of hydrogen

- Large quantities result as a by-product of the chemical industry as well as in petrochemistry
- From natural gas (CH₄) by steam reforming
- By gasification of biomass
- By **electrolysis of water**



Properties: colourless, odourless gas. Lowest density of all elements, therefore high diffusion through porous diaphragms, even through metals like platinum.

Burns with a weakly bluish flame to form water vapour. Mixtures with oxygen or with chlorine explode at ignition (oxyhydrogen mixtures). Some metals such as palladium are able to accumulate hydrogen up to 12.000 fold of their volumes.

Uses: The gas is available in red steel bottles and is the most important welding gas besides acetylene. It is an important raw material for the production of ammonia (fertilizer), for making methanol and for reducing ores.

It is a source of energy in rocket fuels (Space shuttle) and for the production of current in hydrogen fuel cells.

"And what will they burn instead of coal?" "Water," replied Harding. "Water!" cried Pencroft, "water as fuel for steamers and engines! Water to heat water!"

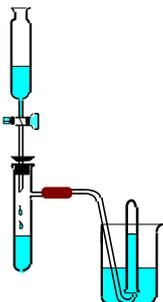
"Yes, my friends, I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable."

J. Verne, "The mysterious island" 1874



Experiments for the "hydrogen" topic:

1. Produce hydrogen in a gas designer made of zinc grains and weak hydrochloric acid. The generated hydrogen is caught pneumatically. Check whether the gas burns by holding the opening of the test-tube into the flame.



Symbol equation:

2. Find out the different reactivity between the alkali metals lithium, sodium and potassium with water.

metal	speed of reaction	further observations
Li		
Na		
K		

Note down the three symbol equations!

3. „The singing tin"
Explanation:

