

Organic Chemistry I, CHEM-201
Worksheet 4
Due Date: Wednesday, Nov. 1, 2006



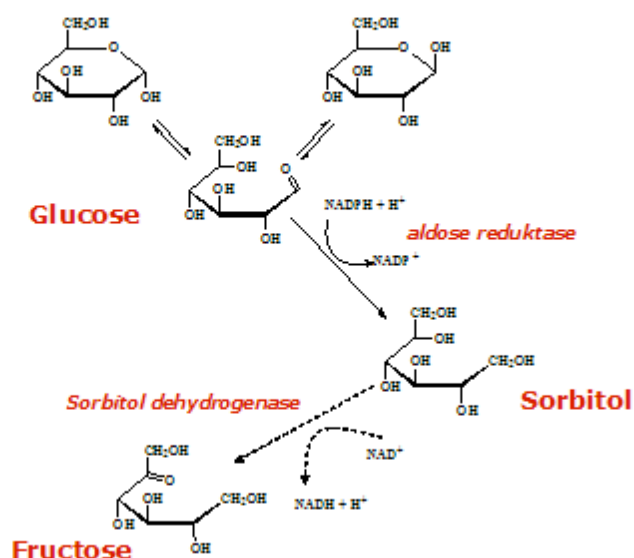
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Here is an example of how small changes in substitution and shape can affect our body chemistry. There is an important aspect of conversion of glucose to sorbitol with ensuing osmotic disturbance for people affected with diabetes. This occurs through the "polyol pathway", a normal reaction sequence in testes but not other tissues. In the first step, Glucose is converted to sorbitol by aldose reductase. The sorbitol formed is then oxidized to fructose. A problem arises when sorbitol production occurs in tissues other than testes. At high glucose levels, aldose reductase activity occurs in other organs which often lack sorbitol dehydrogenase. This leads to an accumulation of sorbitol in these tissues, notably in the lens of the eye, leading to cataract formation due to osmotic damage.

The Polyol Pathway



1. a) What functional group transformation occurs by the reaction of glucose with aldose reductase? _____

b) What functional group is shown in fructose that is not present in glucose? _____

c) What functional group does glucose and fructose share? _____

d) What is the formula of glucose? _____

e) What is the formula of sorbitol? _____

f) Redraw the acyclic form of glucose and identify each stereogenic carbon with an R or S.

g) Redraw the acyclic form of sorbitol and identify each stereogenic carbon with an R or S.

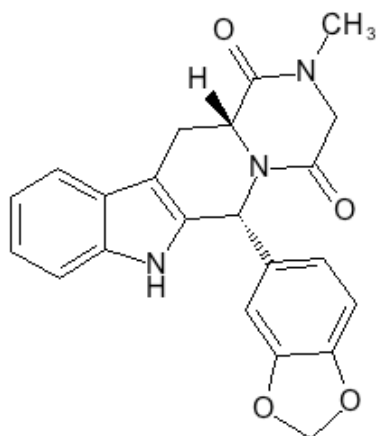
h) Draw the structure of NADH and NAD⁺

For the following questions MATCH each definition to a term from the list below. Place the letter of the term in the blank to the left of the definition.

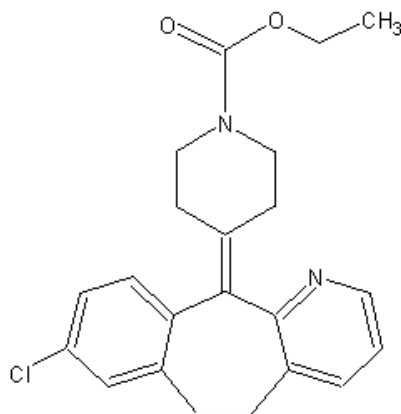
- a. racemates
- b. chirality center
- c. chirality
- d. diastereomers
- e. enantiomers
- f. meso compounds
- g. optically active
- h. prochirality center
- i. optically inactive
- j. achiral

2. _____ describes organic molecules which rotate plane-polarized light.
3. _____ is the property of "handedness"; the property of an object that causes it to be nonsuperimposable on its mirror image.
4. _____ are stereoisomers that are mirror images.
5. _____ are stereoisomers that most likely have different properties.
6. _____ are enantiomers produced in a chemical reaction.

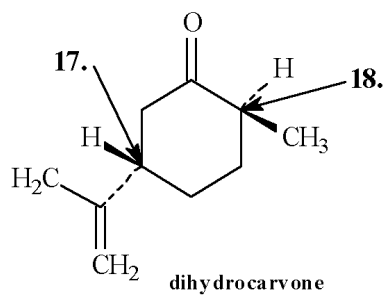
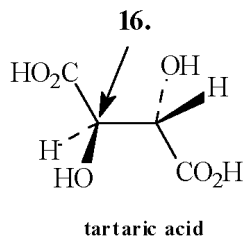
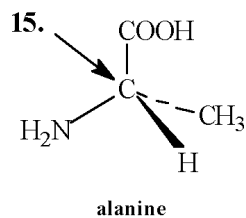
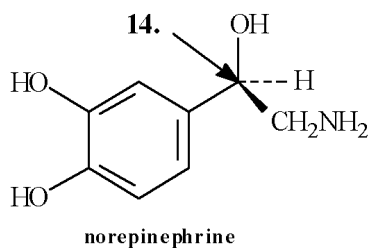
7. Place asterisks at all the chirality centers in the Cialis and Claritin molecules below.



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Assign *R*, *S* configurations to each indicated chirality center in the molecules below.



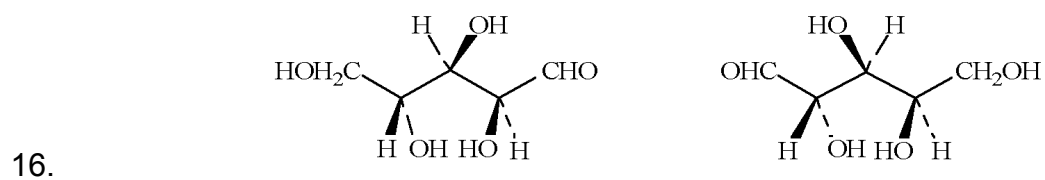
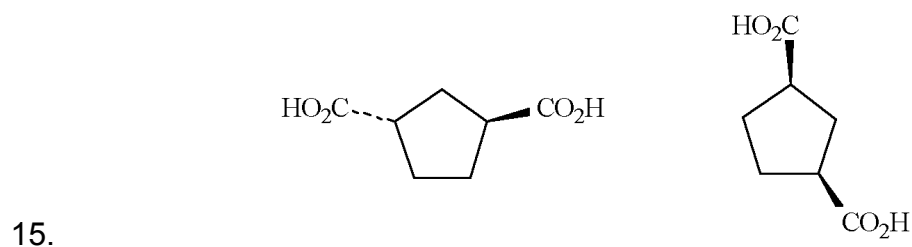
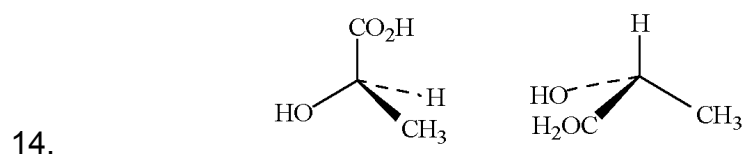
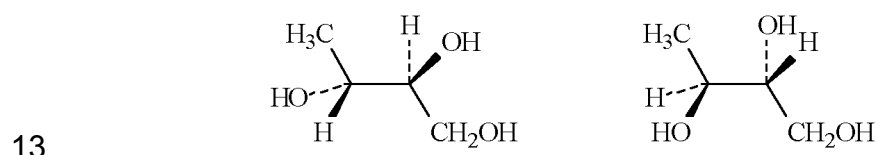
8. The configuration of this carbon atom (#14) is _____.
9. The configuration of this carbon atom (#15) is _____.
10. The configuration of this carbon atom (#16) is _____.

11. The configuration of this carbon atom (#17) is _____.
12. The configuration of this carbon atom is (#18) is _____.

Label each pair of stereoisomers below as:

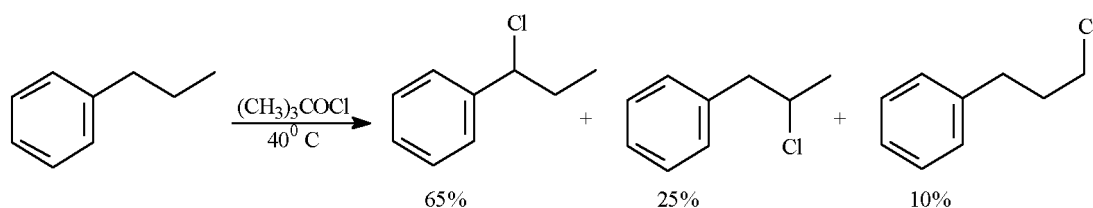
- a. enantiomers
 b. diastereomers
 c. identical

Place the letter of the correct answer in the blank to the left of the pair of stereoisomers.



17. Draw a Newman projection of the most stable conformation of (2*R*,3*R*)-2-bromo-3-chlorobutane sighting down the C2-C3 bond.

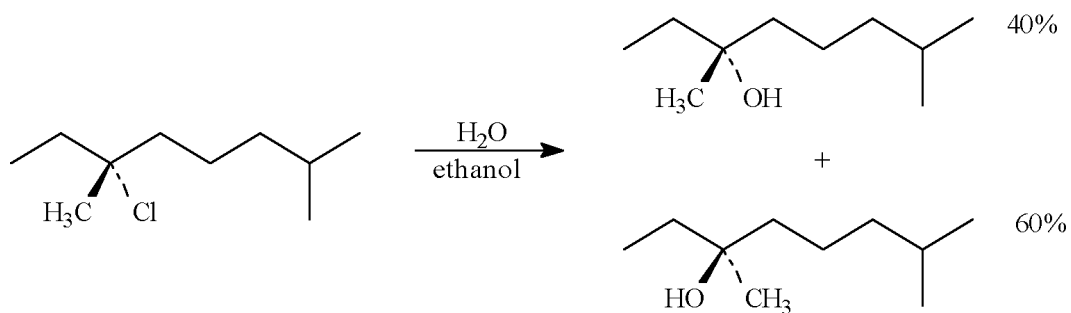
To answer the following questions consider the reaction below:



18. a) The reaction of propylbenzene with *tert*-butylhypochlorite proceeds by a radical substitution pathway. Draw the structure of the radical intermediate leading to each product.

b) Are any of the products of this reaction chiral? If so draw them and label the chirality center with an asterisk.

Consider the reaction below to answer the following questions.



19. a) Write the complete stepwise mechanism for this reaction. Clearly show the formation of both products. Show all electron flow with arrows and draw all intermediate structures.

20. a) Draw the structure of (1S, 4S)-1-ethyl-4-methylcyclohexane.

b) Draw the most stable conformation of (1S, 2S)-1-ethyl-2-propylcyclohexane.

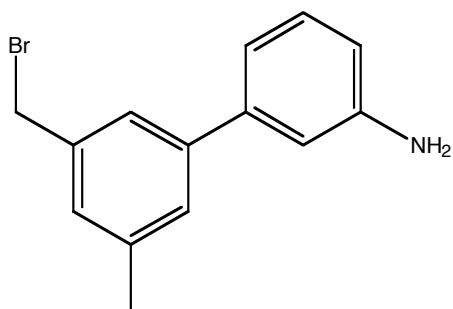
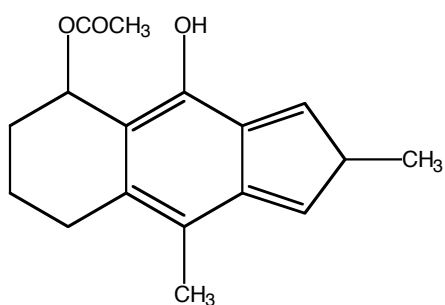
21. Draw the mechanism and product for the S_N2 reaction of potassium acetate with (S)-3-bromoheptane. Be sure to indicate any necessary stereochemical information.

22. Show the mechanism and product(s) obtained for the S_N1 reaction of (*R*)-2-bromopentane with sodium iodide.

23. a) Define the term nucleophile. List five good nucleophiles.

b) Define the term leaving group. List three good leaving groups.

c) Circle the nucleophile "part" in the following molecules and place a square around the leaving group "part" in the following molecules.



24. Starting with butane, devise a synthetic route to 2-iodobutane.

25. Draw the S_N1 mechanism for the reaction of water with (2S,4S)-2-bromo-4-methylhexane.