

Section 1.3: The Carbon Chemistry of Life

Section 1.3 Questions, page 28

1. Carbon has four unpaired valence electrons allowing it to form four covalent bonds. Carbon can bond with one or two other carbons to form straight chains. When carbon bonds with three or four other carbons, each secondary carbon can form a chain resulting in a branched chain. Due to electron repulsion, the bonds form a tetrahedral structure. The angles between the bonds allow chains of carbon to bend around and form ring structures.

2. Functional groups are specific groups of atoms within organic molecules that are responsible for the characteristic chemical reactions of those molecules. The same functional group will undergo the same or similar chemical reaction(s) regardless of the size of the molecule it is a part of.

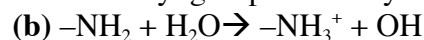
3. Compounds with similar structures often have similar uses. Their use is dependent on the properties of the compounds and the properties are dependent on structures of the compounds.

4. Answers may vary. Sample answer: Functional groups help determine if a molecule is polar or non-polar. This property determines the types of solvents and molecules that it is attracted to. For example, polar solvents dissolve polar and ionic compounds and non-polar solvents dissolve non-polar compounds.

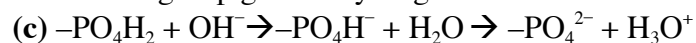
5. Answers may vary. Sample answer: In many functional groups, oxygen helps establish the polarity of the molecule. In some groups, oxygen acts as a reducing agent by losing electrons from compounds while in other groups, it acts as an oxidizing agent by gaining electrons to form a bond.



The carboxyl group loses a hydrogen ion.

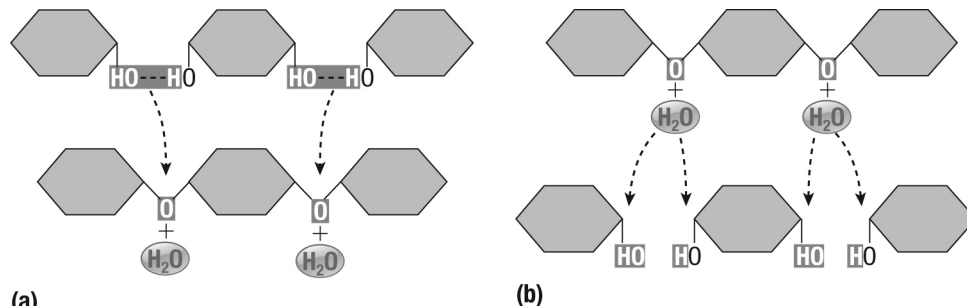


The amino group gains a hydrogen ion.



The phosphate group loses a hydrogen ion.

7. Answer may vary. Sample answer: Student drawings should resemble Figure 6 on page 27 of the student textbook.



8. Dehydration synthesis and hydrolysis are both processes that rearrange molecules in organic substances. Dehydration synthesis connects smaller molecules to form larger organic compounds. Water is lost during the process. In hydrolysis, water is added and larger compounds are broken down into smaller units.

9. This is an example of hydrolysis because the products are smaller than the reactants and water is added.

10. Answers may vary. Sample answer: Dehydration could be used to form longer and more complex polysaccharides for cell function. Hydrolysis could be used to reduce polysaccharides into simple more easily utilized sugars.

11. Answers may vary. Sample answer: Alcohols are common in organic molecules but the alcohol functional group is polar. This makes them a good solvent for both organic and polar solutes, such as colognes or cleaning products.

12. (a) Figure 7: amino group, carboxyl group

Figure 8: phosphate group, carbonyl group, hydroxyl group

(b) Amino groups decrease the acidity and increase the solubility of the molecule in polar solvents. Carboxyl groups increase the acidity and solubility of the molecule in polar solvents. Phosphate groups increase the acidity and solubility of the molecule in polar solvents. Carbonyl groups increase the acidity of neighbouring functional groups and increase the solubility of the molecule in polar solvents. The hydroxyl group does not influence acidity, but it does enhance water solubility.

(c) Figure 7 is alanine, an important amino acid that is found in proteins. Alanine can be transaminated (transfer of amino group) to the α -keto acid pyruvate, which is an intermediate in sugar metabolism.

Figure 8 is dihydroxyacetone phosphate, an important intermediate in many biochemical pathways including the Calvin cycle, lipid biosynthesis, and glycolysis.