CHE 102 - Extra Practice - Stereoisomers - S22 - ver 1 Score: _____/0

Name: _____ Class: _____ Date: _____

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

1. Why is the study of stereoisomers important? Explain using complete sentences.

   Enantiomers are hard to separate physically and chemically and can have very different biological properties, for drugs this could cause one E to be beneficial while the other E is detrimental.

2. Define plane-polarized light. How is plane-polarized light different then ordinary (unpolarized) light?

   Light that only vibrates in one direction, ordinary light vibrates in all directions.

3. What are the requirements for a atom to be considered chiral? Draw a example of a chiral atom.

   Makes 4 individual bonds
   Makes bonds to 4 different atoms or groups of atoms.

4. Define the term 'meso compound'? Why are they important? Draw an example of one. Why don't meso compounds rotate plane polarized light?

   A molecule that contains chiral carbons but has an additional plane of symmetry resulting in a molecule that does not rotate plane polarized light.
   Examples will vary, should indicate where the additional plane of symmetry is.
   The chiral atoms cancel each other out (one rotates light clockwise, one rotates light counterclockwise) resulting ia molecule that does not rotate plan polarized light.

5. If a molecule had 5 chiral carbons in it, how many possible stereoisomers would there be?

   2(# of chiral carbons) $2^5 = 32$! omg hopefully you don't have to draw them all! If you don't like math you can memorize the pattern:
   1 chiral carbon = $2^1 = 2$ stereoisomers
   2 chiral carbon = 2^2 =4 stereoisomers
   3 chiral carbon = 2^3 =8 stereoisomers
   4 chiral carbon = 2^4 =16 stereoisomers
   5 chiral carbon = 2^5 =32 stereoisomers

6. What is a racemic mixture? Why don't racemic mixtures rotate the plane of polarized light?

   A mixture of two enantiomers. One enantiomer rotates light clockwise, the other rotates light counterclockwise, thus canceling each other out and resulting in a solution that does not rotate plan polarized light.

7. Why don't solutions of meso compounds rotate the plane of polarized light?

   Due to the plane of symmetry - The chiral atoms cancel each other out (one rotates light clockwise, one rotates light counterclockwise) resulting ia molecule that does not rotate plan polarized light.

8. What is one major difference between the chemical synthesis of optically active molecules and the biological synthesis of optically active molecules?

   Chemically you make both enantiomers equally (unless you take special precautions). Biologically you generally make only one specific enantiomer.

9. Define the following terms:
   (a) Optically Active:

   A molecule that contains chiral carbons and can rotate plan polarized light

   (b) Dextrorotatory:

   An stereoisomer that rotates plane polarized light to the right (clockwise)

   (c) Levorotatory:

An stereoisomer that rotates plane polarized light to the left (counter-clockwise)

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

    (a) An example of molecule with a chiral atom. What are the requirement to have a chiral atom?

    A carbon atom with 4 bonds to 4 different groups.
    Answers will vary.

    (b) An example of a Meso compound. What makes it Meso?

    A molecule with a chiral carbon (normally at least 2) that contains an additional plane of symmetry.
    Answers will vary

11. Draw an example of the following:

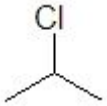
    (a) Structural Isomers

    Same Formula, Different Structures (and Physical, Chemical, Biological properties) (Technically does not have different geometry and does not rotate plan polarized light).
    Examples will vary - easiest example is butane and 2-methylpropane (same formula C_4H_{10} different structures.

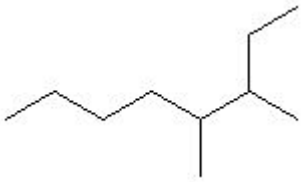
    (b) Cis/Trans Isomers (make sure to label them)

    Same formula, same structure, different geometry around the C=C. Different physical, chemical and biological properties, and does not rotate plan polarized light).
    Examples will vary.

12. Circle the chiral atom(s) in each molecule. If no chiral atoms exist, place the word "NONE" in the answer blank.

(a) 

12(a) **None**

(b) 

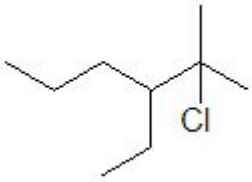
12(b) **5th and 6th carbon**

(c) 

12(c) **None**

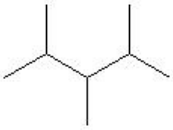
(d) 

12(d) **None**

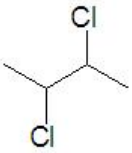
(e) 

12(e) **4th carbon**

13. Circle the chiral atom(s) in each molecule. If no chiral atoms exist, place the word "NONE" in the answer blank. Count from the left side to the right side.

(a) 

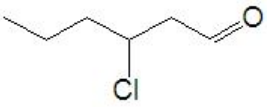
13(a) **None**

(b) 

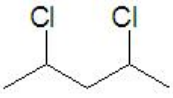
13(b) **2nd and 3rd carbon**

(c) 

13(c) **None**

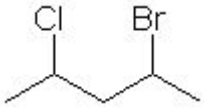
(d) 

13(d) **4th Carbon**

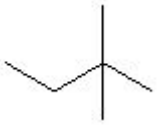
(e) 

13(e) **2nd and 4th carbon**

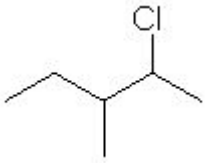
14. Circle the chiral atom(s) in each molecule. If no chiral atoms exist, place the word "NONE" in the answer blank. Count from the left side to the right side.

(a) 

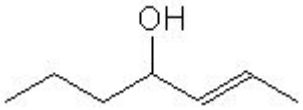
14(a) **2nd and 4th**

(b) 

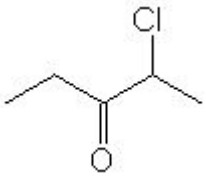
14(b) **None**

(c) 

14(c) **3rd and 4th**

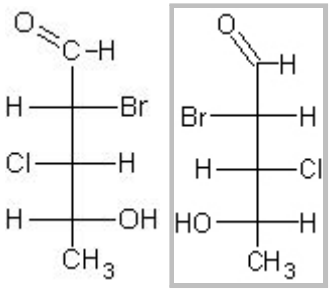
(d) 

14(d) **4th**

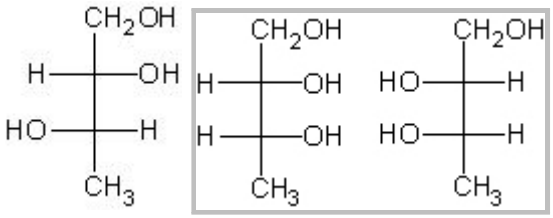
(e) 

14(e) **4th**

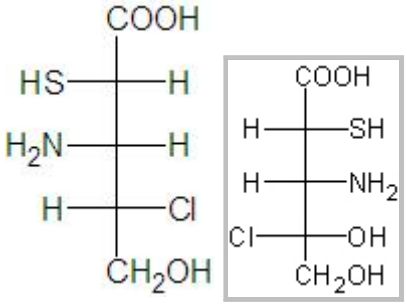
15. Draw all of the enantiomers for the following compound:



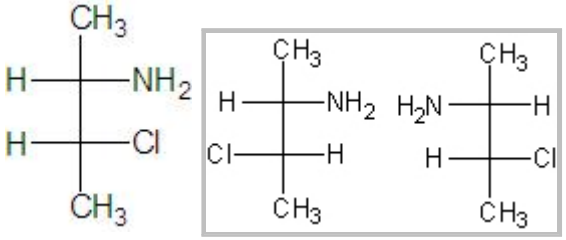
16. Draw all of the diastereomers for the following compound:



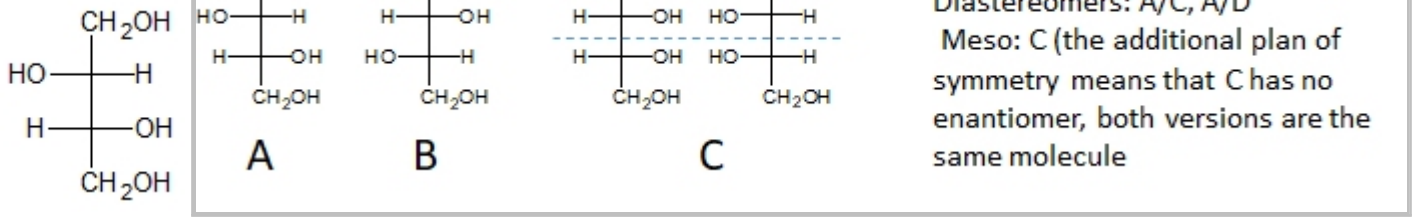
17. Draw all of the enantiomers for the following compound:



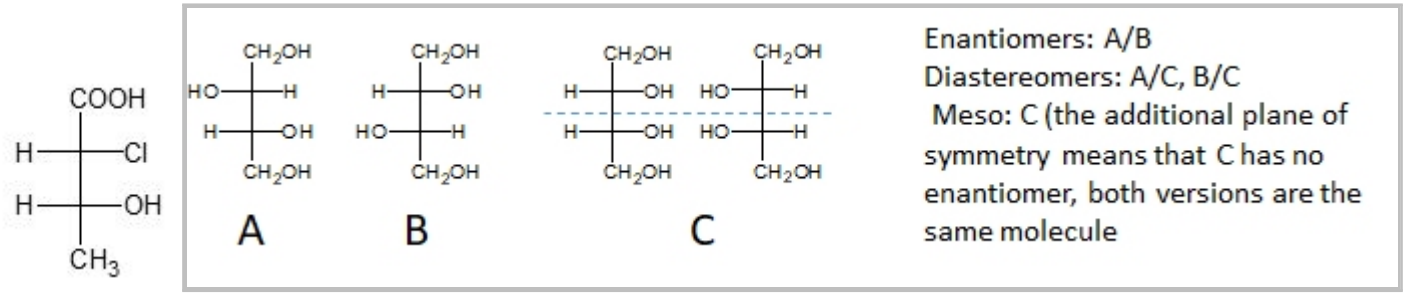
18. Draw all of the diastereomers for the following compound:



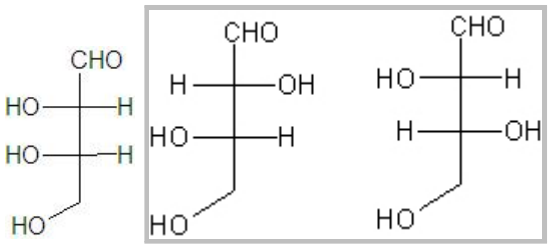
19. Draw all of the stereoisomers for the following compound. Label them A, B etc, and identify which ones are Enantiomers, Diastereomers and Meso.



20. Draw all of the stereoisomers for the following compound. Label them A, B etc, and identify which ones are Enantiomers, Diastereomers and Meso.



21. Draw all of the epimers for the following compound:


CHO
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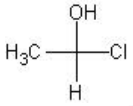
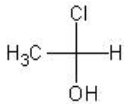
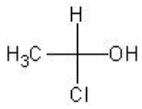
22. Are the following molecules the (S)ame or (D)ifferent from the molecule shown at the top. Explain your answers in the space provided.

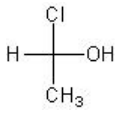


(a) 

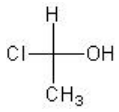
22(a) **S**

(b) 

22(b) **S**

(c) 

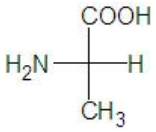
22(c) **S**

(d) 

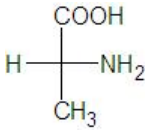
22(d) **D**

Odd # swaps = same, Even # swaps = different

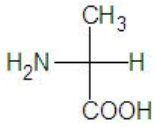
23. Identify each projection formula below as representing (+)-alanine or (−)-alanine.



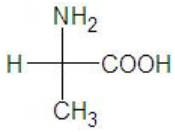
(+)-alanine



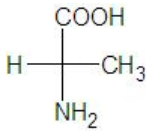
(−)-alanine.

(a) 

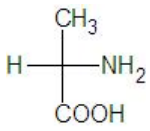
23(a) **-**

(b) 

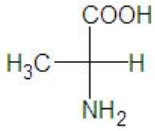
23(b) **+**

(c) 

23(c) **+**

(d) 

23(d) **+**

(e) 

23(e) **-**

24. Complete the following table with (S)ame or (D)ifferent or (NA) not applicable.

Property	Structural	Cis/Trans	Enantiomers	Diastereomers
Chemical Formula	S	S	S	S
Structure	D	S	S	S
Geometry	NA	D	D	D
Physical Properties	D	D	S	D
Chemical Properties	D	D	S	D
Biological Properties	D	D	D	D
Optical Rotation	NA	NA	D	D

25. Define the term "Enantiomer" and complete the chart below by placing an X in the appropriate boxes.

Property	Same	Different
Chemical Formula	X	
Structure	X	
Geometry		X
Physical Properties	X	
Chemical Properties	X	
Biological Properties		X
Optical Rotation		X

26. Define the term "Diastereomer" and complete the chart below by placing an X in the appropriate boxes.

Property	Same	Different
Chemical Formula	X	
Structure	X	
Geometry		X
Physical Properties		X
Chemical Properties		X
Biological Properties		X
Optical Rotation		X

27. (+)-2-methyl-1-butanol has the following properties: specific rotation = +5.76°, boiling point = 129 ℃, melting point = 54 ℃, density = 0.819 g/mL, and molecular weight = 88 g/mol. What are the corresponding physical properties for (−)-2-methyl-1-butanol?

specific rotation : -5.76°

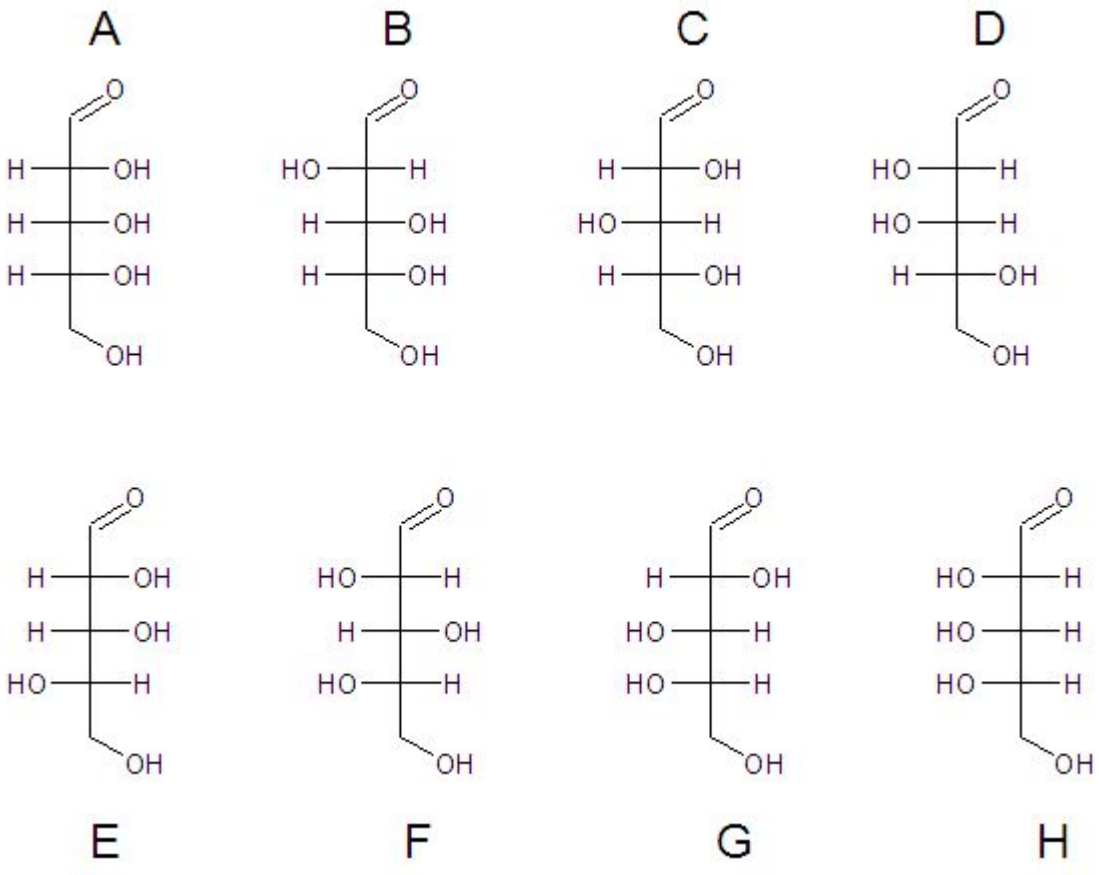
melting point: 54 ℃

boiling point: 129 ℃

density: 0.819 g/mL

molecular weight: 88 g/mol

28. Answer the following question about the stereoisomers in the figure below.



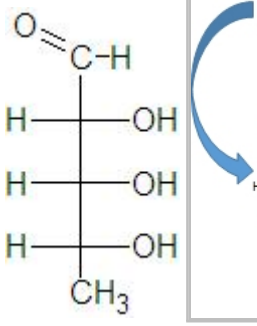
(a) Which of the molecule(s) are enantiomers of A? 28(a) **H**

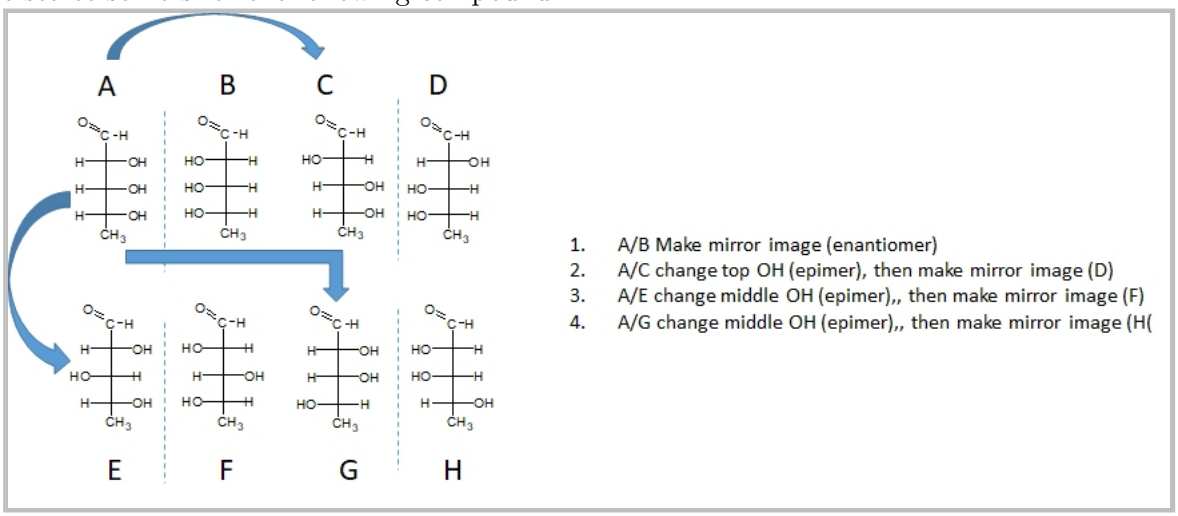
(b) Which of the molecule(s) are diastereomers of A? 28(b) **B-G**

(c) Which of the molecules(s) are meso compounds of A? 28(c) **none**

(d) Which of the molecule(s) are epimers of A? 28(d) **B,C,D**

29. Draw all of the stereoisomers for the following compound:





30. Label the stereoisomers in the previous problem A,B,C... starting with the molecule given, and answer the following questions about them:

(a) Which of the molecule(s) are enantiomers of A? 30(a) **B**

(b) Which of the molecule(s) are diastereomers of A? 30(b) **C-H**

(c) Which of the molecules(s) are meso compounds of A? 30(c) **none**

(d) Which of the molecule(s) are epimers of A? 30(d) **C,E,G**

Answers may vary depending on the order you drew your enantiomers and diastereomers for the molecule.