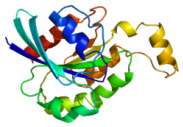
Chem 331 Biochemistry

Carbohydrates

Learning Objectives, Study Guides



Key concepts: Monosaccharides are defined as polyhydroxyls, ether as aldehydes or ketones. Sugars that contain 4 or more carbons exist primarily as ring structures known as hemiacetals (aldehydes) or hemiketals (ketones). Monosaccharides are single sugars examples are glucose, fructose and ribose. Disaccharides are two liked sugars examples are sucrose, lactose, cellobiose and maltose. Oligosaccharides are polymers of simple sugars linked together by O and N linked glycosidic bonds. Examples are cellulose, glycogen and glycosaminoglycans.

Learning Objectives

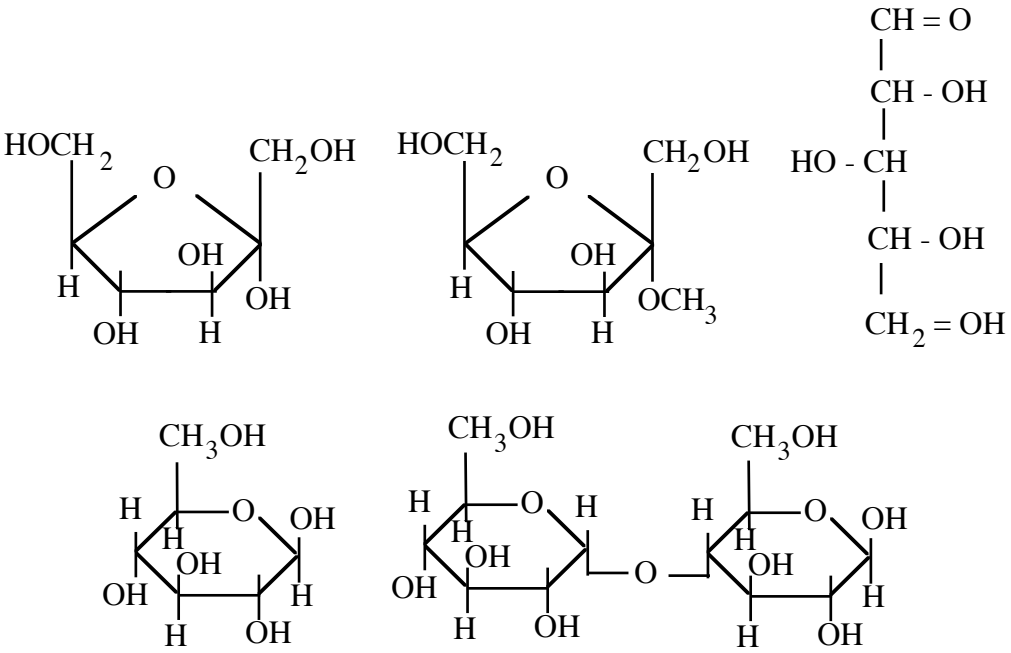
- Define carbohydrate and the groups of saccharides in chemical and descriptive terms
- DRAW fructose, glucose, galactose, sucrose and lactose
- Understand the concepts of enantiomers, diastereomers and epimers of simple sugars. Know the definitions of these terms
- Know how the ring structures of aldehyde and ketone sugars are formed
- Describe the role that mutarotation plays in intraconversion between the alpha and beta anomers.
- Know the glycosidic bonds for the acetal and ketal bonds. Know the different positions for the alpha and beta linkage conformations.
- Be able to convert the straight chain structure of any 5 or 6 carbon containing monosaccharide to its corresponding ring structure
- Be able to recognize the structures of the modifications of sugars:
- glycosides, sugar alcohols, sugar acids, phosphate esters, deoxy sugars and amino sugars.
- Understand the role saccharides play in biology
- Tell the difference between the major sugar polymers in biochemistry
- Know the differences between glycoprotein and proteoglycans.
- Know the biochemical functions and differences between the various heteropolysaccharides
- Be able to recognize the N and O linked polysaccharides
- Know how dietary polysaccharides are digested by humans

Study Notes from Dr P: *This is a pretty straight forward chapter. Learn the importance of the sugars and learn the structures of selected saccharides. I think it important to know what forces stabilize the complex sugars and some of the chemistry. Much of the stereochemistry is a repeat of what you've already learned in organic chemistry so much of this is review and isn't a key part of what we will go over in class or on the test (outside of the basics of the learning objectives above). Learn the roles of complex carbohydrates and the forces that make one soluble or insoluble and digestible or not…*

Chapter Questions (not assigned for homework but to help you practice, don't turn in. BUT some may or will show up on the exam).

1) Draw the following
Fructose, Lactose, glucose ß (1, 4)- glucose, Fructose 6-Phosphate

2) Which sugar is a reducing sugar?



3) Draw an a glycosidic bond

4) Describe where you would expect to see a carbohydrate with two glycosidic bonds

5) Why does cellulose from dense linear fibrils, whereas amylose forms open helices?

7) The terms reducing and non-reducing are often applied to the ends of pollysaccharides. How would you describe the ratio of the reducing: nonreducing ends in glycogen and cellulose.
a) Glycogen 1:1, Cellulose 1:1
b) Glycogen 1:1, Cellulose many:1
c) Glycogen many:1, Cellulose 1:1
d) Glycogen 1:many, Cellulose 1:1
e) Glycogen 1:1, Cellulose 1:many

8) What is maltose?
a) A disaccharide made of galactose and glucose
b) A disaccharide composed of glucose
c) A disaccharide composed of galactose and fructose
d) a non-reducing sugar
e) A monosaccharide

9) Identify the anomeric carbon of glucose.

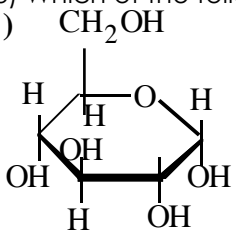
10) Consider the structure of ATP. Describe the saccharide in that molecule. What kind of glycosidic bond does it have.

11) Which inborn metabolic disease is due to the build up of galactose?

12) Lactose intolerance is characterized by the inability to hydrolyze:
a) α-1,4 fructosidic bonds

b) ß-1,6 galactosidic bonds
c) ß-1,4 glycosidic bonds
a) α-1,6 glycosidic bonds

13) Which of the following compounds is α-D-galactose:

a)


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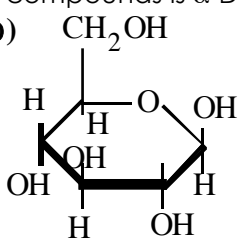

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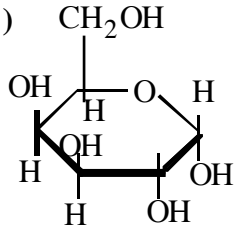

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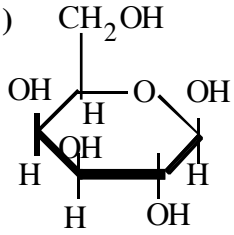

14) Conversion of the α anomer to the ß anomer is called
a) rotation
b) mutation
c) epimeration
d) mutarotation
e) hydroxylase turnaroundase

15) The disaccharide _____ consists of galactose and glucose
a) sucrose
b) fructose
c) lactose
d) maltose
e) Cellobiose

16) Glycogen and starch are extensively branched high-molecular weight polymers. Give two reasons why such a structure is advantageous for a fuel-storage molecule?