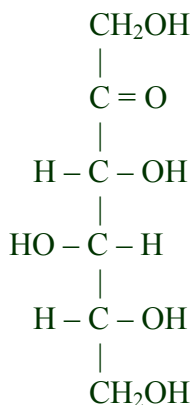


Questions with Answers- Carbohydrates

A. The following structure is D-sorbose. (Questions 1–7)



1. _____ Which characteristic is different when comparing the open-chain forms of D-sorbose and D-ribose?
 - a) **the number of primary alcohol groups.**
 - b) the number of secondary alcohol groups.
 - c) the number of stereogenic centers.
 - d) the number of carbonyl groups.

2. _____ Which characteristic is shared by the ring forms of D-sorbose and D-galactose?
 - a) Both contain a hemiacetal bond.
 - b) Both exist mainly as furanoses.
 - c) **Both can undergo mutarotation.**
 - d) Both are stable at neutral pH.

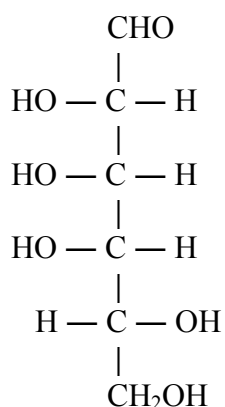
3. _____ Which describes the relationship between D-sorbose and D-fructose?
 - a) They are diastereomers that are also epimers.
 - b) **They are diastereomers but not epimers.**
 - c) They are epimers but not diastereomers.
 - d) They are neither epimers nor diastereomers.

4. _____ The enantiomer of D-sorbose
 - a) is a D-sugar that has opposite configuration around one carbon.
 - b) is a D-sugar that has opposite configuration around three carbons.
 - c) is an L-sugar that has opposite configuration around one carbon.
 - d) **is an L-sugar that has opposite configuration around three carbons.**

5. _____ Which reagent will oxidize D-sorbose?
 - a) **alkaline cupric ion**
 - b) bromine water
 - c) lithium borohydride
 - d) phenylhydrazine

6. _____ When 3.0 moles of D-sorbose are completely oxidized by periodate,
- six moles of formaldehyde are produced.*
 - six moles of carbon dioxide are produced.
 - twelve moles of formic acid are produced.
 - twelve moles of periodate are consumed.
7. _____ When comparing D-sorbose with D-glucose,
- they have the same number of equatorial substituents.
 - they have the same number of epimers.
 - they have the same chemical formula.*
 - they have the same osazone.
-

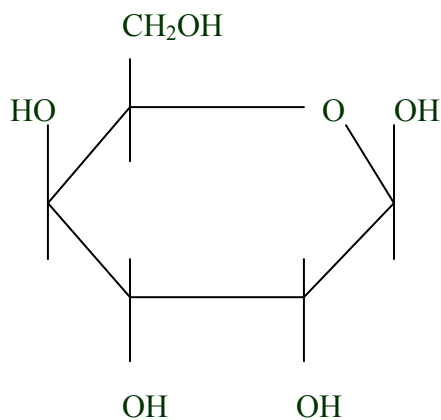
B. The following structure is D-talose. (Questions 8-13)



8. _____ When comparing D-talose to D-fructose,
- D-gulose has the same number of aldehyde groups as D-fructose.
 - D-gulose has the same number of carbon atoms as D-fructose.*
 - D-gulose has the same number of primary alcohol groups as D-fructose.
 - D-gulose has the same number of secondary alcohol groups as D-fructose.
9. _____ When comparing D-talose to D-ribose,
- D-ribose has more anomers than D-gulose.
 - D-ribose has more epimers than D-gulose.
 - D-gulose has more diastereomers than D-ribose.*
 - D-gulose has more enantiomers than D-ribose.
10. _____ What is the relationship between D-talose and D-galactose?
- They are C-2 epimers.*
 - They are C-3 epimers.
 - They are C-4 epimers.
 - They are diastereomers but not epimers.

11. _____ The open-chain structure of L-talose
- a) has three OH groups pointing left.
 - b) has one OH group pointing left.**
 - c) has four OH groups pointing left.
 - d) has two OH groups pointing left.
12. _____ Which of the following is a reaction of D-talose?
- a) It will be converted into an alditol by phenylhydrazine.
 - b) It will be converted into an osazone by bromine water.
 - c) It will be converted into an aldonic acid by borohydride.
 - d) It will be converted into an aldaric acid by nitric acid.**
13. _____ When 2.0 moles of D-talose are completely oxidized by periodate
- a) 2 moles of CO_2 are produced.
 - b) 2 moles of HCOOH are produced.
 - c) 2 moles of IO_4^- are consumed.
 - d) 2 moles of HCHO are produced.**
-

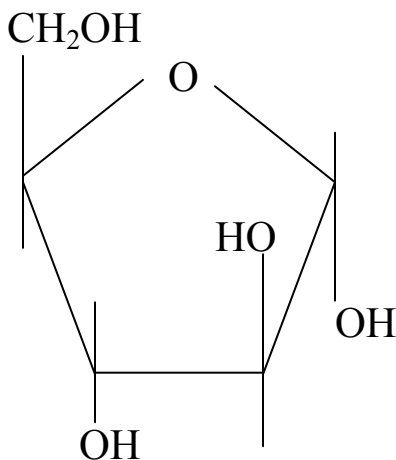
C. The following is the structure of D-gulose. (Questions 14-21)



14. _____ The complete name of this structure is
- a) α -D-gulopyranose.
 - b) β -D-gulopyranose.**
 - c) α -D-gulofuranose.
 - d) β -D-gulofuranose.
15. _____ What characteristic is shared by D-gulose and D-glucose?
- a) They both are non-reducing sugars.
 - b) They both contain a glycosidic bond.
 - c) They both form pyranoses which are mirror images.
 - d) They both have two anomeric forms.**

16. _____ When D-gulose is written in the open-chain form
- a) four OH groups are on the right and one OH group is on the left.
 - b) three OH groups are on the right and one OH group is on the left.**
 - c) three OH groups are on the right and two OH groups are on the left.
 - d) two OH groups are on the right and two OH groups are on the left.
17. _____ When D-gulose forms a ring structure,
- a) a ketone and a hydroxyl group react to form a hemiketal.
 - b) the ring is unstable at neutral pH.**
 - c) the ring contains four stereogenic centers.
 - d) an intramolecular reaction creates a glycosidic bond.
18. _____ The anomeric forms of D-gulose
- a) can mutarotate between two open-chain forms.
 - b) have different configurations around all the chiral carbons.
 - c) have different numbers of axial substituents.**
 - d) will be present in equal amounts in an equilibrium solution of D-gulose.
19. _____ When D-gulose is treated with Benedict's reagent,
- a) it will oxidized into an aldonic acid.**
 - b) it will be reduced into an alditol.
 - c) it will be oxidized into an aldaric acid.
 - d) a new stereogenic center will be created.
20. _____ When comparing D-gulose and a D-ketohexose
- a) both can interconvert between α and β forms.**
 - b) both form ring structures that are planar.
 - c) both form ring structures in which C-1 is anomeric.
 - d) both form ring structures with four OH groups directly attached to the ring.
21. _____ If D-gulose is converted into a monosaccharide derivative,
- a) it forms an amino sugar that has an overall negative charge.
 - b) it form a sugar phosphate that could have L-configuration.
 - c) it forms a glycoside that contains a carboxyl group.
 - d) it forms a deoxy sugar that could mutarotate.**
-

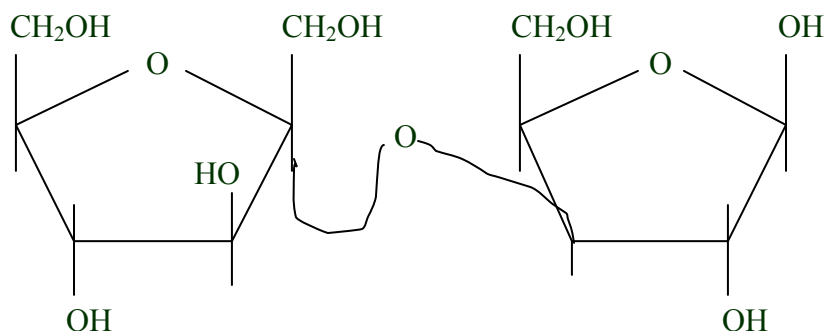
D. The following structure is a ring form of D-arabinose. (Questions 22-28)



22. _____ The name of this structure is
a) ***α -D-arabinofuranose***
b) β -D-arabinofuranose
c) α -D-arabinopyranose
d) β -D-arabinopyranose
23. _____ What is the relationship between D-arabinose and D-ribose?
a) They are enantiomers that both give a positive reaction with Tollen's reagent.
b) ***They are epimers that both give a positive reaction with Benedict's reagent.***
c) They are anomers that both form ring structures with a chiral carbon-1.
d) They are diastereomers that both contain an acetal bond.
24. _____ When D-arabinose is written in its open-chain form
a) the hydroxyls on C-2 and C-4 point right while the hydroxyl on C-3 points left.
b) the hydroxyls on C-2 and C-4 point left while the hydroxyl on C-3 points right.
c) ***the hydroxyls on C-3 and C-4 point right while the hydroxyl on C-2 points left.***
d) the hydroxyls on C-3 and C-4 point left while the hydroxyl on C-2 points right.
25. _____ Which is a property of D-arabinose?
a) An alcohol and an aldehyde can react to form an intramolecular glycosidic bond.
b) ***There are more stereogenic centers in a ring form than in an open-chain form.***
c) Mutarotation creates a mixture with equal amounts of open-chain and ring forms.
d) Mutarotation allows interconversion between a D-aldopentose and an L-aldopentose.

26. _____ The α anomer and the β anomer of D-arabinose
- are two unstable ring structures that are mirror images.
 - contain axial or equatorial carbonyl groups.
 - contain different numbers of hydroxyl groups.
 - have different configurations around only one carbon atom.*
27. _____ Which derivative of D-arabinose will be negatively charged at pH=7.0?
- deoxy sugar
 - amino sugar
 - sugar acid*
 - sugar alcohol
28. _____ Which of the following properties is shared by both D-arabinose and D-glucose?
- Both form ring structures with the formula $(CH_2O)_n$.*
 - Both form planar structures that contain a hemiacetal bond.
 - Both form chair structures that contain four anomeric OH groups.
 - Both form furanose structures that are non-reducing sugars.

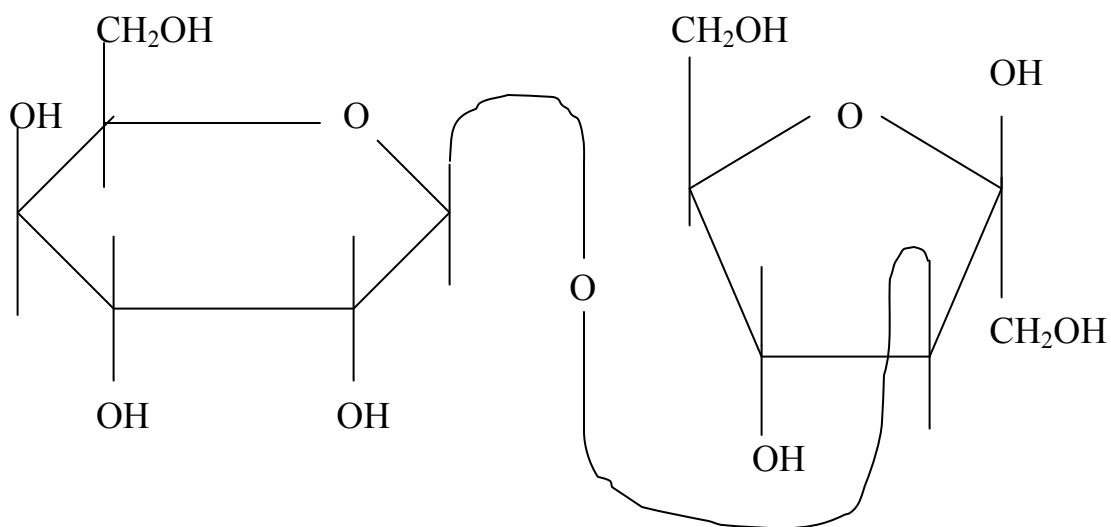
- E. The following disaccharide is named D-fannose.
(Questions 29-34)



29. _____ This structure
- is α -D-fannose containing an epimer of D-fructose.
 - is α -D-fannose containing an epimer of D-ribose.
 - is β -D-fannose containing an epimer of D-ribose.*
 - is β -D-fannose containing an epimer of D-fructose.
30. _____ What type of glycosidic bond exists in this disaccharide?
- β 1,3
 - β 2,3
 - α 1,3
 - α 2,3*

31. _____ The glycosidic bond in D-fannose
- is a covalent acetal linkage.
 - allows the aldopentose ring to open.**
 - contains two anomeric carbon atoms.
 - can mutarotate between α and β orientations.
32. _____ When D-fannose is treated with dimethylsulfate and strong acid, one of the products will be
- a 1, 3, 4, 5-tetra-O-methyl ketohexose.
 - a 2, 3, 4, 5-tetra-O-methyl ketohexose.
 - a 1, 3, 4, 6-tetra-O-methyl ketohexose.**
 - a 2, 3, 4, 6-tetra-O-methyl ketohexose.
33. _____ Which is a difference when comparing D-fannose and D-lactose?
- Only D-fannose contains one furanose and one pyranose.
 - Only D-fannose contains one permanently closed ring with a ketal bond.**
 - Only D-lactose will react with bromine water to create a sugar acid.
 - Only D-lactose is a reducing sugar with anomeric forms.
34. _____ Which property does D-fannose share with the carbohydrate prosthetic group of a glycoprotein?
- Both are hydrophilic biomolecules.**
 - Both are branched biomolecules.
 - Both are stable in acid and in base.
 - Both contain an aldose and a ketose.

F. The following disaccharide is named D-avatoose. (Questions 35-40)



35. _____ What monosaccharides will be produced upon acid hydrolysis of D-avatoose?
- a) D-galactose and D-fructose
 - b) D-galactose and an epimer of D-fructose
 - c) an epimer of D-galactose and an epimer of D-fructose
 - d) *D-fructose and an epimer of D-galactose***
36. _____ This structure
- a) is α -D-avatoose which contains a β 1,3 glycosidic bond.
 - b) is α -D-avatoose which contains a β 1,2 glycosidic bond.
 - c) *is β -D-avatoose which contains a β 1,3 glycosidic bond.***
 - d) is β -D-avatoose which contains a β 1,2 glycosidic bond.
37. _____ The glycosidic bond in D-avatoose
- a) connects two anomeric carbon atoms.
 - b) allows the aldohexose ring to open.
 - c) is formed by a reaction between two alcohol groups.
 - d) *is a covalent acetal bond that is stable at neutral pH.***
38. _____ D-avatoose and D-maltose
- a) *both have α and β anomers that can mutarotate.***
 - b) both contain a hemiketal bond in their structures.
 - c) both have a potential aldehyde group that can be oxidized.
 - d) both contain one pyranose and one furanose.
39. _____ D-avatoose and D-sucrose
- a) *both contain an aldose component and a ketose component.***
 - b) both give the same products when reacted with dimethyl sulfate.
 - c) both are reducing sugars that are hydrophilic molecules.
 - d) both are cleaved under acidic conditions and basic conditions.
40. _____ When comparing D-avatoose with a typical oligosaccharaide prosthetic group of a glycoprotein,
- a) only D-avatoose could contain a β glycosidic bond.
 - b) *only the oligosaccharide could be charged at pH = 7.0.***
 - c) only D-avatoose could contain different types of monsaccharides.
 - d) only the oligosaccharide could have a permanently closed ring.

G. Amylopectin and cellulose are compared. (Questions 41-45)

41. _____ Both these polysaccharides
- a) have extended linear shapes.
 - b) function as structural components.
 - c) contain α -glycosidic bonds.
 - d) *contain 1,4-glycosidic bonds.***

42. _____ Which property is shared by these polysaccharides?
- a) **Both are composed entirely of D-glucose.**
 - b) Both are heteropolysaccharides.
 - c) Both contain negatively charged groups.
 - d) Both are branched structures.
43. _____ Which product could be formed from the breakdown of these polysaccharides?
- a) Cellulose could be broken down into sucrose.
 - b) Cellulose could be broken down into chitin.
 - c) **Amylopectin could be broken down into maltose.**
 - d) Amylopectin could be broken down into glucosamine.
44. _____ When comparing cellulose to a bacterial cell wall,
- a) only cellulose contains a monosaccharide derivative.
 - b) only the cell wall contains β -glycosidic bonds.
 - c) only cellulose has an exact molecular weight.
 - d) **only the cell wall contains peptide crosslinks.**
45. _____ Which characteristic distinguishes amylopectin and glycogen?
- a) They have different types of glycosidic bonds.
 - b) **They have different degrees of branching.**
 - c) Only amylopectin can form hydrogen bonds.
 - d) Only glycogen has a coiled shape.
-

H. Amylose and cellulose are compared. (Questions 46-49)

46. _____ Which property is shared by these two polysaccharides?
- a) Both function mainly in energy storage.
 - b) Both have coiled shapes.
 - c) **Both are homopolysaccharides.**
 - d) Both have the same molecular weight.
47. _____ Which property differs between these two polysaccharides?
- a) the monosaccharide components
 - b) **the orientation of the glycosidic bonds**
 - c) the degree of branching
 - d) the carbons linked by the glycosidic bonds
48. _____ When comparing amylose to glycogen,
- a) only amylose contains hydrogen bonds.
 - b) only glycogen contains a reducing end.
 - c) only amylose contains 1,4 glycosidic bonds.
 - d) **only glycogen contains 1,6 glycosidic bonds.**

49. _____ When comparing cellulose to chitin,
- a) *only chitin contains a monosaccharide derivative.*
 - b) only chitin can be hydrolyzed to produce glucose.
 - c) only cellulose can be negatively charged.
 - d) only cellulose contains peptide crosslinks.