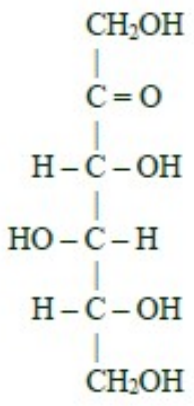
Questions with Answers - Carbohydrates

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 neutal 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

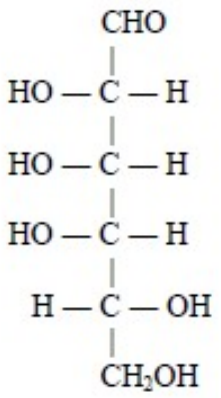
6._____ When 3.0 moles of D-sorbose are completely oxidized by periodate,

a) ***six moles of formaldehyde are produced.***
b) six moles of carbon dioxide are produced.
c) twelve moles of formic acid are produced.
d) twelve moles of periodate are consumed.

7._____ When comparing D-sorbose with D-glucose,

a) they have the same number of equatorial substituents.
b) they have the same number of epimers.
c) ***they have the same chemical formula.***
d) they have the same osazone.

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



8. _____ When comparing D-talose to D-fructose,

a) D-gulose has the same number of aldehyde groups as D-fructose.
b) ***D-gulose has the same number of carbon atoms as D-fructose.***
c) D-gulose has the same number of primary alcohol groups as D-fructose.
d) D-gulose has the same number of secondary alcohol groups as D-fructose.

9. _____ When comparing D-talose to D-ribose,

a) D-ribose has more anomers than D-gulose.
b) D-ribose has more epimers than D-gulose.
c) ***D-gulose has more diastereomers than D-ribose.***
d) D-gulose has more enantiomers than D-ribose.

10._____ What is the relationship between D-talose and D-galactose?

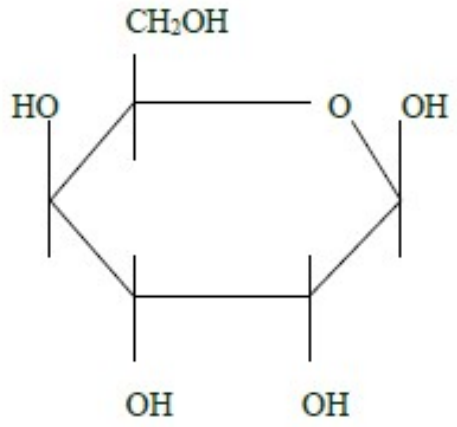
a) ***They are C-2 epimers.***
b) They are C-3 epimers.
c) They are C-4 epimers.
d) They are diastereomers but not epimers.

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.

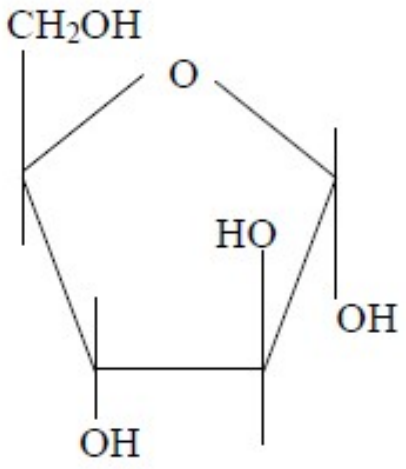
20.____ When comparing D-gulose and a D-ketohexose

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.

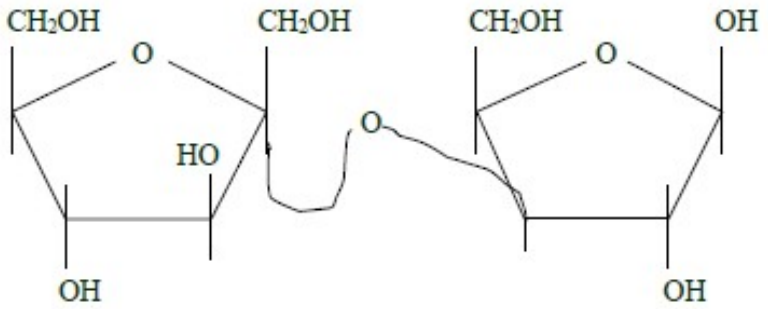
25._____ Which is a property of D-arabinose?
a) An alcohol and an aldehyde can react to form an intramolecular glycosidic bond.
b) ***There are more stereogenic centers in a ring form than in an open-chain form***.
c) Mutarotation creates a mixture with equal amounts of open-chain and ring forms.
d) Mutarotation allows interconversion between a D-aldopentose and an L-aldopentose.

26._____ The α anomer and the β anomer of D-arabinose
a) are two unstable ring structures that are mirror images.
b) contain axial or equatorial carbonyl groups.
c) contain different numbers of hydroxyl groups.
d) ***have different configurations around only one carbon atom.***

27._____ Which derivative of D-arabinose will be negatively charged at pH=7.0?
a) deoxy sugar
b) amino sugar
c) ***sugar acid***
d) sugar alcohol

28. _____ Which of the following properties is shared by both D-arabinose and D-glucose?
a) ***Both form ring structures with the formula $(CH_2O)_n$.***
b) Both form planar structures that contain a hemiacetal bond.
c) Both form chair structures that contain four anomeric OH groups.
d) Both form furanose structures that are non-reducing sugars.

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



29._____ This structure
a) is α-D-fannose containing an epimer of D-fructose.
b) is α-D-fannose containing an epimer of D-ribose.
c) ***is β-D-fannose containing an epimer of D-ribose.***
d) is β-D-fannose containing an epimer of D-fructose.

30._____ What type of glycosidic bond exists in this disaccharide?
a) β 1,3
b) β 2,3
c) α 1,3
d) ***α 2,3***

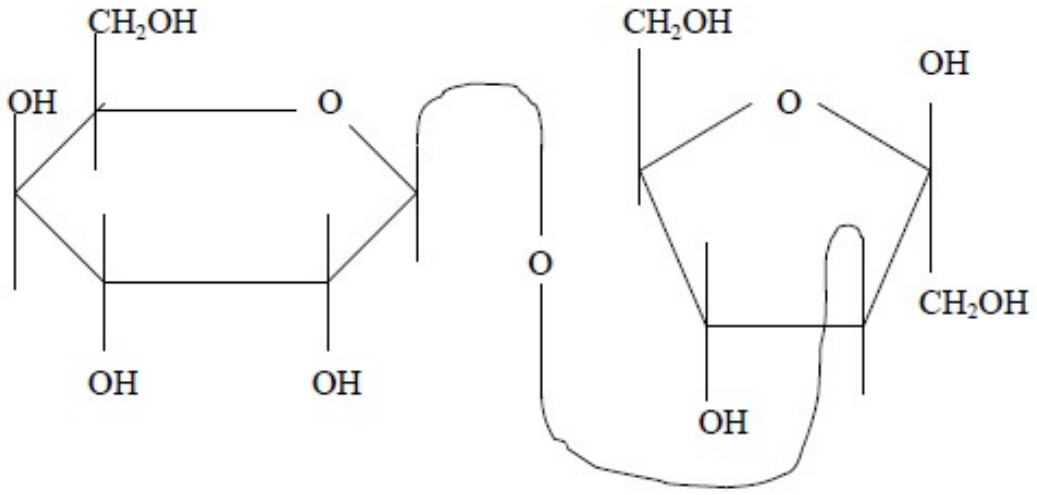
31._____ The glycosidic bond in D-fannose
a) is a covalent acetal linkage.
b) ***allows the aldopentose ring to open.***
c) contains two anomeric carbon atoms.
d) can mutarotate between α and β orientations.

32._____ When D-fannose is treated with dimethylsulfate and strong acid, one of the products will be
a) a 1, 3, 4, 5-tetra-O-methyl ketohexose.
b) a 2, 3, 4, 5-tetra-O-methyl ketohexose.
c) ***a 1, 3, 4, 6-tetra-O-methyl ketohexose.***
d) a 2, 3, 4, 6-tetra-O-methyl ketohexose.

33._____ Which is a difference when comparing D-fannose and D-lactose?
a) Only D-fannose contains one furanose and one pyranose.
b) ***Only D-fannose contains one permanently closed ring with a ketal bond.***
c) Only D-lactose will react with bromine water to create a sugar acid.
d) 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?
a) ***Both are hydrophilic biomolecules.***
b) Both are branched biomolecules.
c) Both are stable in acid and in base.
d) Both contain an aldose and a ketose.

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



35. _____ What monosaccharides will be produced upon acid hydrolysis of D-avatose?
   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-avatose which contains a β 1,3 glycosidic bond.
   b) is α-D-avatose which contains a β 1,2 glycosidic bond.
   c) ***is β-D-avatose which contains a β 1,3 glycosidic bond.***
   d) is β-D-avatose which contains a β 1,2 glycosidic bond.

37._____ The glycosidic bond in D-avatose
   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-avatose 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-avatose 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-avatose with a typical oligosaccharaide prosthetic group of a glycoprotein,
   a) only D-avatose could contain a β glycosidic bond.
   b) ***only the oligosaccharide could be charged at pH = 7.0.***
   c) only D-avatose 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.