

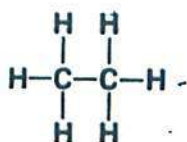
ACTIVITY 2-2. ORGANIC CHEMISTRY

carbon bonds

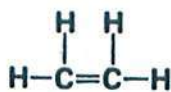
All organic compounds contain carbon. The outer shell of the carbon atom contains four electrons. In organic compounds, each carbon atom fills its outer shell by sharing four pairs of electrons with other atoms. That is, each carbon atom forms four covalent bonds. Some of these bonds may form between one carbon atom and another. A framework of carbon-to-carbon bonds forms the basic structure in most organic compounds. A carbon atom may be joined to another atom by a single bond, a double bond, or a triple bond.

Question

The following structural formulas show three different compounds of carbon and hydrogen. Below each structural formula, write the empirical formula for that compound. Label the double and triple bonds in these structures.



CH₃



CH₂



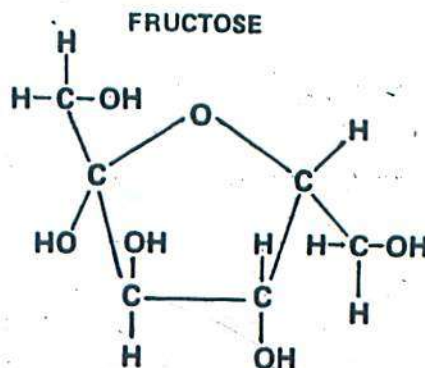
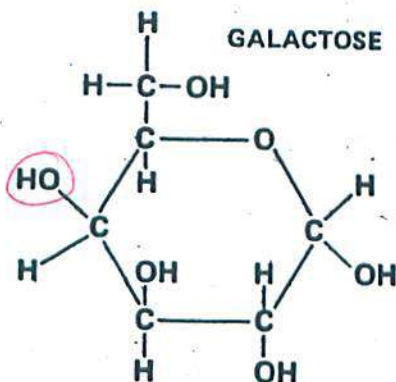
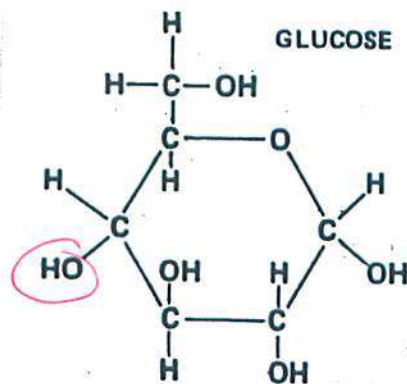
CH

carbohydrates

Carbohydrates are organic compounds composed of carbon, hydrogen, and oxygen. The proportion of hydrogen atoms to oxygen atoms in carbohydrates is the same as in water—two hydrogens to one oxygen. There are three basic types of carbohydrates—monosaccharides, disaccharides, and polysaccharides.

mono-saccharides

Monosaccharides, or simple sugars, are the least complicated carbohydrates. In biology the three most common simple sugars are glucose, galactose, and fructose. These three sugars all have the same empirical formula (C₆H₁₂O₆), but their atoms are arranged differently (see below).



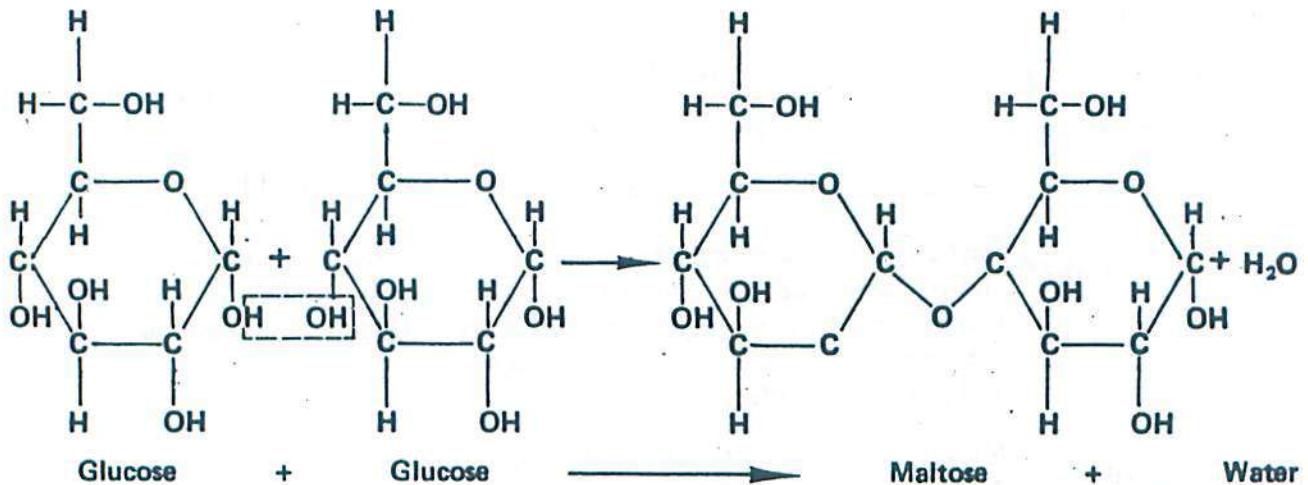
Questions

1. In what way do glucose and galactose differ from each other? Circle the parts of both compounds that show this difference.
2. Another name for glucose is monosaccharide.
3. The simplest possible formula that illustrates the proportion of elements in monosaccharides is C_nH_{2n}O_n.

dehydration synthesis and hydrolysis

Carbohydrates, proteins, and lipids are all synthesized and broken down by the same types of reactions. In *dehydration synthesis*, a hydrogen atom from one molecule joins with a hydroxyl group from another molecule to form water, leaving the two molecules bonded to the same oxygen atom. For example, when two molecules of glucose are joined by dehydration synthesis, they form maltose and water (see below).

In *hydrolysis*, complex organic molecules are broken down by the addition of the components of water — H^+ and OH^- . Both dehydration synthesis and hydrolysis require certain conditions of pH and temperature and the presence of particular enzymes.



Questions

1. In the space below show the hydrolysis of maltose. (The reaction is the reverse of the dehydration synthesis of maltose.)



2. What are the products of the hydrolysis of maltose? *2 Glucoses*
3. In what life process does hydrolysis occur? *Digestion*

disaccharides

When two monosaccharides combine, they form a *disaccharide*. A disaccharide can consist either of two molecules of the same simple sugar combined or of two different simple sugars combined. Some common disaccharides are maltose, sucrose and lactose.

Questions

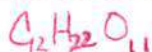
1. Name the monosaccharides that make up the following disaccharides:

maltose: *glucose + glucose*

sucrose: *glucose + fructose*

lactose: *glucose + galactose*

2. What is the empirical formula for maltose, sucrose and lactose?



3. Why is the empirical formula not double that of the monosaccharides?

lost a water

polysaccharides and polymers

The most complex carbohydrates are the polysaccharides, which are made up of long chains of glucoselike units. Starch, cellulose and glycogen are polysaccharides. Large molecules made up of chains of repeating units are called *polymers*. Polysaccharides, such as the ones mentioned above, are polymers.

Questions

1. What substance is the repeating unit that makes up starch, cellulose and glycogen?

Glucose

2. Starch, cellulose and glycogen are all made up of the same repeating unit. In what way to these three substances differ from one another?

The bonds between the glucose

3. Name another type of compound (beside polysaccharides) that fits the definition of a polymer.

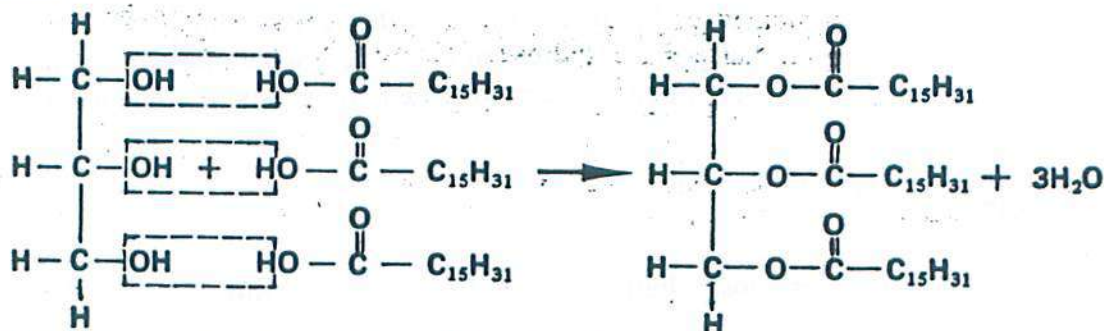
Polypeptide

lipids

Lipids are a group of organic compounds that include fats, oils, waxes and related substances. Lipids are composed of carbon, hydrogen and oxygen, but there is no definite ratio of hydrogen to oxygen atoms in lipids as there is in carbohydrates. Simple lipids, which are the most common type, are made up of three fatty acid molecules and one glycerol molecule.

Questions

- Label each of the components in the equation below. What type of reaction is shown in the equation?



- What type of compound is glycerol? *Alcohol*
- Write the empirical formula for fatty acids. *$\text{C}_{16}\text{H}_{32}\text{O}_2 \rightarrow \text{C}_8\text{H}_{16}\text{O}$*
- What is the difference between a saturated and an unsaturated fatty acid? *Double bonds*

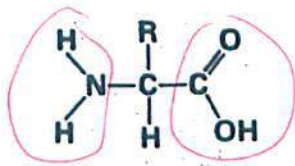
proteins

Proteins are the most abundant type of organic compound in cells. They are made up of many amino acid molecules bonded together. Proteins, which may be very large and complex, play a wide variety of roles in the cell. Some are structural, others are hormones, neurohumors, enzymes or pigments.

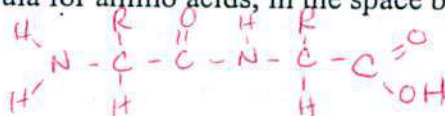
Amino acids are made up of carbon, hydrogen, oxygen and nitrogen; some also contain sulfur. Amino acids are bonded together to form proteins by dehydration synthesis. The type of bond formed between amino acids is called a *peptide bond*. It involves a carboxyl group from one molecule and an amino group from the other.

Questions

- Name three foods that are high in protein. *Fish, Beef, Beans*
- Below is the general formula for an amino acid. Circle the amino group and the carboxyl group.



- Using the general formula for amino acids, in the space below show the formation of a peptide bond.



- What does the R represent in the general formula for amino acids? *Variable group*
- If the R is a hydrogen atom, what amino acid is formed? *Glycine*
- If the R is a methyl group (CH_3), what amino acid is formed? *Alanine*