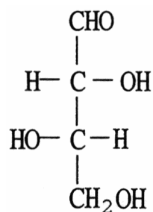


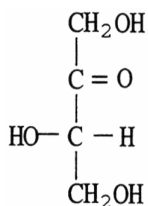
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) A carbohydrate can be defined as a molecule 1) _____
 A) composed of amine groups and carboxylic acid groups bonded to a carbon skeleton.
 B) composed mostly of hydrocarbons and soluble in non-polar solvents.
 C) whose name ends in "-ase".
 D) that is an aldehyde or ketone and that has more than one hydroxyl group.
 E) composed of carbon atoms bonded to water molecules.

- 2) Classify the molecule shown according to the location of its carbonyl group and the number of carbon atoms. 2) _____

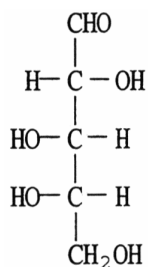


- A) ketotriose
 B) ketotetrose
 C) aldotetrose
 D) aldopentose
 E) aldotriose
- 3) Classify the molecule shown according to the location of its carbonyl group and the number of carbon atoms. 3) _____



- A) aldotetrose
 B) aldopentose
 C) aldotriose
 D) ketotriose
 E) ketotetrose

4) Classify the molecule shown according to the location of its carbonyl group and the number of carbon atoms. 4) _____



- A) ketotriose
- B) aldotriose
- C) aldotetrose
- D) aldopentose
- E) ketotetrose

5) Glucose can be classified as a(an) 5) _____

- A) ketohexose.
- B) aldopentose.
- C) aldohexose.
- D) ketopentose.
- E) aldoketose.

6) Ribose can be classified as a(an) 6) _____

- A) ketohexose.
- B) aldohexose.
- C) ketopentose.
- D) aldopentose.
- E) aldoketose.

7) Fructose can be classified as a(an) 7) _____

- A) aldohexose.
- B) ketohexose.
- C) aldopentose.
- D) aldoketose.
- E) ketopentose.

8) How many stereoisomers of an aldotetrose can exist? 8) _____

A) 16 B) 32 C) 2 D) 4 E) 8

9) How many stereoisomers of an aldopentose can exist? 9) _____

A) 2 B) 16 C) 8 D) 32 E) 4

10) Left- and right-handed mirror image molecules are known as 10) _____

- A) structural isomers.
- B) enantiomers.
- C) diastereomers.
- D) anomers.
- E) cis-trans isomers.

11) Molecules such as erythrose and threose, which are stereoisomers but not mirror images, are referred to as a pair of _____. D- and L-threose are mirror images and are referred to as a pair of _____.

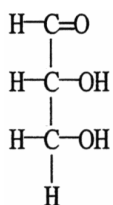
11) _____

- A) anomers; diastereomers
- B) diastereomers; anomers
- C) diastereomers; enantiomers
- D) enantiomers; diastereomers
- E) anomers; enantiomers

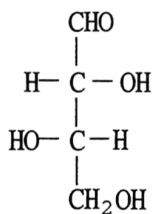
12) Which molecule shown is D-glyceraldehyde?

12) _____

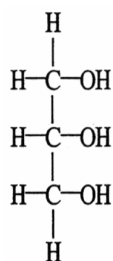
A)



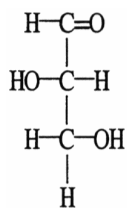
B)



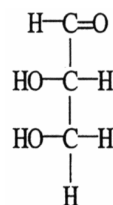
C)



D)



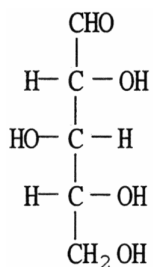
E)



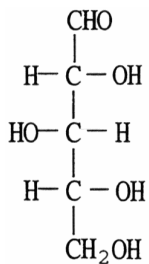
- 13) A sugar is classified as a D-isomer if the hydroxyl group 13) _____
- A) on the chiral carbon nearest to the carbonyl points to the right.
 - B) on the chiral carbon farthest from the carbonyl points to the left.
 - C) on the end carbon farthest from the carbonyl points to the left.
 - D) on the chiral carbon farthest from the carbonyl points to the right.
 - E) on the chiral carbon nearest to the carbonyl points to the left.

- 14) Which molecule shown is an L-isomer? 14) _____

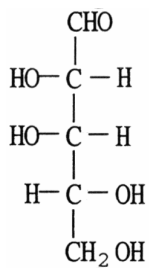
A)



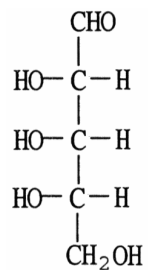
B)



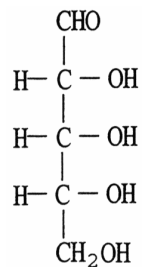
C)



D)



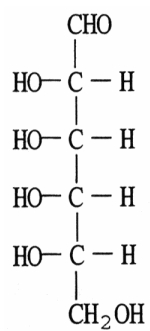
E)



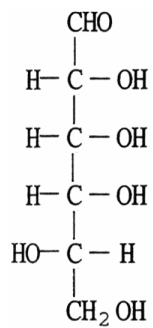
15) Which molecule shown is a D-isomer?

15) _____

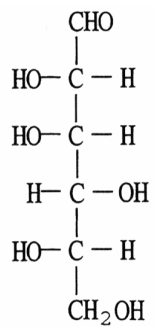
A)



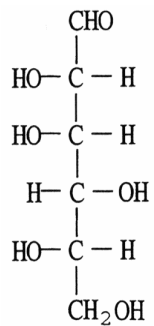
B)



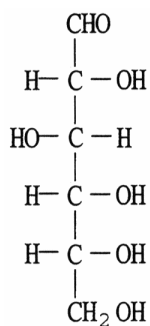
C)



D)



E)



- 16) Two isomeric sugars that are cyclic and only differ in the position of the -OH group attached to the hemiacetal carbon are called 16) _____
- A) enantiomers.
 - B) anomers.
 - C) diastereomers.
 - D) mutarotations.
 - E) epimers.
- 17) Mutarotation is process where 17) _____
- A) two glucose molecules react to form a disaccharide.
 - B) glucose undergoes reaction to form an equilibrium mixture of anomers.
 - C) glucose isomerizes to fructose.
 - D) glucose reacts with an alcohol forming a cyclic acetal.
 - E) the aldehyde group present in a sugar is converted to a hemiacetal.
- 18) All of the statements concerning monosaccharides are correct **except** 18) _____
- A) A molecule is classified as a D or L isomer by the position of the hydroxyl group on the chiral center farthest from the carbonyl group.
 - B) Monosaccharides have the general formula $C_n(H_2O)_n$, but this only describes the number and kinds of atoms, not their structure.
 - C) Monosaccharides with 5 or 6 carbon atoms exist in solution in cyclic form.
 - D) The number of stereoisomers possible is 2^n , where n is the number of chiral carbon atoms in the molecule.
 - E) The two different cyclic forms of a particular monosaccharide are called tautomers.
- 19) The conversion of cyclic glucose between the alpha form and the beta form is called 19) _____
- A) dimerization.
 - B) hydrolysis.
 - C) polymerization.
 - D) cyclization.
 - E) mutarotation.
- 20) When a monosaccharide forms a ring by interaction of one of its hydroxyl groups with its aldehyde group, the bond is referred to as a(an) _____ linkage. 20) _____
- A) ester
 - B) glycosidic
 - C) hemiacetal
 - D) acetal
 - E) ether

- 21) A hemiacetal linkage consists of a _____ 21) _____
A) carbon atom bonded to two -OH groups.
B) carbon atom bonded to both an -OH and an -OR group.
C) carbon atom that is bonded to an -OR group and an -NH₂ group.
D) carbonyl group that is also bonded to a hydroxyl group.
E) carbonyl group that is also bonded to an ether linkage.
- 22) A sugar is classified as an L-isomer if the hydroxyl group _____ 22) _____
A) on the chiral carbon closest to the carbonyl group points to the right.
B) on the chiral carbon farthest from the carbonyl group points to the right.
C) on the chiral carbon closest to the carbonyl group points to the left.
D) on the end carbon farthest from the carbonyl points to the left.
E) on the chiral carbon farthest from the carbonyl group points to the left.
- 23) All of the following are common monosaccharides of interest in human biochemistry **except** _____ 23) _____
A) glucose. B) maltose. C) ribose. D) galactose. E) fructose.
- 24) Fructose is similar to glucose and galactose in all of the following aspects **except** _____ 24) _____
A) it forms a hemiacetal ring.
B) it can undergo mutarotation from α to β anomers.
C) its formula is C₆ H₁₂O₆.
D) it is a ketose.
E) none of the above
- 25) When a monosaccharide forms a cyclic hemiacetal, the carbon atom that contained the carbonyl group is identified as the _____ carbon atom because _____ 25) _____
A) D; the carbonyl group is drawn to the right.
B) anomeric; its substituents can assume an α or a β position.
C) L; the carbonyl group is drawn to the left.
D) acetal; it forms bonds to an -OR and an -OR'.
E) enantiomeric; depending on its position, the resulting ring can have a mirror image.
- 26) reaction of a simple sugar with an alcohol produces a _____. 26) _____
A) a mixture of anomers
B) cyclic acetal
C) glycoside
D) all of the above
E) none of the above
- 27) _____ of glucose leads to gluconic acid. 27) _____
A) Reduction
B) Oxidation
C) Isomerization
D) Esterification
E) Glycosidation

- 28) Common reducing reactions of monosaccharides are due to 28) _____
 A) the presence of more than one hydroxyl group.
 B) the presence of at least one chiral carbon atom.
 C) the presence of at least one hydroxyl group.
 D) their cyclic structures.
 E) the presence of a carbonyl group, usually on the #1 carbon atom.
- 29) Which molecule is **not** a reducing sugar? 29) _____
 A) glucose B) galactose C) lactose D) sucrose E) maltose
- 30) Which molecule is a reducing sugar? 30) _____
 A) starch
 B) glycogen
 C) amylopectin
 D) maltose
 E) sucrose
- 31) Ketoses can act as reducing sugars in basic solution because 31) _____
 A) their carbonyl groups can readily be oxidized just as in aldoses.
 B) mutarotation makes the carbonyl group accessible to oxidizing agents.
 C) the large number of hydroxyl groups allows oxidation of the molecules.
 D) the ketone is converted to an aldehyde by keto-enol tautomerization.
 E) none of the above
- 32) A glycosidic bond is 32) _____
 A) a bond between any two carbohydrate molecules.
 B) a bond formed between an anomeric carbon atom and any -OR group.
 C) a bond between anomeric carbon atoms on two separate monosaccharides.
 D) any bond that can be broken by reaction with water.
 E) none of the above
- 33) All of the following are functions of modified carbohydrate molecules **except** 33) _____
 A) As heparin they form a fibrous network in blood clots.
 B) As a component of hemoglobin they transport oxygen.
 C) As a receptor molecule on cell surfaces they assist in the functioning of the immune system.
 D) As a component of cartilage they provide support to joints.
 E) As chitin they act as a structural component of lobster shells.
- 34) Cellulose is produced by _____, and its major function is _____. 34) _____
 A) animals; energy storage
 B) plants; energy storage
 C) animals; as a structural component
 D) plants; as a structural component
 E) none of the above
- 35) The reaction in which a disaccharide is broken down into its component monosaccharides is 35) _____
 A) oxidation.
 B) hydrolysis.
 C) reduction.
 D) glycoside formation.
 E) enediol formation.

- 36) Lactose result from reacting glucose at its _____ carbon and galactose at its _____ carbon. 36) _____
A) 6, 1 B) 4, 1 C) 1, 1 D) 1, 4 E) 1, 6
- 37) The bond connecting the two monosaccharides in maltose is a(an) _____ linkage. 37) _____
A) 1,2 anomeric
B) α -1,4 glycosidic
C) β -1,6 glycosidic
D) β -1,4 glycosidic
E) α -1,6 glycosidic
- 38) The bond connecting the two monosaccharides in sucrose is a(an) _____ linkage. 38) _____
A) α -1,6 glycosidic
B) α -1,4 glycosidic
C) β -1,6 glycosidic
D) β -1,4 glycosidic
E) 1,2 anomeric
- 39) The molecular formula of the common disaccharides in human biochemistry is 39) _____
A) $C_{12}H_{22}O_{11}$.
B) $C_2(H_2O)_2$.
C) $C_{12}H_{24}O_{12}$.
D) CH_2O .
E) $C_6H_{12}O_6$.
- 40) Sucrose is **not** a reducing sugar because its 40) _____
A) disaccharide bond is a β -1,4 linkage.
B) disaccharide bond is an α -1,4 linkage.
C) hemiacetal groups cannot be converted to aldehyde groups.
D) disaccharide bond is a 1,2 anomeric link.
E) none of the above
- 41) Glocoproteins are formed by bonding a oligosaccharide to a protein through a _____ linkage. 41) _____
A) glucuronic
B) ester
C) ether
D) glycosidic
E) imine
- 42) Starch is produced by _____, and its major function is _____. 42) _____
A) animals; energy storage
B) animals; as a structural component
C) plants; energy storage
D) plants; as a structural component
E) none of the above

- 43) Glycogen is produced by _____, and its major function is _____. 43) _____
 A) plants; as a structural component
 B) animals; as a structural component
 C) plants; energy storage
 D) animals; energy storage
 E) none of the above
- 44) Starch is composed of two polymers, _____, which is an unbranched chain, and _____, which 44) _____
 is a branched polymer.
 A) amylose; amylose
 B) amylose; amylose
 C) amylopectin; amylose
 D) amylose; amylopectin
 E) amylose; amylopectin
- 45) Which of the following statements comparing amylopectin and glycogen is false? 45) _____
 A) Both are polymers of α -D-glucose.
 B) Both serve as energy storage molecules.
 C) Glycogen is more highly branched than amylopectin.
 D) Glycogen molecules are generally larger than amylopectin molecules.
 E) none of the above

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 46) Explain why cows and other grazing animals can eat grass and benefit from its nutritive 46) _____
 value, but humans cannot.

MATCHING. Choose the item in column 2 that best matches each item in column 1.

Match the following.

- | | | |
|-------------------|--|-----------|
| 47) enantiomers | A) a monosaccharide that is sweeter than sucrose and found in honey and fruits | 47) _____ |
| 48) diastereomers | B) an aldopentose that is a component of nucleic acids | 48) _____ |
| 49) anomers | C) stereoisomers that are not mirror images of each other | 49) _____ |
| 50) galactose | D) a monosaccharide which is a component of milk sugar | 50) _____ |
| 51) ribose | E) mirror-image forms of chiral molecules | 51) _____ |
| 52) fructose | F) isomers of cyclic sugars that exist in the position of the hydroxyl group at the hemiacetal carbon atom | 52) _____ |

53) glucose	A) a monosaccharide that functions as the transport form of carbohydrates in blood	53) _____
54) reducing sugar	B) a polysaccharide composed of glucose units joined by β -1,4 linkages	54) _____
55) polysaccharide	C) a disaccharide composed of one molecule of glucose and one molecule of galactose	55) _____
56) sucrose	D) a disaccharide composed of two molecules of glucose	56) _____
57) maltose	E) a very highly branched polysaccharide composed of glucose units	57) _____
58) lactose	F) a component of starch composed of glucose units joined by β -1,4 linkages	58) _____
59) disaccharide	G) a carbohydrate that yields two monosaccharides upon hydrolysis	59) _____
60) amylose	H) a carbohydrate composed of a large number of monosaccharides chemically combined	60) _____
61) cellulose	I) a carbohydrate that can be oxidized to produce an acid molecule or its corresponding anion	61) _____
62) glycogen	J) a disaccharide composed of one molecule of glucose and one molecule of fructose	62) _____

Answer Key

Testname: UNTITLED1

- 1) D
- 2) C
- 3) E
- 4) D
- 5) C
- 6) D
- 7) B
- 8) D
- 9) C
- 10) B
- 11) C
- 12) A
- 13) D
- 14) D
- 15) E
- 16) B
- 17) B
- 18) E
- 19) E
- 20) C
- 21) B
- 22) E
- 23) B
- 24) D
- 25) B
- 26) D
- 27) B
- 28) E
- 29) D
- 30) D
- 31) D
- 32) B
- 33) B
- 34) D
- 35) B
- 36) B
- 37) B
- 38) E
- 39) A
- 40) D
- 41) D
- 42) C
- 43) D
- 44) D
- 45) E
- 46) Humans do not have the enzyme that breaks the β -1,4-linkages in cellulose. Grazing animals and some insects have bacteria in their digestive systems that produce an enzyme that hydrolyzes these linkages. Therefore these animals can digest and metabolize cellulose.
- 47) E
- 48) C

Answer Key

Testname: UNTITLED1

49) F

50) D

51) B

52) A

53) A

54) I

55) H

56) J

57) D

58) C

59) G

60) F

61) B

62) E