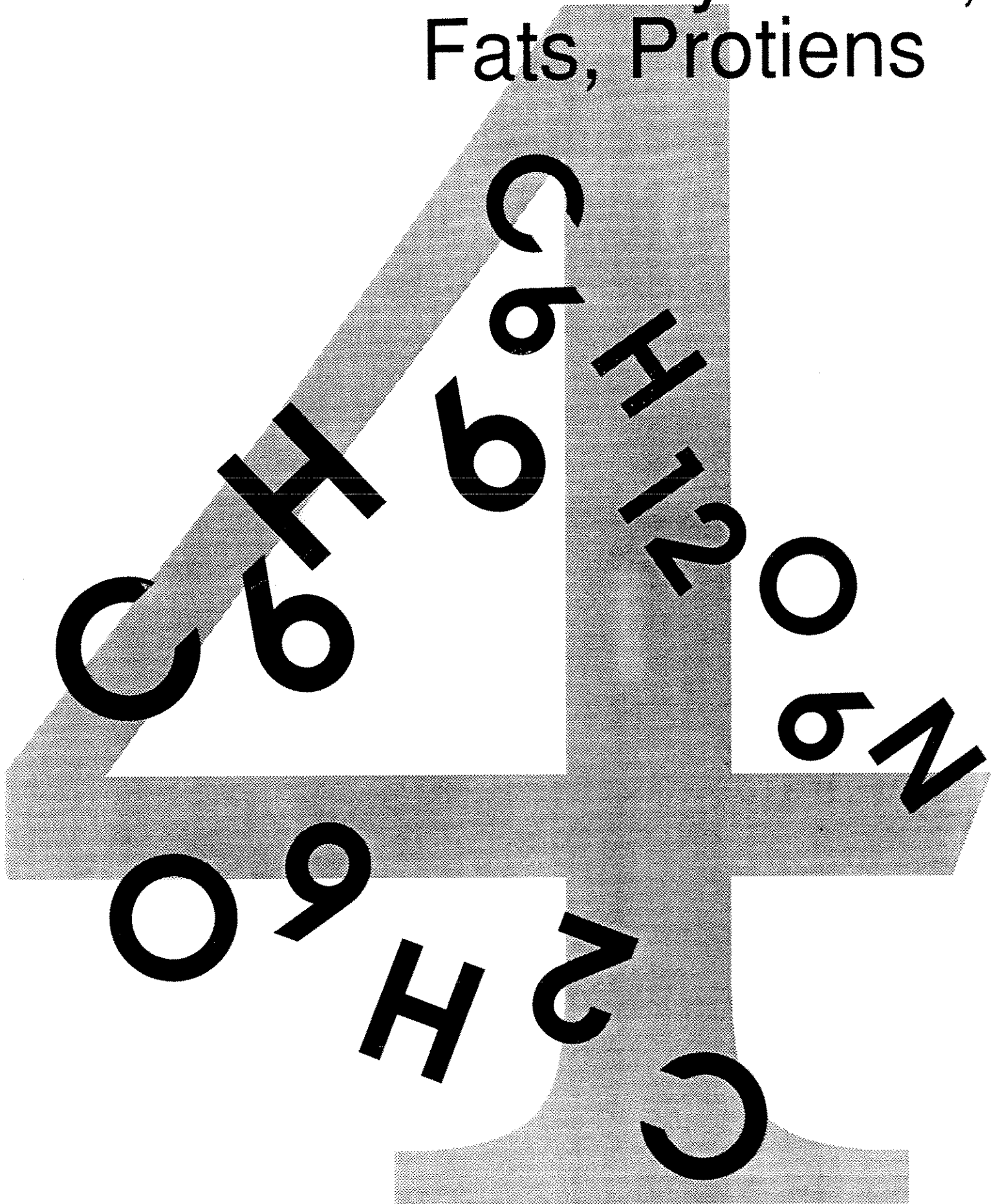


# Carbohydrates, Fats, Proteins



CARBOHYDRATES, FATS, PROTEINS

209. Carbohydrates contain the elements carbon, hydrogen, and oxygen, and only these elements. A compound containing elements other than these three is not a carbohydrate.

The word hydrate refers to water. Carbohydrates usually contain hydrogen and oxygen in the same ratio as in water - 2:1.

Which of the following compounds are carbohydrates:

- |   |   |
|---|---|
| ___ (a) C <sub>6</sub> H <sub>6</sub>                   | ___ (d) C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> N |
| ___ (b) C <sub>12</sub> H <sub>22</sub> O <sub>11</sub> | ___ (e) C <sub>2</sub> H <sub>6</sub> O                 |
| ___ (c) C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>   |   |

(b) C<sub>12</sub>H<sub>22</sub>O<sub>11</sub> and (c) C<sub>5</sub>H<sub>10</sub>O<sub>5</sub>

210. From the list of compounds above, why is C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>N not a carbohydrate. \_\_\_\_\_

Why are C<sub>2</sub>H<sub>6</sub> and C<sub>2</sub>H<sub>6</sub>O not carbohydrates? \_\_\_\_\_

carbohydrates contain only C, H, and O, because they have the wrong ratio of H to O.

211. Carbohydrates are divided into three types. One type of carbohydrate is the monosaccharide.

The word saccharide means simple sugar. The prefix mono means \_\_\_\_\_.

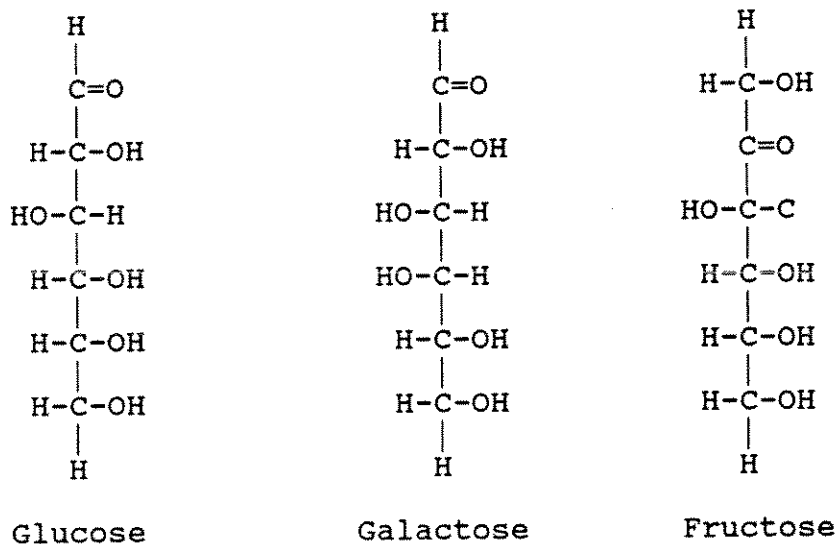
Therefore, monosaccharides are simple sugars - they contain only \_\_\_\_\_ sugar.

one; one

212. Monosaccharides are named for the number of carbon atoms they contain. The most common monosaccharides contain six carbon atoms, so they are called hexoses.

Three common hexoses are glucose, galactose, and fructose. They all contain \_\_\_\_\_ carbon atoms.

213. Glucose, galactose, and fructose, the three common hexoses, all have the same molecular formula, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>. Their structural formulas are given below.



Look at the structures of the above three hexoses. They all have the same molecular formula, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> (count them).

214. Glucose contains what two types of functional groups? (check one)

- ketone and acid
- alcohol and amine
- alcohol and aldehyde
- aldehyde and acid

alcohol and aldehyde

215. Galactose contains which groups?

- alcohol and ketone
- alcohol and acid
- ketone and acid
- alcohol and aldehyde

alcohol and aldehyde

216. Fructose contains what two types of groups? \_\_\_\_\_

alcohol and ketone

217. Monosaccharides containing six carbon atoms are called \_\_\_\_\_

hexoses

218. The chief function of monosaccharides in the body is to provide energy.

The three common monosaccharides are galactose, fructose and \_\_\_\_\_

glucose

219. The second type of carbohydrate is called the disaccharide. The prefix di means "two".

Disaccharides are formed by the combination of two monosaccharides, with water also being produced.

monosaccharide + monosaccharide  $\rightarrow$  disaccharide + water

Also, disaccharides react with water to produce two monosaccharides.

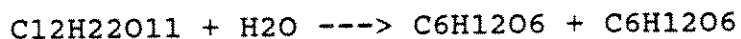
disaccharide + water  $\rightarrow$  monosaccharide + \_\_\_\_\_

monosaccharide

220. This reaction (a reaction with water) is called hydrolysis. Disaccharides, on hydrolysis, yield two \_\_\_\_\_ .  
monosaccharides

221. Monosaccharides contain \_\_\_\_\_ simple sugar(s).  
Disaccharides contain \_\_\_\_\_ simple sugar(s).  
one;two

222. The hydrolysis of a disaccharide may be written as:



disaccharide + water  $\rightarrow$  monosaccharide + monosaccharide

Sucrose,  $C_{12}H_{22}O_{11}$ , is a disaccharide. The hydrolysis of sucrose yields the two \_\_\_\_\_, glucose and fructose.

monosaccharides

223. There are three common disaccharides: sucrose, maltose, and lactose. These disaccharides all have the same molecular formula,  $C_{12}H_{22}O_{11}$ .

Lactose is also called milk sugar and is found in milk.

Maltose, or malt sugar, is found in sprouting grain.

Sucrose, or cane sugar, is found in \_\_\_\_\_  
sugar cane

224. Three monosaccharides are \_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_ and \_\_\_\_\_

Sucrose, \_\_\_\_\_, and lactose are disaccharides.

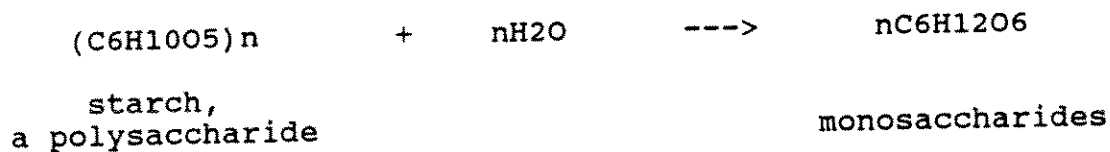
glucose, fructose, galactose (any order); maltose

225. The third type of carbohydrate is the polysaccharide.

The prefix poly means "many", so polysaccharides, on hydrolysis, yield many \_\_\_\_\_.

monosaccharides

226. Starch is a polysaccharide. Its molecular formula is  $(C_6H_{10}O_5)_n$ , where  $n$  is some large number. Upon complete hydrolysis, starch yields many monosaccharides.



Which of the following formulas represents a disaccharide?

- \_\_\_ (a)  $C_6H_{10}O_5$
- \_\_\_ (b)  $C_{12}H_{22}O_{11}$
- \_\_\_ (c)  $(C_6H_{10}O_5)_n$
- \_\_\_ (d)  $C_6H_{12}O_6$

(b)  $C_{12}H_{22}O_{11}$

227. Which of the formulas above represents a polysaccharide?

Which are monosaccharides? \_\_\_\_\_

- (c)  $(C_6H_{10}O_6)_n$
- (a)  $C_6H_{10}O_5$  and (d)  $C_6H_{12}O_6$

228. Other samples of polysaccharides are cellulose, found in plants, and glycogen found in animals.

Plants use the polysaccharide cellulose primarily for support. Animals store carbohydrates in the form of a polysaccharide, glycogen.

(a) Name three common monosaccharides; \_\_\_\_\_.

(b) Name three common disaccharides; \_\_\_\_\_.

(c) Name three polysaccharides; \_\_\_\_\_.

(a) glucose, fructose, galactose; (b) lactose, maltose, sucrose;  
(c) starch, cellulose, glycogen.

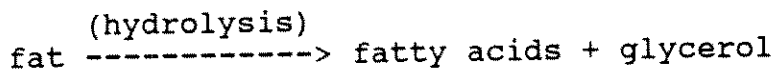
229. Carbohydrates contain the elements \_\_\_\_\_ and \_\_\_\_\_.

carbon, hydrogen, oxygen

230. Fats contain the same elements as do carbohydrates, but with less oxygen in proportion than carbohydrates.

Upon hydrolysis, fats yield fatty acids and glycerol, an alcohol.

The hydrolysis of a fat may be written as:



Remember, hydrolysis means reaction with \_\_\_\_\_.

water

231. The products, fatty acids and glycerol, are produced upon the hydrolysis of a \_\_\_\_\_.

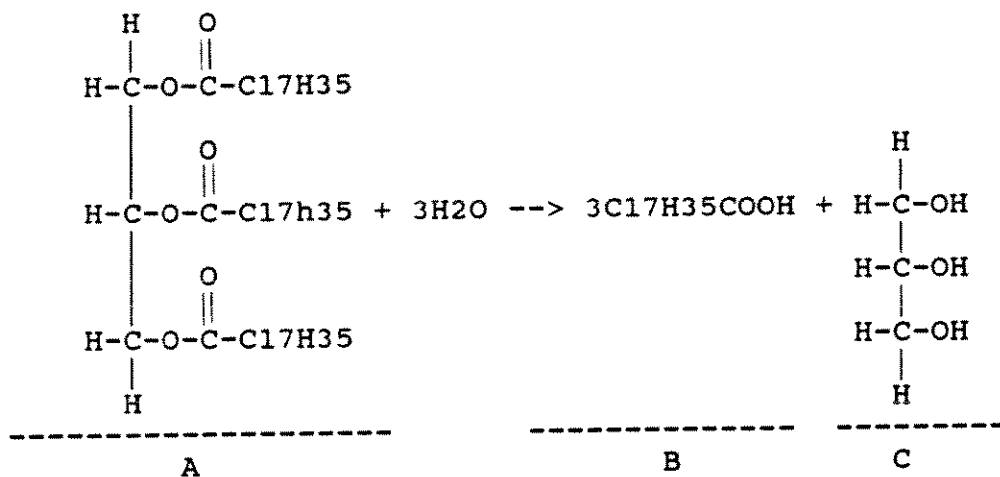
fat

232. Complete the following equation:



fatty acids + glycerol

233. The chemical equation for the hydrolysis of a fat may be written as:



Substance A is a fat.

Substance B is \_\_\_\_\_

Substance C is an alcohol called \_\_\_\_\_  
fatty acid; glycerol

234. (a) The hydrolysis of a polysaccharide yields \_\_\_\_\_

\_\_\_\_\_ (b) The hydrolysis of a disaccharide yields \_\_\_\_\_

\_\_\_\_\_ (c) The hydrolysis of a fat yields \_\_\_\_\_

- (a) many monosaccharides; (b) two monosaccharides;
- (c) fatty acids and glycerol



## PROTEINS

235. Proteins contain the same elements as do carbohydrates and fats, except that proteins always contain one additional element, nitrogen.

All proteins contain the four elements:

- (1) \_\_\_\_\_ (3) \_\_\_\_\_  
(2) \_\_\_\_\_ (4) \_\_\_\_\_

carbon; hydrogen; oxygen; nitrogen (in any order)

236. Some proteins also contain additional elements such as sulfur, phosphorus, or iron.

The hydrolysis of proteins yields amino acids.

Amino acids contain which functional groups? \_\_\_\_\_  
\_\_\_\_\_

amine and acid (or NH<sub>2</sub> and COOH)

237. The hydrolysis of proteins yields amino acids. In the same way, the combination of amino acids yields proteins.

protein  $\xrightarrow{\text{hydrolysis}}$  amino acids  
 $\xleftarrow{\text{combination}}$

238. When two amino acids combine, the product is called a dipeptide.

A tripeptide would be formed when \_\_\_\_\_ amino acids combine.

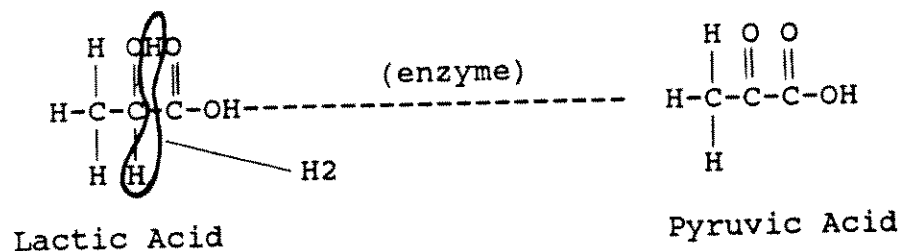
A polypeptide would be found when \_\_\_\_\_ amino acids combine.

3; many (or more than 3)

## OXIDATION - REDUCTION

239. Oxidation may be defined as either the loss of hydrogen by a compound or the gain of oxygen by a compound.

The compound acetic acid may be oxidized to pyruvic acid according to the following equation.

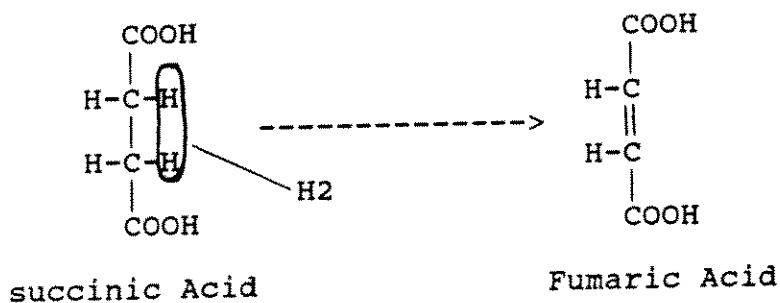


This is an oxidation reaction in involves

- \_\_\_ the gain of oxygen by the lactic acid molecule.
- \_\_\_ the loss of hydrogen by the lactic acid molecule.

the loss of hydrogen by the lactic acid molecule

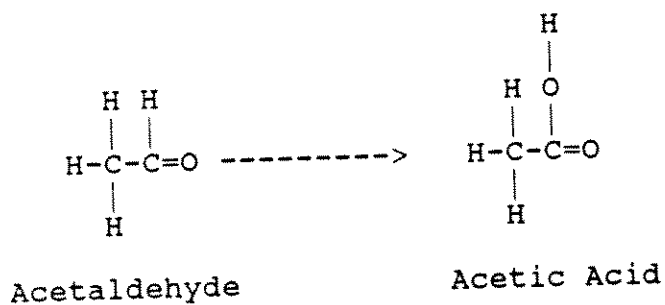
240. Similarly, succinic acid may be oxidized to fumaric acid.



This is an oxidation reaction because it involves \_\_\_\_\_

loss of hydrogen

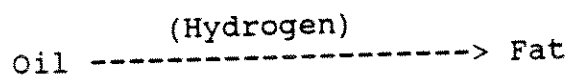
241. Another example of oxidation is the reaction of acetaldehyde to form acetic acid.



This reaction is oxidation because it involves \_\_\_\_\_  
 gain of oxygen

242. Reduction is the reverse of oxidation. Oxidation is the loss of hydrogen or the gain of oxygen by a compound. Therefore, reduction is \_\_\_\_\_  
 gain of hydrogen or loss of oxygen

243. An oil may be changed to a fat by a process of reduction. This process involves the addition of hydrogen to the oil.



Oxidation is \_\_\_\_\_  
 Reduction is \_\_\_\_\_

loss of hydrogen or gain of oxygen  
 gain of hydrogen or loss of oxygen