**Properties of Water**

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According to Weingartner (2016), the most abundant substance on the Earth's surface which exists as a solid, liquid, and gas is known as water(H20). It is a polar inorganic compound that is tasteless, odorless, colorless with an inherent hint of blue, and is usually at room temperature. In the universe, it is the third most abundant molecule (Weingartner et al., 1997) making it the most studied chemical compound (Greenwood et al., 1997). It is also described as the universal solvent.In 1781, Henry Cavendish showed that water was composed of oxygen and hydrogen.

Water molecules form hydrogen bonds that give its unique properties such as; polarity, a high boiling point of 100° for its molar mass, and a high heat capacity. Polarity allows it to dissociate ions in salts and bond to other polar substances such as alcohols and acids. Water exhibits the properties of an acid and base depending on the pH of the solution it’s in as it is amphoteric. Kelvin, Celsius, Rankine, and Fahrenheit scales are temperature scales used to define the freezing and boiling points of water.

The properties of water are owed to its physical appearance, structure, and types of bonds formed. As such, in this essay, we explore and analyze the physical, electrical, and chemical properties of water.

**Physical Properties**

Water is a chemical substance with the chemical formula H2O where one molecule of water has two hydrogen atoms covalently bonded to one oxygen atom (Campbell et al., 2006). It is odorless, and tasteless liquid at ambient temperature and pressure. The molecules of water form hydrogen bonds that are continually breaking and reforming. The liquid phase which is the most common is generally denoted as water, whereas, it exists as vapor in a gaseous state (Degachi et al., 2007). It exists in the solid phase which takes the structure of hard, amalgamated crystals such as ice cubes.

It has a high heat capacity of 4184 J/(Kg-K) at 20° as well as a high heat of vaporization of 40.65 KJ/mol at normal boiling point. The density of water is about 1 gram per cubic centimeter and is directly proportional to water temperature (Greenwood et al., 1997). Additionally, due to its polar nature, water is miscible with liquids of high polarity such as ethanol and acetone, and immiscible with compounds that have low polarity such as hydrocarbons.

At a melting point of 0 °C, liquid water can be supercooled well below that temperature without freezing if the liquid is not mechanically disturbed and can remain in a fluid state down to its nucleation point of about 231 K (Stanley et al., 2003). Also, at 0 °C the limit of zero pressure, the compressibility of water is 5.1 \* 10-10 Pa-1. The compressibility of water is inversely proportional to pressure since an increase in pressure leads to a decrease in pressure.

***Electrical Properties***

In the liquid state, water undergoes auto-ionization forming one hydroxide anion (OH-) and one hydronium cation (H30+). This leads to liquid water having a similar intrinsic charge carrier concentration to the semiconductor enabling it to be a limited conductor of ionic charge making water an excellent electronic insulator. The collective action of hydrogen bonds between water molecules creates cohesion and adhesion forces formed due to their polar nature (Campbell et al., 2009). This is seen when water forms a thin film on a smooth clean glass since adhesive forces between the glass and water molecules are stronger than cohesive forces.

Water has a high surface tension of 71.99 mN/m at 25 °C caused by strong hydrogen bonds between water molecules which also allows insects to walk on water (Lide, 2003). It is also an excellent solvent due to its dielectric constant (Greenwood et al., 1997). The strong attractive forces formed by water molecules between other molecules determine the ability of substances to dissolve in water.

Water is transparent and absorbs different types of light such as ultraviolet light, infrared light, and microwaves (Pope et al., 1996). In microwaves, ovens use radiation and water’s opacity to heat the water inside foods. The molecular structure of water is bent and not linear since there is a repulsive effect on two Ione pairs on the oxygen atom. These oxygen atom Ione pairs are physically larger and take up more space than oxygen atom bonds to the hydrogen atom.

**Chemical Properties.**

Liquid water undergoes self-ionization giving hydronium and hydroxide ions. This is the equilibrium constant known as an ionic product which has a value of about 10-14 at 25 °C (Boyd, 2000). Physical processes such as weathering and water erosion are caused by water contained in rocks over a long period. This leads to chemical reactions with water which results in mineral hydration that produces clay minerals. Acid rain is produced when high amounts of nitrogen and Sulphur oxides present in the air dissolve in the clouds and raindrops. Water acts as an acid or base in chemical reactions since it is amphoteric (Zumdahl et al., 2013). It acts as a base when reacting with a strong acid and acts as an acid when it reacts with a strong base.

Water forms only one bond with the central atom making it a monodentate ligand (Zumdahl et al., 2013). This is seen in hydrogen bonding contacts in FeSO4.7H2O which consists of [Fe2(H2O)6]2+ centers and one ‘lattice water’. The constituents of water can be split by passing an electric current through it producing two elements hydrogen and oxygen through a process known as electrolysis (Zumdahl et al., 2013). This process produces gases that bubble to the surface and can either be collected or ignited with a flame. The electrolysis of pure water is 1.23 V at 25 °C.

**Conclusion**

Water is the most abundant substance on the Earth’s surface that exists as a solid, liquid, and gas. It has a chemical formula of [H2O]. Also, it is a polar inorganic compound, tasteless, odorless, and colorless liquid usually at room temperature. It forms hydrogen bonds, has a boiling point of 100°, and a melting point of 0 °C. It also has a high heat and vaporization capacity.

Water is a limited conductor of ionic charge therefore making it an excellent electronic insulator. The hydrogen bonds formed between water molecules create cohesion and adhesion forces which help in capillarity that is required in transporting water in trees. It has a high surface tension that allows insects to walk on water. It is also an excellent solvent and thus determines the ability of substances that dissolve. Water also absorbs light and is also transparent.

Water undergoes self-ionization to produce hydronium and hydroxide ions. Weathering and water erosion are caused by water that is contained in rocks over a long period. When Sulphur and Nitrogen oxides dissolve in clouds and raindrops, acid rain is formed. Water also acts as both an acid and base since it is amphoteric. Electrolysis is the process where water is split into two elements hydrogen and oxygen by passing an electric current through it.

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