

Section 1.1: The Fundamental Chemistry of Life

Section 1.1 Questions, page 18

1. (a) Both atoms are isotopes of carbon: ^{13}C and ^{15}C .

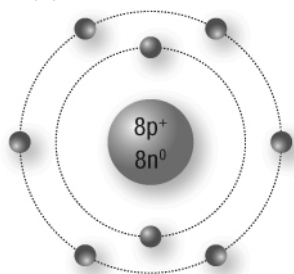
(b) The difference in the mass numbers is because one atom has 2 more neutrons in its nucleus than the other.

2. (a) The three common isotopes of hydrogen are ^1H (protium or hydrogen), ^2H (deuterium), and ^3H (tritium).

(b) Radioisotopes are unstable forms of an atom that decay into other atoms by releasing energy and particles.

(c) Radioisotopes are used as tracer molecules for medical diagnostics and for scientific studies involving transportation of metabolism of molecules of interest.

3. (a)



Electrons occupy the $1s^2$, $2s^2$, and $2p^4$ shells.

(b) The element is oxygen.

4. Answers may vary. Sample answer: To minimize their energy, electron pairs in atoms move as far away from each other as possible, which causes the bonds to be at different angles from one another.

5. Answers may vary. Sample answer: Ionic bonds form when an electron is transferred from one atom to another, and the resulting ions are attracted to each other. Covalent bonds form when atoms share electrons to fill their valence shell.

6. For a molecule to be polar it must contain atoms that differ in electronegativity and the resulting electronegative bonds must be arranged asymmetrically in the molecule. The asymmetrical shape of a molecule containing polar bonds can result in an overall unbalanced distribution of charge, making the molecule as a whole polar.

7. Answers may vary. Sample answer:

(a) Polarity, size, and shape can affect the solubility, melting and boiling points, and brittleness of molecules.

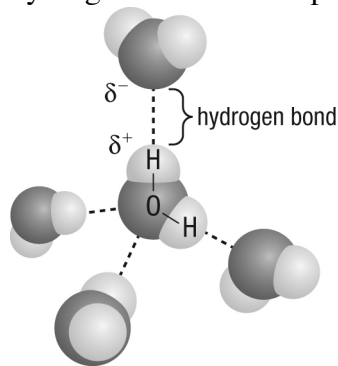
(b) Larger molecules have greater number of intermolecular forces, so molecule is held more tightly to another molecule. Linear molecules also have greater intermolecular forces than globular molecules because of their ability to get closer together. Polar molecules have stronger forces of attraction between them.

8. Electrons are not shared equally in a polar covalent bond while electrons are shared relatively equally in non-polar covalent bonds.

9. Nitrogen has a higher electronegativity than hydrogen, so the electrons will be closer to the nitrogen atom.

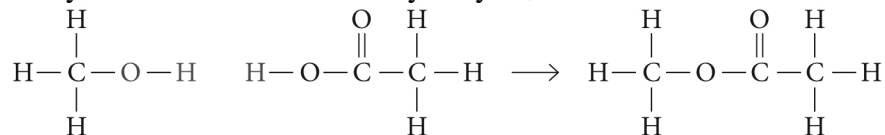
10. Answers may vary. Sample answer: Oxygen has a very high electronegativity, so it strongly attracts electrons of other elements and forms polar bonds. Oxygen has two pairs of non-bonding electrons in its out orbital and therefore forms two bonds that are not aligned—oxygen produces “bent” molecules. Oxygen also plays a role in redox reactions. It is frequently the oxidizing reagent because of its strong electronegativity in a reaction.

11. (a) Hydrogen bonds produce attractive forces by lining up partially positively charged hydrogen atoms with a partially negative charged atoms of different molecules.

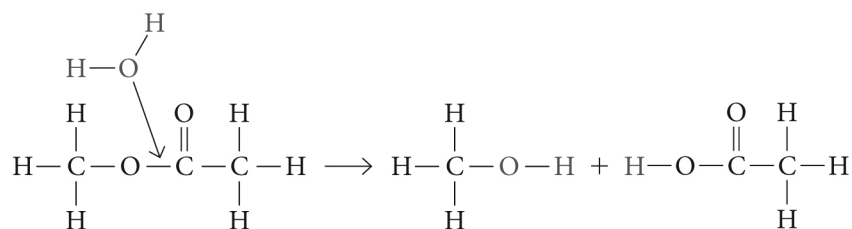


(b) Hydrogen bonds give water a high heat capacity, high melting and boiling points, and high surface tension, cohesion and adhesion.

12. Dehydration is the removal of -OH and -H from two reactant molecules, which allows the reactant molecules to form a bond, as well as creating water. Hydrolysis is the breaking of a bond between two subunits and the addition of water in the form of -OH and -H to the subunits. Dehydration is the reverse of hydrolysis, and vice versa.



(a) dehydration reaction



(b) hydrolysis reaction

13. (a) Reduction is the gain of electrons by a molecule and oxidation is the loss of electrons by a molecule.

(b) The reduction or oxidation of one molecule always implies the oxidation or reduction of another molecule; they cannot occur independently.