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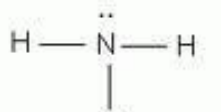
Chapter 2 Answer Key

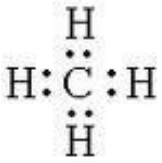
Critical Thinking Questions

1. a. Nitrogen (N) - 5 valence electrons - will share 3 in covalent bonds or gain 3 electrons (become a -3 ion)
   Sulfur (S) - 6 valence electrons - will share 2 in covalent bonds or gain 2 electrons (become a -2 ion)
   Carbon (C) - 4 valence electrons - will share 4 electrons in covalent bonds; can either donate or accept 4 electrons.
   Phosphorus (P) - 5 valence electrons - will share 3 in covalent bonds or gain 3 electrons (become a -3 ion)
   Oxygen (O) - 6 valence electrons - will share 2 in covalent bonds or gain 2 electrons (become a -2 ion)
   Hydrogen (H) - 1 valence electron - will share 1 in covalent bond, lose 1 (become a +1 ion), or gain 1 electron
   Calcium (Ca) - 2 valence electrons - will lose 2 electrons (become a +2 ion)
   Iron (Fe) - 2 valence electrons - will lose 2 electrons (become a +2 ion)
   Magnesium (Mg) - 2 valence electrons - will lose 2 electrons (become a +2 ion)

2. Predict the types of bonds:
   a. ammonia (NH_3) - 3 single polar covalent bonds
   b. phosphate (PO_4^{3-}) - covalent bonds between P & O; will bond ionically to a cation
   c. disulfide (S–S) - single nonpolar covalent bond
   d. magnesium chloride ($MgCl_2$) - ionic bonds

3.
   a. A hydrogen bond will form. $H_3C–CH=O$- - - HOH (dotted line is H-bond)
   b. Cl–Cl is nonpolar, ammonia is polar

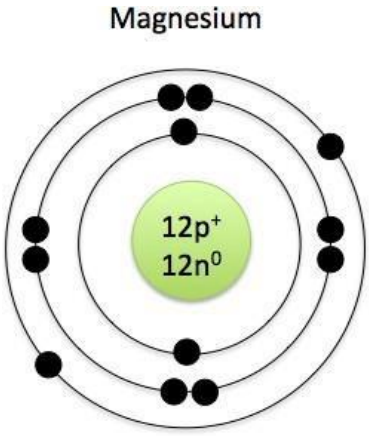


methane is nonpolar 

c. $[H^+] = 0.00001$ mol/L = 1×10^{-5} mol/L = pH = 5

d. $[OH^-] = 0.00001$ mol/L = 1×10^{-5} mol/L therefore $[H^+] = 1 \times 10^{-9}$ mol/L = pH = 9

e.



Magnesium has two electrons in shell 1, eight electrons in shell 2, and only two in shell 3.

f. Magnesium would make a cation with a valence of 2, Mg^{+2}

4. Polar molecules are created when electrons are shared unequally between two atoms of a covalent bond. One atom has a stronger attraction for the shared electrons than the other atom in the bond. Polar molecules are made of two or more nonmetallic elements. Ionic bonds are created by oppositely charged ions attracting each other like the north and south poles of a bar magnet. The cation (positive) loses electrons and the anion (negative) gains electrons. Ionic compounds are made from metals (cations) and nonmetals (anion).

5. Galactose is an aldehyde sugar with the carbonyl group on the end of the linear molecule.

6. a. Three water molecules are released when a triglyceride is formed.
   b. There are five peptide bonds in a hexapeptide molecule.

7. Adenine forms two hydrogen bonds with thymine (or uracil) and cytosine forms three hydrogen bonds with guanine. The bonds occur due to the locations of the oxygens and nitrogen with hydrogen attached. A single ring base must pair with a double ring base so that the “steps” of the DNA ladder are the same length.

8. a. Butter (in stick form) is saturated
   b. Olive oil is unsaturated

c. Cholesterol can add stability to the cell membrane because as a nonpolar molecule, it is attracted to the nonpolar fatty acid chains of the tails of the nearby phospholipid molecules. This attraction holds the phospholipid molecule in place, making the membrane less fluid.

Visual Challenge

1. Figure (1) is starch. The alpha-glucose molecules bond in such as way as to create a compact, almost spherical structure.

   Figure (2) is cellulose. The beta-glucose molecules bond in a branched, linear chain that interconnects with other chains.