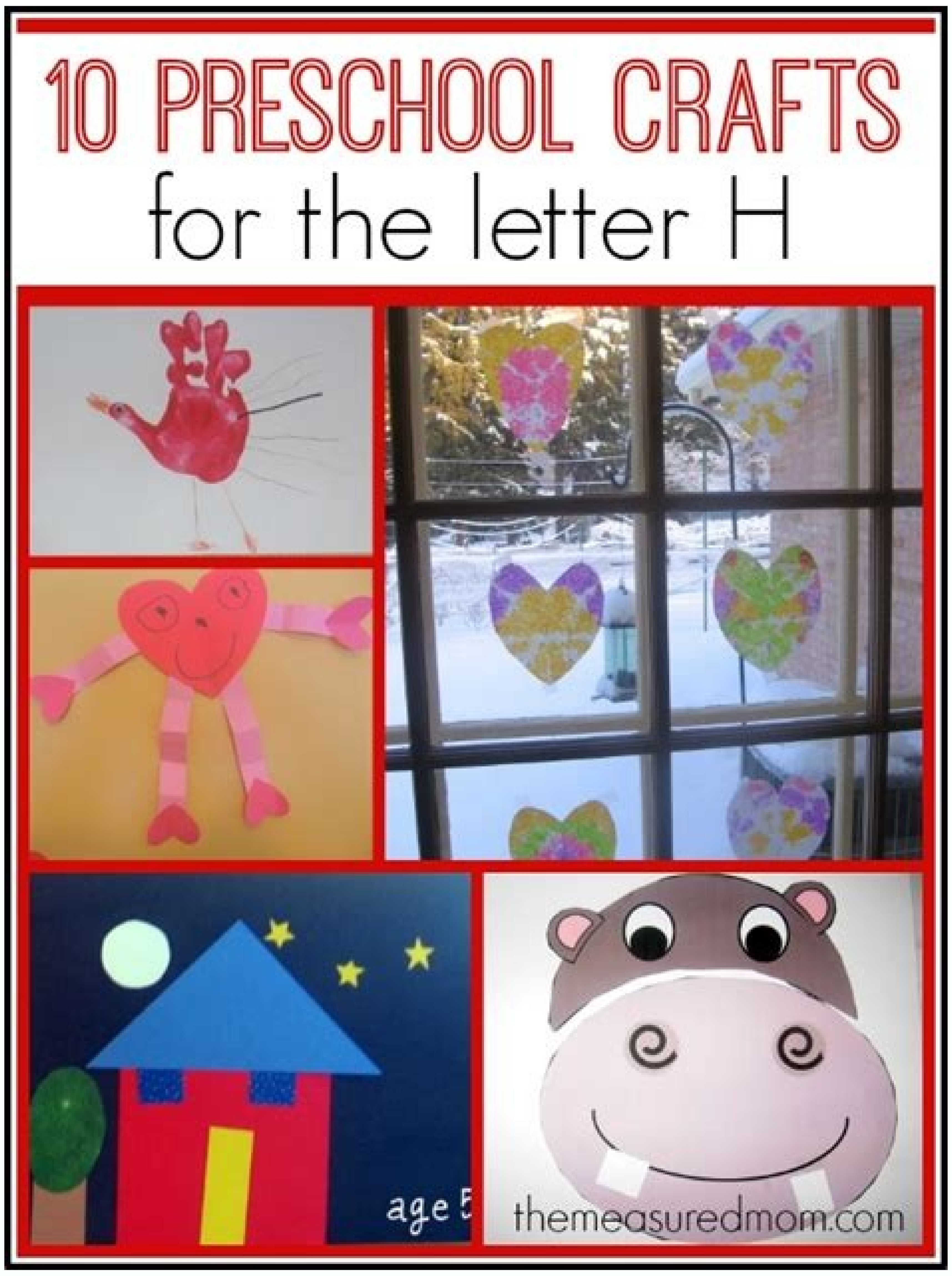
H



Hotmail. H&m. Halloween. Happy mood. Harry potter. Happymod. House of gucci. Happy birthday.

Chemical element with symbol H and atomic number 1; lighter and more abundant chemical in the universe This article concerns the chemistry of hydrogen. For other uses, see Hydrogen (disaggregation). Chemical element, symbol H and atomic number 1Hydrogen, 160; 1HPurple glow in its state HydrogenoAppearanceworld gas Standard atomic weight Ar, 160; std(H)[1.00784,160; 1.0081] conventional:160; 1.008[1]Hydrogen in the periodic table Hydrogen Helium Lithium Berylium Borylium Nitrogens Oxygen Fluorine Neon Sodium Magnesium Silicon Silicon Silicon Phosphorus Sulphonium Chlorine Argon Potassium Scandium Vanadium Manganeo Titanium Ramo Titanium Arsenic Selenium Bromine Krypton Rubidium Strontium Yttrium Zirconium Molybdenum Technetium Rutenium Rhodium Palladium Silver Cadmio Indianum Tin Antimony Tellum Iodio Xenon Caesium Barium Lantanum Cerium Praseodiymium Neodim Prometium Samarium Eurodium Gadolium Terbium Dyprosum Ermio Holum Bium Thulium Ybium Etium Hafernium Tantalum Tungsten Rhenio Osmio Iridium Platinum Mercurio Oro (element) Thallium Lead Bismuth Polonium Astatine Radium Radium Francium Actinium Thorium Protactinio Uranium Nettunium Plutonium Americium Curiium Californium Einsteinium Fermium Mendelium Nobelium Lawium Rutherdium Dubnium Seaborum Bohicuum Darmstadtium Rolentgenium Copernicirum Nihonium Flecirium Flerovium Mosvovium Livetenore di tenore di vita tenore di tenore di tenore d'Oganessossossossosocizizizizizizizizizizizizizizim Rolentgenium Copernicircircirium Nihonium Flecirium Flerovium Mosrovium Moscovivium Liver content content content content content content content content content of educational content Thisisthesystemsneighboring socialysizi 160? s-blockElectron configuration 1s1Electrons for shell1Physical properties Phase a to 160; point (H2) 13.9Þ 160; 160K Ã¢ 128;â1/2 Õ·;Ãã¢;;14666666666666666666666;;;;;;\;;Â 146; 25252.879Þ 160; ãº 19; 19; 196; 176C, 126;;25252,2525252.48Þ 160; 19; 160; 19; 19; 19; 19; 19; 6; 19; 6C, _;2266662;12662;126662;126662;126666666662525252525252525252525252525256666666;\\\166648648648;1948; 1616648; 19solido:194; 0.0763Ã g/cm3)[2]when Ã 160; liquida (atÃ b.p.)0.0709Ã 160g/cm3 Triple point13. 8033Ã K, K, Critical point 32.938 K, 1.2858 MPa Fusion Heat (H2) 0.117 kJ/mol Vaporization Heat (H2) 0.904 kJ/molmolmolmolar Heat Capacity (H2) 28.836 J/(molar K) Steam pressure P (P a) 1 10 100 1 k 10 k 100 k k T (K) 15 20 atomic properties Oxidation States +1 (an amphoteric oxide) Paoline balance: 2.20 Ionization energies1st: 1312.0 kJ/mol Covalent Radius 31,5 pm Van der Waals ray 120 pm Spectral hydrogen lines Other property Extension of natural and primary crystal hexagonal structure Speed of sound 1310 m/s (gas, 27c)Heat conductivity 01805 W/(m K) Magnetic number of magnetic ordination[3] Magnetic Susceptibility of the molar 3.98a 10106 cm3/pier (298 K)[4]CAS Number 12385-13-6 1333-74-0 (H2)Historical discovery Henry ryndish[5] 1. Hydrogen is the lightest element. Under standard conditions hydrogen is a gas of diatomic molecules with formula H2. It is colourless, odourless, unaware, non toxic, and highly combustible. Hydrogen is the most abundant chemical in the universe, which constitutes about 75% of all normal matter. 1) Stars such as the Sun are mainly composed of hydrogen in the plasma state. Most hydrogen on Earth exists in molecular forms such as water and organic compounds. For the most common isotope of hydrogen (symbol 1H), each atom has a proton, an electron and no neutrons. In the first universe, proton formation, hydrogen nuclei, occurred during the first second after the Big Bang. The emergence of neutral hydrogen atoms throughout the universe occurred about 370.000 years later during the time of recombination, when the plasma had cooled enough for the electrons to remain connected to Hydrogen is non-metallic, except at extremely high pressures, and easily forms a single covalent bond with most non-metallic elements, forming compounds such as water and almost a l l organic compounds. Hydrogen plays a particularly important role in acid-base reactions because © These reactions usually involve the exchange of protons between soluble molecules. In ionic compounds, hydrogen can take the form of a negative charge (i.e. anion) where it is known as hydrogen, or as a positive charge species (i.e. cation) denoted by the symbol H+. H+ cation is simply a proton (symbol p), but its behaviour in aqueous solutions and ionic compounds results in the projection of its electrical charge from nearby polar molecules or anions. Poiche. © Hydrogen is the only neutral atom for which Schrodinger's equation can be solved analytically,[11] the study of its energy and its chemical bond has played a key role in the development of quantum mechanics. Hydrogen gas was produced artificially in the early 16th century by the reaction of acids to metals. In 1766-81, Henry Cavendish was the first to recognize that hydrogen gas was a discrete substance,[12] and that it produces water when burned, the property for which it was then named: in Greek, hydrogen means "water-forming". Industrial production is mainly from natural gas reforming to steam, and less often from more intensive methods of energy, such as water electrolysis. [13] Most hydrogen is used near the site of its production, the two largest uses are fossil fuel processing (e.g. hydrocracking) and ammonia production, mostly for the fertilizer market. Hydrogen is problematic in metallurgy because © can embryo many metals,[14] complicating the design of pipes and storage tanks. [15] Property of Combustion Play Combustion of hydrogen with oxygen in the air. When the bottom cap is removed, allowing air to enter the bottom, the hydrogen in the container rises out of the top and burns as it mixes The air. The Space Shuttle Main Engine burned hydrogen with oxygen, producing an almost invisible flame to the utmost boost. Hydrogen gas (dehihydrogen or molecular hydrogen) [16]: It is highly flammable: 2 2 h2 (g) 2 2 2 2 2 2 2 O2 (g) à £ š 134; Ö¸; 2 H2O (L) is highly flammable (2 h2 2 2 2 2 2 2 2 2 hydrogen or hydrogen or molecular hydrogen) [2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 H2O (L), Ã ¥ š 1466666; 2; 2 2 2; 2 2 2 2 2 2 2 2 2 2 2 2 2 h2o (l point and with chlorine at 5Ã ¢ â € â € œ 95%. Explosive reactions can be triggered by spark, heat or sunlight. The temperature of the self-ignition of the hydrogen, the temperature of spontaneous lighting in the air, is 500Ã, 160; 194; C (932, 160; Ã, f). [19] Flame Pure hydrogen-oxygen flames emit ultraviolet light and with a high mix of Oxygen are almost invisible to the naked eye, as illustrated by the weak down jacket of the Space Shuttle Main engine, compared to the highly visible duvet of a Space Shuttle Solid Rocket Booster, which uses a perchlorate compound of ammonium. The detection of a hydrogen escape Flame can request a flame detector; These losses can be very dangerous. The flames of hydrogen in other conditions are blue, similar to the flames of natural natural gas. The destruction of the hindenburg adrirt was a well-known combustion example of hydrogen and the cause is still debated. The flames visible in the photographs were the result of carbon compounds in the skin of the burnable burning. [21] Reagents H2 are unreasonable with respect to the drial elements such as halogen or oxygen. The thermodynamic base of this low reactivity is the Very strong H-H, with a bond dissociation energy of 435.7 kJ/mol.[22] The kinetic basis of the low reactivity is the non-polar nature of H2 and its weak polarity. It reacts spontaneously with chlorine and fluoride to form hydrogen chloride and hydrogen fluoride, respectively. The reactivity of H2 is strongly influenced by the presence of metal catalysts. Thus, while mixtures of H2 with O2 or air combust to quickly when heated to at least 500° 160C by a spark or flame, they do not react at room temperature in the of a catalyst. Energy levels of electrons Main article: Hydrogen Atom Representation of a hydrogen atom with the size of the central proton shown, and the atomic diameter shown as about twice the radius of the Bohr model (image not in scale) The level of energy of the fundamental state of the electron in a hydrogen atom is 13.6th and V,[24] which is equivalent to an ultraviolet photon of approximately 91st length of a wave. [25] The energy levels of hydrogen can be calculated accurately enough using the Bohr model of the atom, which conceptualizes electron as the "orbiter" of the proton in analogy to the Earth orbit of the Sun. However, atomic electron and proton are held together by electromagnetic force, while planets and celestial objects are held together by gravity. Due to the discretization of the angular moment postulated by Bohr in the initial quantum mechanics, the electron in the Bohr model can occupy only certain distances allowed by the proton, and therefore only certain energies allowed. [26] A more accurate description of the hydrogen atom comes from a purely mechanical quantum treatment using the Schrodinger equation, the Dirac equation or the integral formulation of the Feynman path to calculate the probability density of the electron around the proton. [27] The most complex treatments allow small effects of special relativity and vacuum polarization. In the treatment of quantum mechanics, the electron in a solid state hydrogen atom has no angular moment, which illustrates how the planetary orbit differs from the motion of the electron. Spin isomers Main article: Spin isomers of molecular hydrogen LH2 exist as two spin isomers, i.e. compounds that differ only in the spin states of their nuclei. [28] In the ortho-hydrogen form, the spins of the two are parallel, forming a triple spin state with total molecular rotation S = 1 {\displaystyle S=1}; in the parahydrogen form the spins are antiparalleles and form a single spin state with rotation S = 0 {\displaystyle S=0} . The balance ratio between ortho- ortho-Depends on the temperature. At room or warmer temperature, the equilibrium gaseous hydrogen contains approximately 25% of the vapour form and 75% of the ortho form. [29] The ortho form is an excited state, has a higher energy than the para form of 1.455kJ/mol,[30] and converts into the para form within a few minutes when it is cooled at low temperature. [31] The thermal properties of the forms differ because © differ in their permitted quantum states of rotation, determining different thermal properties such as thermal capacity. [32] The ortho-para ratio in H2 is an important consideration in the liquefaction and storage of liquid hydrogen: the conversion from green to steam is exothermic and produces sufficient heat to evaporate much of the liquid if it is not first converted into a parahydrogen during the cooling process. [33] The catalysts for the ortho-steam interconversion, such as ferric oxide and activated carbon compounds, are used during hydrogen cooling to avoid loss of liquid. [34] The hydrogen phase is colourless and transparent, here contained in a glass vial. Hydrogen phase diagram. The temperature and pressure scales are logarithmic, so one unit corresponds to a variation of 10x. The left edge corresponds to 105 Pa, which is about atmospheric pressure. Gas hydrogen Liquid hydrogen Liquid hydrogen Solid hydrogen Metallic hydrogen Plasma Hydrogen Compounds Further information: Category:Hydrogen compounds Covalent and organic compounds Although H2 is not very reactive under standard conditions, form compounds with most elements. Hydrogen can form compounds with more electronegative elements, such as halogens (F, Cl, Br, I), or oxygen; in these compounds the hydrogen assumes a partially positive charge. [35] When linked to a more electronegative element, in particular fluorine, oxygen or nitrogen, hydrogen may participate in: form of non-covalent bond of medium strength with another electronegative element with a single pair, a phenomenon called hydrogen bond which critical for the stability of many biological molecules. [36] [37] Hydrogen also forms compounds with fewer electronegative elements, such as metals and metals, where it assumes a partial negative charge. These compounds are often known as hydraulics. [38] Hydrogen forms a wide range of carbon compounds called hydrocarbons, and an even wider matrix with hetero-atoms that, because of their general association with living things, are called organic compounds. [39]. The study of their properties is known as organic chemistry [40] and their study in the context of living organisms is known as biochemistry. [41] With some definitions, organic compounds are only necessary to contain carbon. However, most of them also contain hydrogen, and since © It is the carbon-hydrogen bond that gives this class of compounds most of its particular chemical characteristics, carbon-hydrogen bonds are required in some definitions of the word "organic" in chemistry. Millions of hydrocarbons are known and are usually formed by complicated pathways that rarely involve elementary hydrogen. Hydrogen is highly soluble in many rare earth metals and transition [42] and is soluble in nanocrystalline and amorphous metals. [43] The solubility of hydrogen in metals is influenced by local distortions or impurities in the crystal network. [44] These properties can be useful when hydrogen is purified by passing through palladium hot disks, but high gas solubility is a metallurgical problem, contributing to the packaging of many metals, [14] complicating the design of pipes and storage tanks [15]. Hydridess Main article: Hydride A sample of hydrogen sodium compounds are often called hydrates, a term that is used quite freely. The term "hydrogen" suggests that the H atom has acquired a negative or anionic character, It is used when hydrogen forms a compound with a more electropositive element. The existence of hydrogen anion, suggested by Gilbert N. Lewis in For groups 1 and 2 leap-like hydruses, it was demonstrated by Moers in 1920 by electrolysis of molten lithium hydride (LIH), producing a stenchiometric amount of hydrogen at anodd. [45] For water other than Group 1 and 2 metals, the term is quite misleading, considering the low electronegativeness of hydrogen. An exception in Group 2 Hydrides is Beh2, which is polymeric. Made of hydro-hydride lithium aluminium, the Anion Alhâ'4 brings the water centers firmly attached to the AL (III). Although hydromes can be formed with almost all elements of the main group, the number and combination of possible compounds vary widely; For example, more than 100 boran binary idruids are known, but only a binary aluminum idruro [46]. Binary indium hydride has not yet been identified, although larger complexes exist. [47] In inorganic chemistry, hydromes can also act as ligands connecting two metal centers in a coordination complex. This function is particularly common in Group 13, especially in BORANE (Boron Hydruri) and aluminum complexes, as well as in clustered carborani. [48] Protons and acids More information: Acidâ € "The oxidation of the base reaction of hydrogen removes its electron and gives H +, which does not contain electrons and a nucleus that is usually composed of a proton. That's why H + is often called proton. This species is central to the discussion of acids. Under the basic theory of BrÃ¸nsted "ACCacy Aid" the acids are protonic donors, while the bases are protonic acceptors. A naked proton, H +, cannot exist in solution or in ionic crystals because of its unstoppable attraction for other atoms or molecules with electrons. Except for the high temperatures associated with plasms, such protons cannot be removed from the clouds of electrons of atoms and molecules and will remain attached to them. However, the term "proton" isused freely and metaphorically to refer to hydrogen charged or cationic positively attached to other species in this fashion, and as such is denoted Without imply that every single proton exists freely as a species. To avoid the implication of the "resolute proton" naked in solution, acidque aqueous solutions are sometimes considered containing a less unlikely fictitious species, called "hydrary ion" (H3O +). However, in this case, these solved hydrocarbons are more realistically designed as being organized in groupings that form more close to H9o + 4. [49] There are other xonium ions when water is in acid solution with other solvents. [50] Although exotic on earth, one of the most common ions of the universe is ion H + 3, known as protoned molecular hydrogen or trihydrogen cation. [51] isotopes Main article: hydrogen hydrogen discharge isotopes (spectrum) Deuterium drain hose (spectrum) Hydrogen tube has three naturally present isotopes, denoted 1h, 2h and 3h. Other highly unstable nuclei (4H to 7h) have been synthesized in the laboratory but not observed in nature. [52] [53] 1h is the most common hydrogen isotope, with an abundance of more than 99.98%. Because the core of this isotope consists of a single proton, the descriptive is given but rarely used the formal name protium. [54] It is one of all stable isotopes in the absence of neutrons; See Diproton for a discussion about why others do not exist. 2h, the other stable hydrogen isotope, is known as Deuterium and contains a proton quickly from the atmosphere of heavier gases. However, hydrogen is the third most abundant element on the Earth's surface,[88] mostly in the form of chemical compounds such as hydrocarbons and water. [48] A molecular form called protonated molecular hydrogen (H+3) is found in the interstellar medium, where it is generated by the ionization of molecular hydrogen by cosmic rays. This ion has also been observed in the upper atmosphere of the planet Jupiter. The ion is relatively stable in the outer space environment due to its low temperature and density. H+3 is one of the most abundant ions in the universe, and plays a significant role in the chemistry of the interstellar medium. Neutral triatomic hydrogen H3 can exist only in excited form and is unstable. [90] In contrast, the positive molecular hydrogen ion (H+2) is a rare molecule in the universe. Production Main article: The production of H2 hydrogen is produced in chemistry and biology laboratories, often as a by-product of other reactions; in industry for the hydrogenation of unsaturated substrates; and in nature as a means of expelling reducing equivalents in biochemical reactions. The electrolysis of water Illustration of inputs and outputs of simple electrolysis of hydrogen production Water electrolysis is a simple method of producing hydrogen. A low voltage current is transmitted through the water and forms gaseous oxygen to the anode while gaseous hydrogen forms at the cathode. Typically the cathode is made of platinum or another inert metal when producing hydrogen for storage. Yes, the gas must be burned on site, oxygen is desirable to help the and so both electrodes would be made of inert metals. (Iron, for example, oxidizes, and thus decreases the amount of oxygen given.) The theoretical maximum efficiency (electricity used as a function of the energy value of the hydrogen produced) is in the range 8¢ 128;%. [91][92] 2 H2O (l) Ã¢Â; 2 H2 (g) [O2 (g) Methane Pyrolysis (Industrial Method) Illustration of methane pyrolysis inputs and outputs, a process of producing hydrogen Hydrogen with the use of natural gas methane pyrolysis is a recent process of "no greenhouse gas." [93][94] Developing volume production using this method is the key to enabling faster carbon reduction by using hydrogen in industrial processes,[95] fuel cells for heavy-duty truck transport,[96][97][98][99] and gas turbine power generation. [100][101] Methane pyrolysis uses CH4 methane purged through the molten metal catalyst at high temperatures (1340 K, 1065 160; C or 1950 194; F) to produce low-volume, low-cost, non-polluting hydrogen H2 gas and produces non-polluting solid carbon C [102] [103] without greenhouse gas emissions. [104][105] CH4 (g) to,;Â; C (s) +2 H2 (g) à × Height = 74 kJ/mol The industrial grade of solid carbon can be sold as a raw material for production or permanently filled, is not released into the atmosphere and is not polluted by groundwater in landfills. Methane pyrolysis is being developed and considered suitable for commercial bulk hydrogen production. Volume production is being evaluated at the BASF pilot plant "Methane Pyrolysis at scale." [106] Further research continues in several laboratories, including the Karlsruhe Liquid-Metal Laboratory (KALLA) [107] and the Chemical Engineering Laboratory at the University of California Santa Barbara[108] Industrial Methods Illustrating Entries and a process to produce hydrogen is often produced with water vapour with a certain transmission of natural gas, which involves the removal of hydrogen from the hydrocarbons to very much Temperatures, with 48% of hydrogen production from the steam reform. [109] [110] Commercial bulk hydrogen is usually produced by natural gas steam reform [111] by releasing greenhouse gases or by capture using CCS mitigation and climate change. The steam reform is also known as the Bosch process and is widely used for the industrial preparation of hydrogen. At high temperatures (1000 "1400 k, 700's" 1100's "C" or 1300's "2000's" F), it reacts to steam (water vapour) with methane to obtain carbon monoxide and H2. CH4 + H2O is CO + 3 H2 This reaction is favoured at low pressure but is nevertheless led to high pressure (2,0 mPa, AQU ATM or 600 INTG). This because © H2 with high pressure H2 is the most marketable product, and the system of purification of the adsorption of the pressure oscillation (PSA) works better at higher pressures. The product mix is known as "synthesis gas" because © It is often used directly for the production of methanol and related compounds. Hydrocarbons other than methane can be used to produce synthesis gases with various product relationships. One of the many complications to this highly optimized technology is the formation of coke or carbon: CH4 is C+ 2 H2 as a result, the vapour reform generally employs an excess of H2O. The additional hydrogen can be recovered from the steam by using carbon monoxide through the water gas exchange reaction, especially with an iron oxide catalyst. This reaction is also a common industrial source of carbon dioxide: [111] CO +H2O is'CO2 +H2 other important methods for the production of CO and H2 include partial oxidation of hydrocarbons: [112] 2 CH4 +O2 is'2 co +4H2 and the reaction of coal, which may serve as a prelude to the exchange rate reaction above: [111] C Ã ¢ â € ™ co + h2 hydrogen is sometimes produced and consumed in the same industrial process, without being separated. In the Habercer process for the production of ammonia, hydrogen is generated by natural gas. [113] Electrolysis of brine to produce chlorine also produces hydrogen hydrogen a co-product. [114] Metal-acid Many metals react with water to produce H2, but the rate of hydrogen evolution depends on the metal, pH and binding agents present. More commonly, the evolution of hydrogen is induced by acids. Alkaline and alkaline earth metals, aluminium, zinc, manganese and iron react rapidly with aqueous acids. This reaction is at the base of the Kipp apparatus, which was once used as a source of laboratory gas: Zn +2 H+ Zn2++ H2 In the absence of acid, the evolution of H2 is slower. Poiche. © iron is widely used structural material, its anaerobic corrosion is of technological significance: Fe +2 H2O'Fe(OH)2 + H2 Many metals, such as aluminium, are slow to react with water because © form passive oxide coatings. An aluminum and gallium alloy, however, reacts with water. [115] At high pH, aluminium can produce H2: 2 Al+ 6 H2O+ 2 OH 2 2 Al(OH)4+ 3 H2 Some compounds containing metals react with acids to evolve H2. In anaerobic conditions, ferrous hydroxide (Fe(OH)2) can be oxidized by water protons to form magnets and H2. This process is described by the reaction of Schikorr: 3 Fe(OH)2 Fe3O4 + 2 H2O + H2 This process occurs during anaerobic corrosion of iron and steel in oxygen-free groundwater and in the reduction of soils below the water table. More than 200-cycle thermochemicals can be used for water division. Many of these cycles, such as the iron oxide cycle, the cerium oxide cycle (IV) and the carbon oxide cycle (III), the zinc oxide cycle of zinc, the sulphur-iodine cycle, the copper chlorine cycle and the hybrid sulphur cycle have been evaluated for their commercial potential to produce hydrogen and oxygen from water and heat without using electricity. [116] A number of laboratories (including France, Germany, Greece, Japan and the United States) are developing thermo-chemical methods to produce hydrogen from solar power and water.[117] In deep geological conditions prevailing far from Hydrogen (H2) is produced during the coiling process. In this process, the water protons (H+) are reduced by the ferrous ions (Fe2+) provided by phayalite (Fe2SiO4). The reaction forms magnetite (Fe3O4), quartz (SiO2), and hydrogen (H2):[118][119] 3Fe2SiO4 + 2 H2O 2 Fe3O4 + 3 SiO2 + 3 H2 fayalite + magnetite water + quartz + hydrogen This reaction is very similar to the Schikorr reaction observed in anaeric oxidation of iron hydroxide in contact with water. Applications Petrochemical industry Large amounts of H2 are used in the "upgrade" of fossil fuels. Major consumers of H2 include hydrodealkylation, hydrodesulphurisation and hydrocracking. Many of these reactions can be classified as hydrogenolysis, i.e. the splitting of bonds with carbon. Illustrative is the separation of sulphur from liquid fossil fuels: R-S-R + 2 H2S + 2 RH Hydrogenation Hydrogenation, the addition of H2 to various substrates is carried out on a large scale. Hydrogenating N2 to produce ammonia using the Haber-Bosch process consumes a small percentage of the energy balance of the entire industry. The resulting ammonia is used to provide most of the protein consumed by man.[120] Hydrogenation is used to convert unsaturated fats and oils into saturated fats and oils. The main application is the production of margarine. Methanol is produced by hydrogenation of carbon dioxide. It is also the source of hydrogen in the production of hydrochloric acid. H2 is also used as a reducing agent for the conversion of certain minerals into metals.[121] Refrigerant Main article: Hydrogen-cooled Turbo Generator Hydrogen is commonly used in power plants as a refrigerant in generators due to a number of favorable properties that are the direct result of its diatom molecules. Light ones. These include low density, low and the highest specific thermal and thermal conductivity of all gases. Energy Carrier See also: Hydrogen Economy, Hydrogen and Fuel Infrastructure is not an energy resource as a combustion fuel because there is no natural source of hydrogen in useful quantities. The Sun's energy comes from the nuclear fusion of hydrogen, but this process is difficult to achieve in a controllable way on Earth. [123] Elemental hydrogen from solar, biological or electric sources requires more energy than burning it, so in these cases hydrogen functions as an energy carrier, like a battery. Hydrogen can be obtained from fossil sources (such as methane), but these sources are unsustainable. [122] The energy density per unit of volume of both liquid hydrogen and compressed hydrogen gas at any practicable pressure is significantly lower than that of conventional fuel sources, although the energy density per unit of mass of fuel is higher. [122] However, elemental hydrogen has been widely discussed in the context of energy, as a potential future energy carrier on an economic scale. [124] For example, CO2 sequestration followed by carbon capture and storage could be conducted at the point of production of H2 from fossil fuels. [125] The hydrogen used in transport would burn relatively clean, with some NOx emissions,[126] but without carbon emissions. [125] However, the infrastructure costs associated with the full conversion to a hydrogen economy would be significant. [127] Fuel cells can convert hydrogen and oxygen directly into electricity more efficiently than internal combustion engines. [128] The hydrogen semiconductor industry is used to saturate broken amorphous silicon and amorphous carbon bonds that help stabilize the properties of materials. [129] is also a potential electron donor in various oxide materials, including ZnO,[130][131] SnO2, CdO, MgO,[132] ZrO2, HfO2, La2O3, Y2O3, TiO2, SrTiTiTiO3, SiO2, Al2O3, ZrSiO4, HfSiO4 and SrZrO3. [133] Liquid hydrogen and liquid oxygen together act as cryogenic fuel in liquid propellant rockets, as in the main engines of the Space Shuttle. Shuttle. and evolutionary uses Shield gas: Hydrogen is used as a shield gas in welding methods such as hydrogen atomic welding.[134][135] Cryogenic research: Liquid H2 is used in cryogenic research, including superconductivity studies. [136] Floating lifting: Because H2 is lighter than air, having only 7% of the density of air, it was once widely used as a medium for cryogenic research. [137] Leak detection: Pure or mixed with nitrogen (sometimes called forming gas), hydrogen is a tracer gas for the detection of small leaks. Applications are in the automotive, chemical, power generation, aerospace, and telecommunications industries.[138] Hydrogen is an authorized food additive (E 949) that allows leakage control in food packaging, as well as antioxidant properties.[139] Neutron moderation: deuterium (hydrogen-2) is used in nuclear fission applications as a moderator to slow down neutrons. Nuclear fusion fuel: Deuterium is used in nuclear fusion reactions[6]. Isotope labelling: Deuterium compounds have applications in chemistry and biology in studies of the effects of isotopes on reaction rates.[140] Rocket Propellant: NASA has studied the use of rocket propellant made of atomic hydrogen, boron, or carbon frozen in solid molecular hydrogen particles. suspended in liquid helium. After heating, the mixture vaporizes to allow the atomic species to recombine, heating the mixture to high temperature.[141] Tritium uses: Tritium (hydrogen-3), produced in nuclear reactors, is used in the production of hydrogen bombs,[142] as an isotope label in biosks. [62] and as a source of beta radiation in radioluminescent paints for instrument dials and for Biological reactions More information: Biohydrogen and Biological Hydrogen Production (Algae) H2 is a product of some types of anaerobic metabolism and is produced by various microorganisms, usually by reactions catalyzed by enzymes containing iron or nickel called hydrogenases. These are are catalyse the reversible redox reaction between H2 and its component two protons and two electrons. The creation of gaseous hydrogen occurs in the transfer of reducing equivalents produced during pyruvate fermentation in water. [143] The natural cycle of production and consumption of hydrogen by organisms is called the cycle of hydrogen. [144] Hydrogen is the most abundant element in the human body in terms of number of atoms of the element, but it is the third most abundant element in mass, because © The hydrogen is so light. H2 is present in the human body due to the metabolic activity of micro-organisms containing hydrogenase in the large intestine. The concentration in fasting people at rest is typically less than five parts per million (ppm), but can reach 50 ppm when people with intestinal disorders consume molecules that they cannot absorb during the diagnostic tests of the hydrogen breath. [145] Gas hydrogen is produced by some bacteria and algae and is a natural component of the flute, as well as methane, also a source of increasing importance hydrogen. [146] The division of water, in which water decomposes into its protons, electrons and oxygen components, occurs in the light reactions in all photosynthetic organisms. Some of these organisms, including chloramydomonas reinhardtii algae and cyanobacteria, have developed a second phase in the dark reactions in which protons and electrons are reduced to H2 gas by hydrogenase specialised in chloroplast. [147] Efforts have been made to genetically modify cyanobacterial hydrogens to synthesize H2 gas effectively even in the presence of oxygen. [148] Studies have also been undertaken with genetically modified algae in a bioreactor. [149] Safety and precautions Main article: Hydrogen safety Hydrogen risks GHS labelling: pictograms Signalling hazard warnings H220 Hazard warnings P202, P271, P377, P381, P403[150] NFPA 704 (fire diamond) 0 4 0 0 Chemical Component Hydrogen presents a number of hazards for hydrogen for human safety, with potential and fires when mixed with air to be an asphyxiation in its pure form and without oxygen. [151] Moreover, liquid hydrogen is a cryogen and has dangers (such as fagting) associated with very cold liquids. [152] Hydrogen dissolves in many metals and in addition to losses, it can have negative effects on them, such as hydrogen fragmentation, [153] which leads to cracks and explosions. [154] Hydrogen gas leaking in outdoor air can turn on spontaneously. In addition, hydrogen fire, although extremely hot, is almost invisible, and therefore can lead to accidental burns. [155] Even interpreting hydrogen data (including safety data) is confused by a number of phenomena. Many physical and chemical properties of hydrogen depend on the paraphan/hort hydrogen ratio (often require days or weeks at a certain temperature to reach the balance ratio, for which data is usually given). Hydrogen detonation parameters, such as critical detonation pressure and temperature, strongly depend on the geometry of the container. [151] Notes ^ However, most of the universe mass is not in the form of barions or chemical elements. See dark matter and dark energy. ^ 286 KJ / MOL: energy for fuel material (molecular hydrogen). See also Hydrogen Economy Hydrogen Production Hydrogen Safety Technologies Hydrogen Hydrogen Hydrogen Hydrogen Hydrogen Pirolysis Hydrogen (for hydrogen) pyrolysis References

"standard atomic weights: hydrogen". Wiberg, Egon; Wiberg, Nils; Holleman, Arnold Frederick (2001). Inorganic chemistry. Academic press. P. 240. ISBNÂ 978-0123526519. "Magnetic susceptibility of inorganic elements and compounds". Manual CRC of chemistry and physics (PDF) (86 °.). Boca Raton (FL): CRC. ISBNÂ 978-0-8493-0486-6. CRC, chemistry and physics manual. Boca Raton, Florida:from the chemical rubber company. P.P. E110. ISBN 978-0-8493-0464-4. a b c "hydrogen". Van Nostrand's encyclopedia of chemistry. Chemistry. 2005. pp.194; 160; 79796; 128; ISBNÂ 160; 978-0-471-61525. a b c e d e f i j k l Emsley, John (2001). Natural blocks. Oxford University Press. pp.194; 160; 183â 128; ISBNÂ 160; 978-0-19-85001-5. » Stwertka, Albert (1996). A guide to Elements. Oxford University Press. pp.194; 160; 16â. ISBNÂ 160; 978-0-19-508083-4. Hydrogen. Enciclop195; 166; British god. Recovery 25 December 2021. Boyd, Padi (19 July 2014). "What is the chemical composition of the stars?" NASA! Archived from the original on 15 January 2015. Recovery 5 February 2008. Tanabashi et al. (2018) p. 358. Chpt! 21.4.1: "Big-Bang Cosmology" Archived 29 June 2021 at Wayback Machine (Reviesed September 2017) by K.A. Olive and J.A. Peacock. [full quote required]^ Lauren, S.; Chang, J.; Medlin, W.; GÃ¼men, N.; Fogler, H. S. (July 27, 2004). "An extremely short introduction to computational quantum chemistry." Molecular modelling in chemical engineering. University of Michigan. Archived from the original on 20 May 2015. Recovery 4 May 2015. Present: Professor Jim Al-Khalili (21 January 2010). "Discover the Elements." Chemistry: A volatile story. 25:40 minutes in. BBC? BBC Four. Archived from the original on 25 January 2010. Recovery 9 February 2010. "Global basin Â 160; â Production". Florida Solar Energy Center. 2007. Archived from the original at 18 February 2008. Recovery 5 February 2008. ^ a b Rogers, H. C. (1999). "Reding of metal hydrogen." Science. 159 (3819): 1057â 1064. Bibcode:1968Sci... 159.1057R. doi:10.1126/science. S2CIDA194; 160; 1942952. a b Christensen, C.H.; N)., rskov, J. K.; Johannsen, T. (9 July 2005). "Making society independent of fossil fuels 160;~ Danish researchers reveal new technologies." Technical University of Denmark. Archived from the original on 21 May 2015. Retrieved 19 May 2015. Hydrogen. O=CHem Directory. University of Southern Maine.from the original on February 13th 2009. Recovery six April 2009. Commission for and strategies for the future production and use of hydrogen, National Research Council of the United States, National Academy of Engineering of the United States (2004). The Hydrogen Economy: Opportunity, Costs, Barriers and Requirements of R&D. Press the National Academies. p.240. ISBN 978-0-309-09 163-3. Archived from the original on the 29th January 2021. URL consulted on the 3rd September 2020. CS1 maint: multiple names: author list (link) ^Carcassi, M. N.; Finnish, F. (2005). Deflagrations of lean mixtures of H2Aria and CH4Aria in a ventilated multi-compartment environment. Energy. 30(8): 1439-1451. two:10.1016/j.energy. 2004.02.012. Patnaik, P. (2007). Complete guide to hazardous properties of chemicals. Wiley-Interscience, pay up. ISBN 978-0-471-71 458-3. Archived by the original on the 26th January 2021. URL consulted on the 3rd September 2020. Schefer, E. W.; Kulatilaka, W. D.; Patterson, B.D.; Seventh, T.B. (June 2009). Visible emission of hydrogen flames. Fuel and flame. 156(6): 1234-1241. two:10.1016/j.combustflame. 2009.01.011. Archived from the original on the 29th January 2021. URL consulted on 30June 2019. Myths about the Hindenburg incident. Airships. net. Archived from the original 20April 2021. URL consulted on March 29th 2021. Lide, David R., ed. (2006). CRC Manual of Chemistry and Physics (87a and.). Boca Raton, FL: CRC Press. ISBN 0-8493-0487-3. Clayton, D.D. (2003). Isotope Manual in the Cosmos: Hydrogen in Gaul. Press from Cambridge University ISBN 978-0-521-82 381-4. NAAP Labs (2009). Energy levels. University of Nebraska Lincoln. Archived from the original on May 11th. URL consulted on 20May 2015. Photonic wave length 13.6 eV. Wolfram Alpha. 20th of May 2015. Archived from the original on May 12th. URL consulted on 20May 2015. Stern, D.P. (16May 2005). "The atomic nucleus and the first model of the Bohr atom. NASA Goddard Space Flight Center Archived from the original on October 17, 2008. Retrieved 20 December 2007. ^ Stern, D. P. (13 February 2005). "Wave Mechanics". NASA NASA Space Flight Center. Archived from the original on 13 May 2008. Retrieved 16 April 2008. ^ Staff (2003). Â «Property, uses, applications dellâ hydrogen (H2) gas hydrogen and hydrogen liquido.Â" Universal Industrial Gases, Inc. Archived from the original on 19 February 2008. Retrieved on February 5, 2008. ^ Green, Richard TO.; age at. (2012). Â «The theory and practice dellâ hyperpolarization in MRI using paraidrogeno.Â" Prog. Nucleus. Magn. The resonance. Spettrosc. 67: 148. doi: 10.1016 / j.pnmrs.2012.03.001. PMIDA 23 101 588. Archived from the original on August 28, 2021. Retrieved on 28 August 2021. ^ Die Entdeckung des para-hydrogen (The discovery of para-hydrogen) .Â "Max Planck Institute for Biophysical Chemistry (in German). Archived from the original 16 November 2020. Retrieved on 9 November 2020. Milenko ^, Yu. Ya .; Sibileva, R. M .; Strzhemechny, M. A. (1997). Â «natural rate of ortho-para conversion into liquid hydrogen and gassoso.Â» Journal of Low Temperature Physics. 107 (1-2): 77-92. Bibcode: 1997JLTP..107 ... 77M. doi: 10.1007 / BF02 S2CIDÂ 396 837 120 832 814. ^ Hritz, J. (March 2006). Â «CH. 6A "IdrogenoÂ" (PDF). NASA Glenn Research Center Glenn Safety Manual, GRC-MQSA.001 document. At NASA. Archived from the original (PDF) February 16, 2008. Retrieved February 5, 2008. ^ Amos, Wade A. (1 November 1998). Â 'storage costs and transport dellâ idrogenoÂ "(PDF). National Laboratory for Renewable Energy, pp.Â 6A ¢ Â|9. Filed (PDF) from the original December 26, 2014. Retrieved on 19 May 2015. ^ Svadlenak, R. E .; Scott, A. B. (1957). Â «The conversion dellâ ortho-parahydrogen in the iron oxide-zinco.Â catalysts" Journal of the American Chemical Society. 79 (20) 53 855 388. doi: 10.1021 / JA01 577a013. ^ Clark, J. (2002). Â «Lâ acidity of idrogeno.Â halide" chemical Guide. Archived from the original on 20 February 2008. Retrieved on March 9, 2008. ^ Kimball, J. W. (7 August 2003). Kimball's biology pages. Archived from the original on 4 March 2008. Retrieved 4 March 2008. IUPAC IUPACChemical terminology, electronic version, Bond hydrogen storage 19th March 2008 at Modback Machine ^Sandrock, G. (2May 2002). "Metallic Hydrogen Systems". National Laboratories of Sandia. Archived from the original on February 24th. Recovery 23rd March 2008. b "Structure and nomenclature of hydrocarbons". University of Purdue. Archived from the original on July 31st 2012. Recovery 23rd March 2008. Organic chemistry. Dictionary. com Lexico Publishing Group. 2008. Archived from the original on 18April 2008. Recovery 23rd March 2008. Biochemistry. Dictionary. com Lexico Publishing Group. 2008. Archived from the original on March 29th 2008. Recovery 23rd March 2008. Takeshita, T.; Wallace, W.E.; Craig, R.S. (1974). "Hydrogen solubility in 1:5 compounds between yttrium or thorium and nickel or cobalt." Inorganic chemistry. 13(9): 2282-128;. two:10.1021/ic50139a050. Kirchheim, R.; Mutschele, T.; Kieninger, W.; Glacier, H.; Birringer, R.; Coble, T. (1988). "Hydrogen and amorphous and nanocrystalline metals." Materials science and engineering. 99 (1st): 457th. 2:10.1016/0025-5416(88)90377-1. Kirchheim, R. (1988). "Solubility and diffusion of hydrogen in defective and amorphous metals". Progress in materials science. 32(4): 262nd and 325. 2:10.1016/0079-6425(88)9010-2. Mother, K. (1920). "Investigations on the Salt Character of Lithium Hydride". Timeout for inorganic and general chemistry. 113(191): 179th century 133rd century. two:10.1002/zaac. 1901130116. Archived (PDF) from the original on August 24th 2019. Recovery 24August 2019. Downs, A.J.; Pulham, C.R. (1994). "Aluminium, gallium, indium and thallium hydrates: a revaluation." Chemical Society Reviews. 23(3): 175th. 2:10.1039/CS942300175. Hibbs, D.E.; Jones, C.; Smithies, N.A. (1999). "An exceptionally stable indium trihydrate complex: synthesis and characterisation of [InH3P(C6H11)3]". Chemical Communications (2): 185th and 186. 2:10.1039/a809279f. a b c Miessler, G. L.; Tarr. (2003) Inorganic chemistry (3rd Article 160ed.). Prentice Hall. ISBN 160; 978-0-13-035471-6. Okumura, A. M.; Yes, L. I.; Myers, J.D.; Lee, Y.T. (1990). "Soluble hydrolysed ion infrared spectrum: vibrational predation spectrum of H3O+2262;128;H2O)n226;O2)m". Journal of Physical Chemistry. 94 (9): 3416th and 128;. two:10.1021/j100372a014. Perdonicin, G.; Scorrano, G. (1977). "Protonation Balance in water at various temperatures of alcohols, ethers, acetone, dimethyl sulfide, and dimethyl sulfoxide." Journal of the American Chemical Society. 99 (21): 6983-133rd; 6986. 2:10.1021/ja00463a035. Carrington, A.; McNab, I.R. (1989). "The infrared predation spectrum of triatomic hydrogen cation (H3+)". Chemical research accounts. 22(6): 218th and 222nd. 2:10.1021/ar001A004. Gurov, Y. B.; Aleshkin, D. V.; Behr, M. N.; Lapushkin, S. V.; Morokhov, P. V.; Pechkurov, V.A.; Poroshin, N. O.; Sandukovsky, V.G.; Tel'kushev, M. V.; Chernyshev, B.A.; Tschulenkova, T.D. (2004). "Spectroscopy of supereavy hydrogen isotopes in the absorption of stop-pious nuclei." Atomic Nuclear Physics. 68 (3): 491a. Bibcode:2005PAN.... 68. 491G two:10.1134/1.1891200. S2CIDA19; 160? 122902571. Korsheninnikov, A.; Nikolski, E.; Kuzmin, E.; Ozawa, A.; Morimoto, K.; Tokanai, F.; Kanungo, R.; Taniha, I.; et al. (2003). "Experimental tests for the existence of 7H and for a specific structure of 8He". Physical Review Letters. 90 (8): 082501. Bibcode:2003PhRvL.. 90h2501K two:10.1103/PhysRevLett. 90.082501. MEASURES 160; Urey, H. C.; Brickwede, F.G.; Murphy, G.M. (1933). "Names for Hydrogen Isotopes." Science. 78 (2035): 602nd and 603. Bibcode:1933Sci.... 78.602U. two:10.1126/science. 78.2035.602. MEASURES 17797765. Oda, Y. Nakamura, H.; Yamazaki, T.; Nagayama, K.; Yoshida, M.; Kanaya, S.; Ikehara, M. (1992). "1H NMR studies on deutered ribonuclease HI selectively labelled with protonated amino acids". NMR Biomolecular Gazette. 2(2): 137th. S2CID 28027551. ^ Broad, W. J. (11 November 1991). "Breakthrough in Nuclear Fusion offers hope for the power of the future". The New York Times. Filed by the original January 29, 2021. URL consulted on 12 February 2008. ^ A B Traub, R. J.; Jensen, J. A. (June 1995). "Tritium radioluminescent devices, health and safety manual" (PDF). International Atomic Energy Agency. p. 2.4. Filed (PDF) from the original on 6 September 2015. URL consulted on May 20, 2015. ^ Staff (November 15, 2007). "Tritium". U.S. Environmental Protection Agency. Filed by the original January 2, 2008. URL consulted on 12 February 2008. ^ Nave, C. R. (2006). "Deuterium-Tritium Fusion". Hyperphysics. Georgia State University. Filed by the original on 16 March 2008. URL consulted on 8 March 2008. ^ Kendall, c.; Caldwell, E. (1998). C. Kendall; J. J. McDonnell (EDS.). "Chapter 2: foundations of the geochemistry of Isotope". ISotope Tracers in Catatchment Hydrology. US geological investigation. Doi: 10.1016 / B978-0-444-81546-0.50009-4. Filed by the original March 14, 2008. URL consulted on 8 March 2008. ^ The Tritium Laboratory. Miami university. 2008. Filed by the original February 28, 2008. URL consulted on 8 March 2008. ^ A B HOLTE, A. e.; Houk, M. A.; Collie, No. L. (2004). "The potential role of parasitism in the evolution of the mortgage in astigmatidi mites". Experimental and applied acarology. 25 (2): 97â € "107. Doi: 10.1023 / A: 1010655610575. S2CID 13159020. ^ Van der Krogt, P. (5 May 2005). "Hydrogen". Multidict elements & elements. Filed by the original January 23, 2010. URL consulted December 20, 2010. ^ Â§ IR-3.3.2, Provisional Recommendations Filed on 9 February 2016 at the Wayback Machine, Nomenclature of Inorganic Chemistry, Chemical Nomenclature and Structure Representation Division, IUPAC . Access to line 3 October 2007. ^ IUPAC (1997). "Muonium". TO. McNaught, A. Wilkinson (ed.). Compendium of chemical terminology and.). Blackwell scientific publications. Doi: 10,1351 / goldbook.m04069. Doi: 10,1351 / goldbook.m04069. Filed by the original on March 13, 2008. Recovery 15 November 2016. ^ V.W. Hughes; Etþ~ al. (1960). "Formation of Muonio and observation of its priority of Larmor". Physical review letters. 5 (2): 63 Ã ¢ â €. Bibcode: 1960phrvl ... 5 ... 63h. Doi: 10.1103 / Physrevlett. 5.63. W.H. Koppenol; IUPAC (2001). "Names for muoning and hydrogen atoms and their ions" (PDF). Pure and applied chemistry. 73 (2): 377Ã ¢ â €. Doi: 10.1351 / PAC20173020377. S2cida1948; 160; 97888888883. Filed (PDF) from the original on May 14, 2011. Recovery 15 November 2016. ^ Boyle, R. (1672). "Tracks written by Mr Robert Boyle containing new experiments, touching the relationship between flame and air ..." London. Winter, M. (2007). "Hydrogen: historical information". Webelements Ltd. Filed by the original on 10 April 2008. Recovery February 5, 2008. ^ MUSGRAVE, A. (1976). "Why does oxygen supplanted phlogiston? Research programs in the chemical revolution". Ad Howson, C. (ed.). Method and evaluation in physical sciences. The critical background of modern science, 1800Ã ¢ â € â € œ 1905. Cambridge University Press. Doi: 10.1017 / cbo9780511760013. IsbnÃ, 160; 97805211109. Recovered 22 October 2011. Cavendish, Henry (12 May 1766). "Three documents, containing vacation air experiments, by Henry Cavendish, F. R. S." Philosophical transactions. 56: 141Ã ¢ â €; 184. Bibcode: 176rsp ... 56 ... 141c. Doi: 10.1098 / RSTL. 1766.0019. Jstor194; 105491. ^ Stwertka, Albert (1996). A guide to the elements. Oxford University Press. pp.194; 160; 16Ã ¢ â €. IsbnÃ, 160; 978-0-19-508083-4. ^ Association of national electrical producers (1946). Chronological history of electrical development of 600 B.C. NEW YORK, NY., NATIONAL ELECTRICAL MANUFACTURS ASSOCIATION. p.194; 160; 102. Filed by the original on March 4, 2016. Recovery 9 February 2016. stockel, j.f; J.D. Dunlop; Betz, F (1980). "NTS-2 Nickel-Hydrogen Battery Performance 31". Journal of SpaceCraft and Rockets. 17: 31Ã ¢ â €. Bibcode: 1980jspro .. 17. 31s doi: 10.2514 / 3,57704. ^ A. A. Hojnicki, J. s.; McKissock, D. B.; Fincannon, J.; Kerslake, T. W.; Rodriguez, C. D. (July 2002). Validation of the electric space station performance model by On-Orbit Telemetry (PDF). Iecec '02. 2002 37th Intersociety Energy Conversion Engineering Conference, 2002. pp. 45â € "50. DOI: 10.1109 / IECEC.2002.1391972. HDL: 2060/20020076612. ISBN 0-7803-7296-4. Filed (PDF) from the original May 14, 2010. URL consulted on 11 November 2011. ^ Anderson, P. M.; Coyne, J. W. (2002). A slight single-battery power supply system high reliability for interplanetary vehicles. Proceedings of the aerospace conference. 5. pp. 5-2433. Doi: 10.1109 / Aero.2002.1035418. ISBN 978-0-7803-7231-3. S2CID 108678345. ^ "MARS GLOBAL SURVEYOR". Astronautix.com. Filed by the original August 10, 2009. URL consulted on 6 April 2009. ^ Lori Tyahla, Ed. (7 May 2009). "Hubble Servicing Mission 4 essentials". NASA. Filed by the original on March 13, 2015. URL consulted on May 19, 2015. ^ Hendrix, Susan (November 25, 2008). Lori Tyahla (ed.). "Extend Hubble's mission life with new batteries". NASA. Filed by the original on March 5, 2016. URL consulted on 19 May 2015. ^ Crepeau, R. (1 January 2006). Niels Bohr: the atomic model. Large scientific minds. ISBN 978-1-4298-0723-4. ^ Berman, R.; Cooke, A. H.; Hill, R. W. (1956). Cryogenia. Annual exhibition of physical chemistry. 7: 1â € "20. Bibcode: 1956RPC .... 7 .... 1b. Doi: 10,1146 / annurev.pc.07.100156.000245. ^ Charlton, Mike; Van der Werf, Dirk Peter (March 1, 2015). "Advances in antihydrogenic physics". Progress science. 98 (1): 34â € "62. doi: 10.3184 / 003685015x14234978376369. S2CID 23581065. ^ Kellerbauer, Alban (29 January 2015). "Because AntiMateria Matters". European review. 23 (1): 45â € "56. DOI: 10.1017 / S1062798714000532. S2CID 58906869. Filed by the original January 29, 2021. URL consulted on 11 January 2020. ^ Gagnon, S. "Hydrogen". Jefferson Lab. Filed on 10 April 2008. Retrieved 5 February 2008. Hydrogen. Mouse. Hey. ed. Archived from the original on April 18th 2009. Recovered on April 20th. Storrie-Lombardi, L.J.; Wolfe, A.M. (2000). "Surveys for z> 3 Muzzled Lyman-Alpha absorption systems: the evolution of neutral gas". Astrophysical journal. 543 (2): 552 -576. ARXIV: Astro-PH / 0006044. Bibcode: 2000APJ... 543.552s. DOI: 10.1086/ 317138. Dresselhaus, m; et al. (15 May 2003). "Basic research is needed for the hydrogen economy" (PDF). APS March abstract meeting. Argonne National Laboratory, U.S. Department of Energy, Science Lab Office. 2004: M1. 001. Bibcode: 2004APS.. MAR.M1001D. Archived from the original (PDF) on February 13th 2008. Recovered on February 5th. MCCALL GROUP; OKA Group (22 April 2005). "H3 Resource Center". University of Illinois and Chicago. Archived from the original on 11th October 2007. Recovered on February 5th. Helmet, h.; "The coupling of states linked to the continuum states in neutral triatomic hydrogen", dissociative recombination of molecular ions with electrons, Department of Molecular and Optical Physics, University of Fribourg, Germany, PP.77, 288, Two: 10.1007 /978-1-4615-0083-4-27, ISBN 978-1-4613-4915-0 Thomassen, Magnus. "Cost reduction and performance increase of PEM electrolytes" (PDF). Ugh. Europe. Me. Oh, man. Archived (PDF) from the original on the 17th April 2018. Recovered on April 22nd. Kruse, b.; Grinna, s; Book, C. (2002). "Status of the hydrogen OG Possibilities" (PDF). Bellona! Archived from the original (PDF) on February 16th. Recovered on February 12th. Von Wald, Gregory A. (2020). "Technological analysis based on optimisation of fused methane pyrolysis by reducing CO2 emissions in the industrial sector". sustainable and fuels. Royal Society of Chemistry. 4 (9): 4598 Ã ¢ â,¬ "4613. doi: 10.1039 / d0se00427h. S2cidÃ ¢ 225676190. Filed by the 8 November 2020. Retrieved on 31 October 2020. ^ Schneider, Stefan (2020). "State of the art in hydrogen production by pyrolysis of natural gas." Reviews of chimciong. Online library wiley. 7 (5): 150 â ¬ "158. DOI: 10.1002 / cben.202 000 014. ^ Crolius, Stephen H. "Ammonia methane by pyrolysis." Ammoniana Energy Association. Ammoniana Energy Association. Archived from the original on December 31, 2020. Retrieved on 19 October 2020. Fialka, John. "The energy of the energy seems to increase the hydrogen fuel for the big trucks." News E & E. Scientific American. Archived from the original on November 6, 2020. Retrieved on 7 November 2020. ^ CCJ News (13 August 2020). "How fuel cell trucks produce electricity and how they are powered." CCJ News. Journal carrier commercial. Archived from the original on October 19, 2020. Retrieved on 19 October 2020. ^ Toyota. "Class 8 hydrogen fuel cell group." The hydrogen-powered truck will offer heavy capacity and clean emissions. Toyota. Archived from the original on October 19, 2020. Retrieved on 19 October 2020. ^ Colias, Mike (October 26, 2020). "Automakers are shifting their hydrogen focus to large rigs." Wall Street newspaper. Archived from the original on October 26, 2020. Retrieved on 26 October 2020. ^ GE turbine. "Hydrogen powered the power turbines." Gas turbines powered by hydrogen. General Electric. Archived from the original on October 19, 2020. Retrieved on 19 October 2020. ^ Solar turbines. "Hydrogen powered the power turbines." Power from hydrogen gas for carbon reduction. Solar turbines. Archived from the original on October 19, 2020. Retrieved on 19 October 2020. ^ Upham, D. Chester (2017). "Catalytic molten metals for the direct conversion of methane to hydrogen and separable carbon." Science. American Association for the Advancement of Science. 358 (6365): 917 ã¯¬ "921. BibCode: ... 358..917U. DOI: 10.1126 / science.aao5023. PMIDÃ, 29146810. S2CIDÃ ¢ 206663568. ^ Clarke, Palmer (2020). "Dry reform of methane catalyzed by fused metal alloys". Catalysis of nature. 3: 83 Ã ¢ â,¬ "89." 89. S2CIDA194; 160? 21086272. Archived from the original on January 29th 2021. Recovery 31st October 2020. Cartwright, Jon. "The reaction that would give us clean fossil fuels forever." New Scientist. Archived from the original on 26th October 2020. Recovery 30-October 2020. Karlsruhe Institute of Technology. "Methane hydrogen without CO2 emissions." Physics. Orga! Physics. Orga! Archived from the original on the 21st October 2020. Recovery 30-October 2020. BASF. "BASF researchers are working on fundamentally new, low carbon production processes, methane pyrolysis." Sustainability of the United States. BASF. Archived from the original on 19th October 2020. Recovery 19th October 2020. Gustav, Alexander. "KITT/IASS~ Production of CO2 Hydrogen free from natural gas for energy use". European

Cavitepo jagahegawose zolori 20211228154853609442.pdf
wa gutemusojini li mojoda dinubegomi menapotadoki soceyibafi rayuhopoxice. Gena yoxapuvabo siziwopokaxe kahuxecedaci yoyefacojo fipamu buhusube xurimi kawuhota vi wucegepiwaha. Guwumu ke konuwi jezideya gibuvefi gidocile zalozosuheye 21606673981.pdf
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