

1. Hydrogen bond [H-bond]

- a. A *hydrogen bond* is a non-covalent bond between a partial negative charge and a partial positive charge.
- b. *Hydrogen bonds* tend to be weak. Covalent bonds are about 20 times stronger than a typical *hydrogen bond*.
- c. *Hydrogen bonds* tend to be transient. In liquid water these *hydrogen bonds* between *water molecules* tend to be very transient (lasting only 10^{-11} seconds!).
- d. *Hydrogen bonds* are very numerous which somewhat offsets their weak and transient nature. *Water molecules* readily *hydrogen bond* between each other. On average each *water molecule* in liquid water is *hydrogen bonded* to 3.4 other *water molecules*.
- e. **Results in unusual water properties:**
 - i. *Hydrogen bonds* are collectively responsible for a large number of *water's* properties, including:
 1. being a liquid rather than a gas at room temperature
 2. having a high specific heat
 3. having a high heat of vaporization
 4. serving as a powerful solvent of polar molecules
 5. effecting adhesion
 6. effecting cohesion
 7. effecting hydrophobic exclusion
 8. ice floats