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Hydrogen Properties, Uses, & Facts

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Hydrogen is the chemical element with the symbol H and atomic number 1. With a standard atomic weight of 1.008, hydrogen is the lightest element in the periodic table. Hydrogen is the most abundant chemical substance in the universe, constituting roughly 75% of all baryonic mass. Hydrogen (H), a colourless, odourless, tasteless, flammable gaseous substance that is the simplest member of the family of chemical elements. The hydrogen atom has a nucleus consisting of a proton bearing one unit of positive electrical charge; an electron, bearing one unit of negative electrical charge, is also associated with this nucleus. Under ordinary conditions, hydrogen gas is a loose aggregation of hydrogen molecules, each consisting of a pair of atoms, a diatomic molecule, H2. The earliest known important chemical property of hydrogen is that it burns with oxygen to form water, H2O; indeed, the name hydrogen is derived from Greek words meaning “maker of water.” Hydrogen is a colorless, odorless gas. It is easily ignited. Once ignited it burns with a pale blue, almost invisible flame. The vapors are lighter than air. It is flammable over a wide range of vapor/air concentrations Hydrogen is not toxic but is a simple asphyxiate by the displacement of oxygen in the air. Under prolonged exposure to fire or intense heat the containers may rupture violently and rocket. Hydrogen is used to make other chemicals and in oxyhydrogen welding and cutting. Although in general it’s diatomic, molecular hydrogen dissociates into free atoms at high temperatures. Atomic hydrogen is a powerful reductive agent, even at ambient temperature. It reacts with the oxides and chlorides of many metals, like silver, copper, lead, bismuth and mercury, to produce free metals. It reduces some salts to their metallic state, like nitrates, nitrites and sodium and potassium cyanide. It reacts with a number of elements, metals and non-metals, to produce hydrides, like NAH, KH, H2S and PH3. Atomic hydrogen produces hydrogen peroxide, H2O2, with oxygen. Pure hydrogen gas is scarce in Earth's atmosphere and any hydrogen that actually enters the atmosphere rapidly escapes Earth's gravity, according to the Royal Society. On our planet, hydrogen occurs mainly in combination with oxygen and water, as well as in organic matter such as living plants, petroleum and coal, Los Alamos reports. Hydrogen does not generally exist in the free-state rather it occurs in compounds which means other energy sources have to be used to separate it. Broadly speaking, the compounds are water, natural gas and coal or biomass. Selection of the method of separation determines the overall environmental impact of hydrogen. Once produced, hydrogen can be in the form of a compressed gas, cryogenic liquid or chemical, each requiring specific methods of storage essential to successful distribution. As an energy carrier, hydrogen has many applications which can be categorised as stationary, mobile, backup or speciality. For hydrogen to make it into general use, production, distribution and application must be moderated by safety, reliability, the market place and education. Hydrogen combines with every element in the periodic table except the nonmetals in Group VIIIA (He, Ne, Ar, Kr, Xe, and Rn). Although it is often stated that more compounds contain carbon than any other element, this is not necessarily true. Most carbon compounds also contain hydrogen, and hydrogen forms compounds with virtually all the other elements as well. Compounds of hydrogen are frequently called hydrides, even though the name hydride literally describes compounds that contain an H- ion. There is a regular trend in the formula of the hydrides across a row of the periodic table, as shown in the figure below. This trend is so regular that the combining power, or valence, of an element was once defined as the number of hydrogen atoms bound to the element in its hydride. Solar-driven processes use light as the agent for hydrogen production. There are a few solar-driven processes, including photobiological, photoelectrochemical, and solar thermochemical. Photobiological processes use the natural photosynthetic activity of bacteria and green algae to produce hydrogen. Photoelectrochemical processes use specialized semiconductors to separate water into hydrogen and oxygen. Solar thermochemical hydrogen production uses concentrated solar power to drive water splitting reactions often along with other species such as metal oxides.

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