**CHE 102 - Practice Exam - Carbohydrates - S22 - ver 1** Score: _____/0

Name: _____ Class: _____ Date: _____

**Read each question carefully. Some questions have multiple parts. Answer all questions with complete sentences.**

1. What feature(s) do all carbohydrates have in common?

2. Carbohydrates are the most abundant organic chemicals in nature, therefore they must be molecules of exceptional utility and importance. Discuss (ie sentences explaining why) two reasons carbohydrates are an important class of organic molecules.

3. Discuss briefly the 3 most important functions of Carbohydrates for life.

   (a)

   (b)

   (c)

4. What are the (3) signs that an oxidation reaction has occurred?

5. What are the (3) signs that an reduction reaction has occurred?

6. While carbohydrates are an important source of energy for the body, lipds (fats) contain more energy then carbohydrates. Give two reasons why.

7. What type of bond is formed when two monosaccharides are connected together to form a disaccharide according to (a) chemists, and (b) biologists?

8. Name either (A) 3 most common monosaccharides (B) 3 most common disaccharides **AND** something important about them.

9. Draw an example of each of the following molecules. Answer any additional questions given.

   (a) A D-aldohexose. Circle the part that makes it a D-isomer

   (b) A D-ketopentose. Circle the part that makes it a D-isomer

   (c) Draw $\alpha$-D-Talopyranose. Circle the part that makes it $\alpha$

   (d) $\beta$-D-Glucopyranose (draw an arrow to the hemiacetal carbon)

   (e) $\alpha$-D-Mannoyranosyl-(1,3)-$\beta$-D-Idopyranose

   (f) $\beta$-D-Iodopyranosyl-(1,4)-B-D-Glucopyranose

10. Draw a $\alpha$-D-Iodopyranosyl-(1,3)-$\beta$-D-Mannopyranose. Draw and label an arrow pointing to the hemiacetal carbon, the acetal carbon, **AND** the carbon capapble of mutarotation.

11. Draw $\alpha$-D-talopyranosyl-(1,3)-$\alpha$-D-mannopyranose.

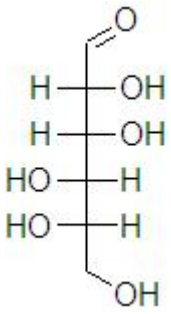
12. Draw the disaccharide $\beta$-D-gulopyranosyl-1,3-$\alpha$-D-mannopyranose. Draw and label an arrow pointing to any carbons that are hemiacetals, acetals, hemiketals or ketals. Is this a reducing sugar? Explain.

13. What type of reaction occurred to form the disaccharide? What functional group is formed (according to chemists? according to biologists?)

14. Draw and Label an example of (a) Hemiacetal (b) Hemiketal (c) Acetal (d) Ketal

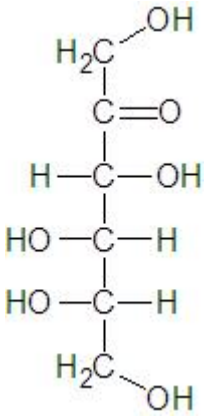
15. Circle **ALL** of the following choices that can be used to describe the molecule shown below.

    D-isomer, L-isomer, $\alpha$-anomer, $\beta$-anomer, furanose, pyranose, (+), (−), triose, tetrose, pentose, hexose, aldose, ketose.



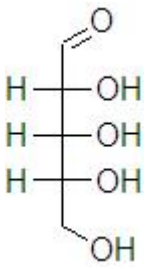

16. Circle **ALL** of the following choices that can be used to describe the molecule shown below.

    D-isomer, L-isomer, $\alpha$-anomer, $\beta$-anomer, furanose, pyranose, (+), (−), triose, tetrose, pentose, hexose, aldose, ketose.

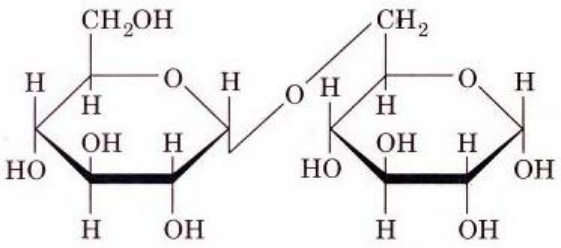


17. Circle **ALL** of the following choices that can be used to describe the molecule shown below.

D-isomer, L-isomer, $\alpha$-anomer, $\beta$-anomer, furanose, pyranose, (+), (−), triose, tetrose, pentose, hexose, aldose, ketose.



18. Answer the following questions about the disaccharide drawn below:



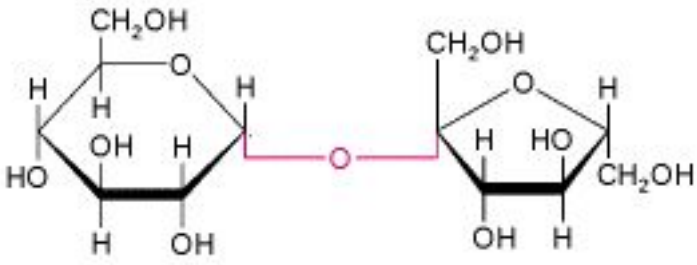
(a) What type of glycosidic bond is between the two molecules? 18(a) _____

(b) Draw and label an arrow pointing to any carbons that are hemiacetals, acetals, hemiketals or ketals.

(c) Which anomer of the molecule is shown, $\alpha$ or $\beta$? Explain. 18(c) _____

(d) Is this a reducing sugar? Explain. 18(d) _____

19. Answer the following questions about the disaccharide drawn below:



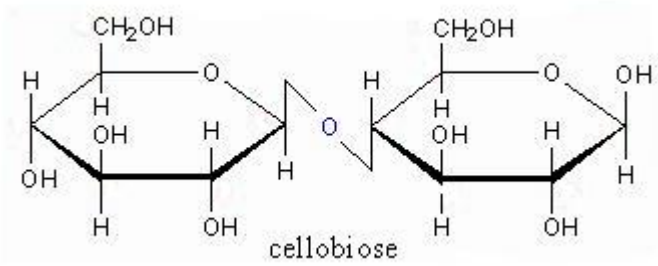
(a) What type of glycosidic bond is between the two molecules? 19(a) _____

(b) Draw and label an arrow pointing to any carbons that are hemiacetals, acetals, hemiketals or ketals.

(c) Which anomer of the molecule is shown, $\alpha$ or $\beta$? Explain. 19(c) _____

(d) Is this a reducing sugar? Explain. 19(d) _____

20. Answer the following questions about the disaccharide drawn below:




(a) What type of glycosidic bond is between the two molecules? 20(a) _____

(b) Place a cicle around any carbon atom(s) that are the center of a hemiacetal.

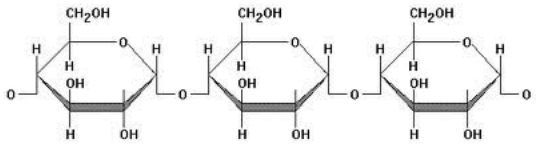
(c) Place a square around any carbon atom(s) that are the center of an acetal.

(d) Which anomer of the molecule is shown, $\alpha$ or $\beta$? Explain. 20(d) _____

(e) Is this a reducing sugar? Explain. 20(e) _____

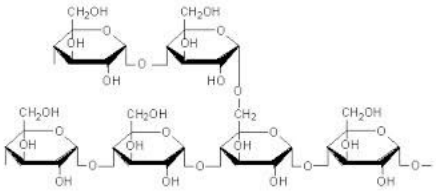
21. Identify the following molecules as (a) Amylose, (b) Amylopectin, (c) Cellulose (d) Not identifiable. Additionally for structures a, b and c tell what type of bond is connecting each molecule together.

(a)



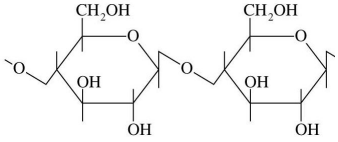

21(a) _____

(b)



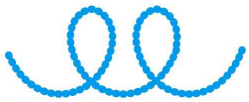

21(b) _____

(c)



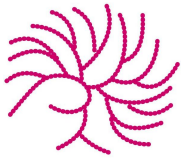

21(c) _____

(d)



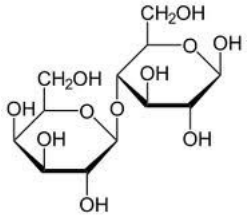
21(d) _____

(e)

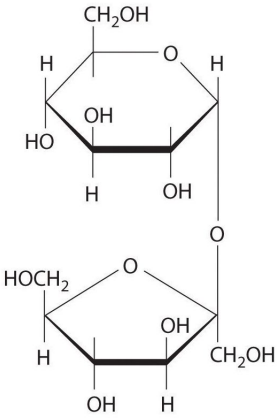


21(e) _____

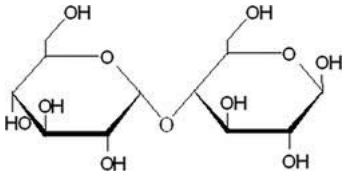
22. Identify the following molecules as (a) Maltose, (b) Lactose, (c) Sucrose (d) Not identifiable. Additionally draw and label an arrow pointing to any hemiacetal carbons.



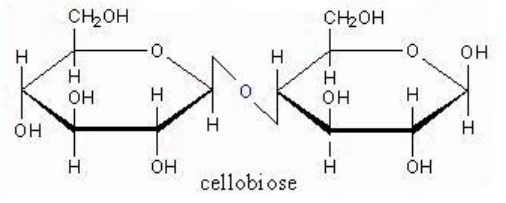
(a) 22(a) _____



(b) 22(b) _____



(c) 22(c) _____

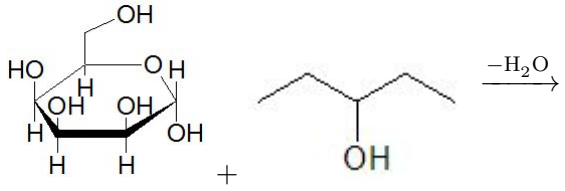


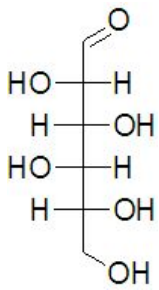

(d) 22(d) _____

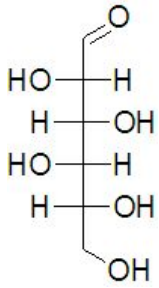
23. What is meant by the term "reducing" sugar? What 3 functional groups give a positive result (name and draw an example of each). What is one chemical test one can perform to determine if a carbohydrate is a reducing sugar, and what is the visual evidence of a positive test?

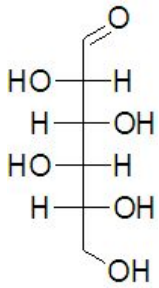
24. What is mutarotation? What functional group must be present for a disaccharide to be capable of mutarotation?

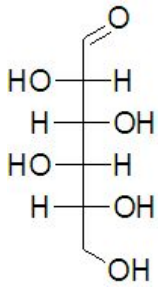
25. Complete the following reactions:

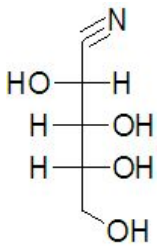
(a)  $\xrightarrow{-H_2O}$

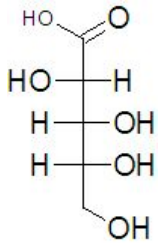
(b)  $\xrightarrow[weak]{[ox]}$

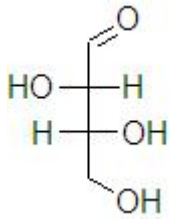
(c)  $\xrightarrow{[red]}$

(d)  $\xrightarrow[strong]{[ox]}$

(e)  $+ 2Cu^{+2} + Na^{+} + 5OH^{-} \longrightarrow$

25(f)  $\xrightarrow[H^+]{[^+H_2O]}$

(g)  $\xrightarrow{[Na(Hg)]}$

(h)  $\xrightarrow{[HCN]}$ $\xrightarrow[H^+]{[H_2O]}$ $\xrightarrow{[NaHg]}$

25(i) D-mannose $\xrightarrow{[oxid]}$

(j) L-idose $\xrightarrow{[oxid]}$

(k) $\beta$-D-galactopyranose + ethanol $\overset{[HCl]}{\rightleftharpoons}$

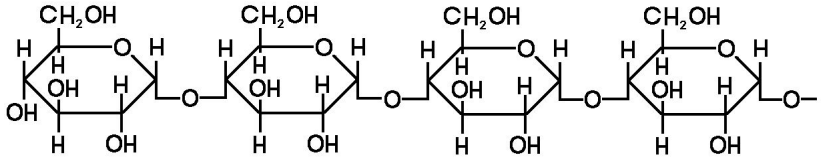
(l) D-erythrose $\xrightarrow{[HCN]}$ (Do not name the product for this reaction)

26. Small changes in the structure of a molecule can have large consequences biologically. Cite one example of this.

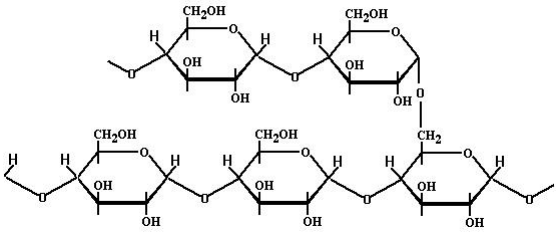
27. Answer the following questions:

27(a) Starch is a mixture of what two polysaccharides?

27(b) The following is a picture of what type of polysaccharide? Explain.



27(c) The following is a picture of what type of polysaccharide? Explain.



27(d) What is mutarotation? What functional group must be present for a disaccharide to be capable of mutarotation?

27(e) What is the difference between a D and L isomer?

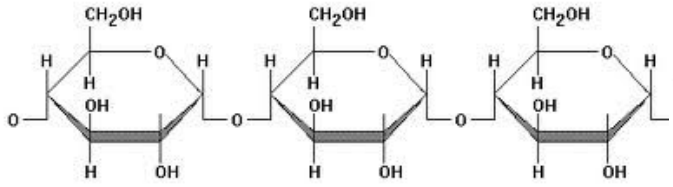
27(f) What is the difference between a furanose and a pyranose?

27(g) What is glycogen used for?

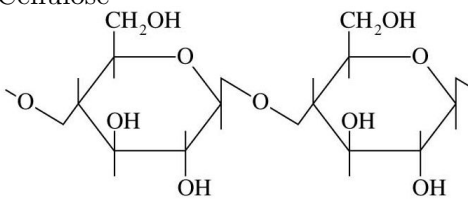
27(h) If the molecule in part (b) above where hydrolyzed what would the product be?

28. Small changes in geometry can lead to large changes in structure, chemical properties and biological properties. One example given in the book is the differences between starch (amylose) and cellulose.

Amylose



Cellulose



(a) What is the difference in the geometry of the glycosidic bond between starch and cellulose

(b) How does this effect the large scale structure/shape?

(c) How does this effect the chemical properties of the molecules?

(d) How does this effect the biological properties of the molecules?

29. Answer the following question about the Benidicts and Barfords tests.

29(a) What three functional groups give a positive result?

29(b) What is the observed change that indicates a positive test?

29(c) What chemical change occurs to the carbohydrate to produce the positive test?

29(d) What chemical change occurs to the reagent to produce the positive test?

30. Complete the table below for each test. Include what functional group/feature of the molecule it test positive (+) and negative (-) for and the visual change which indicates each.

| **Test Name** | **Positive for:** | **Visual Change** | **Negative for:** | **Visual Change** |
|---|---|---|---|---|
| Molisch Test | | | | |
| Seliwanoff Test | | | | |
| Benedict Test | | | | |
| Barfoed Test | | | | |
| Bial Test | | | | |
| Iodine Test | | | | |