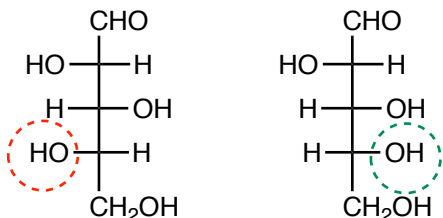


CHM 224
Test 3
Chapters 24, 21, 26

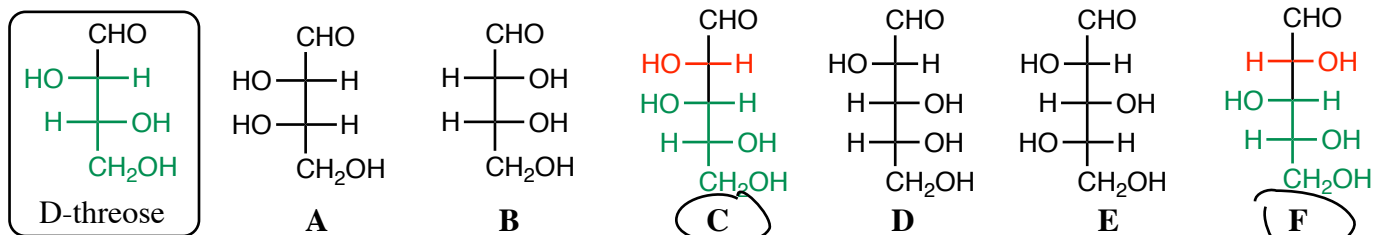
NAME:

1. Draw the Fischer projection for a naturally occurring epimer of the sugar below:



- an epimer means a structure that has several stereogenic carbons, but in which a single stereocenter has been inverted
- to be naturally occurring, the OH circled in red MUST be moved to the right hand side of the Fischer projection

2. If D-threose is subjected to a round of Kiliani-Fischer synthesis, which of the compounds below might be expected as a product (may be more than one)?



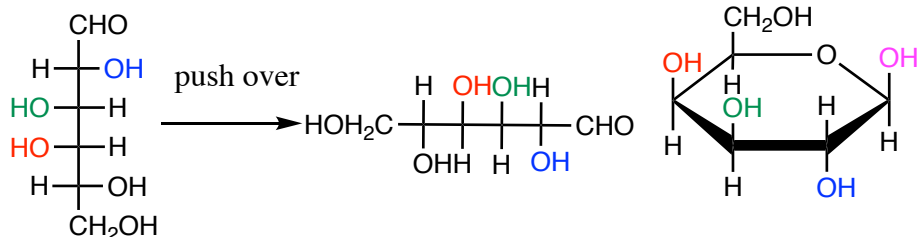
- a round of Kiliani-Fischer synthesis increases the length of the carbon chain by one (hence, from an aldotetrose to an aldopentose)
- the stereocenters in green remain identical after the K-F synthetic step
- the newly formed H-C-OH (in red) carbon can have the OH group on one side or the other

3. A carbohydrate with 8 carbons has how many oxygen atoms?

- A. 4
 B. 16
 C. 8
 D. 32

- the definition of a carbohydrate is that for every carbon in the sugar, there is the “equivalent” of an H₂O molecule in the molecular formula
- ° therefore, if there are 8 carbons, there must be 8 oxygens

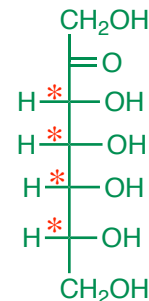
4. Draw the β -anomer for the pyranose ring formed from the sugar below using the template provided:



- this is a D-sugar, so the CH₂OH group is always in the same position as shown
- the pink OH group needs to be on “beside”, i.e., β to the CH₂OH group to be a β -anomer
- the red, green and blue OH groups are placed in position according to their orientation in the original sugar

5. How many stereogenic carbons are found in a carbohydrate that is a ketoheptose?

- a ketoheptose will have the general structure as shown to the right
- therefore, there are 4 stereogenic carbons



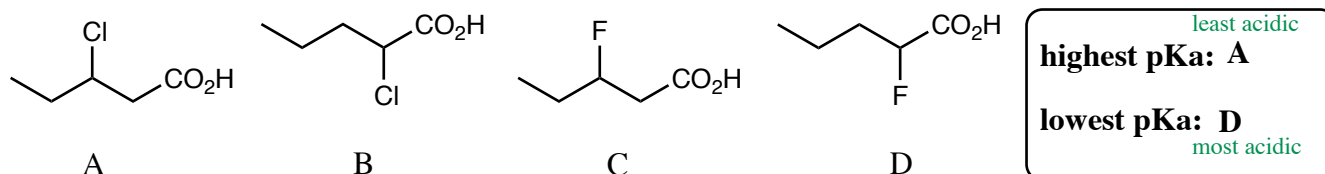
6. A pyranose ring differs from a pyranoside ring because (may be more than one):

- A. pyranose rings are reducing sugars and pyranoside rings are not
- B. pyranoside rings undergo mutarotation and pyranose rings do not
- C. pyranose rings always derive from aldoses and pyranoside always derive from ketoses
- D. pyranose rings are always α -anomers while pyranoside rings are always β -anomers

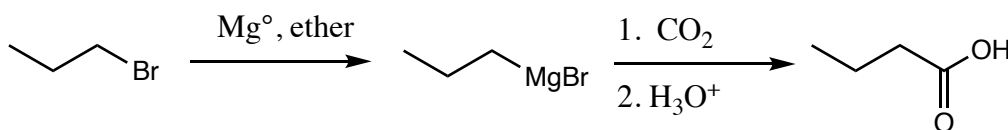
7. Answer the following questions:

- A. the name of the linkage that connects two sugar molecules: **glycoside or pyranoside**
- B. humans *cannot* metabolize complex carbohydrates containing this type of linkage: **β -linkage**
- C. chitin forms the exoskeleton of many types of: **insects**

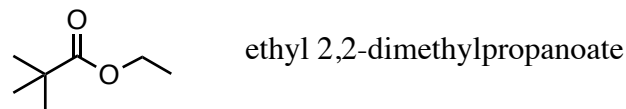
8. Which one of the following is the carboxylic acid with the **highest and lowest** pKa?



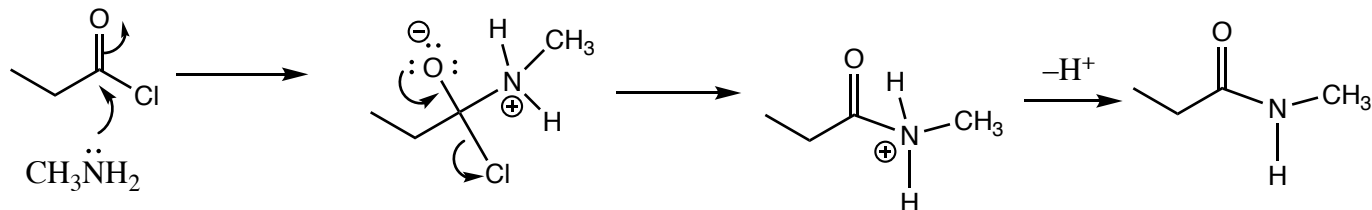
9. Complete the spaces indicated by an ? with either a reagent or a product:



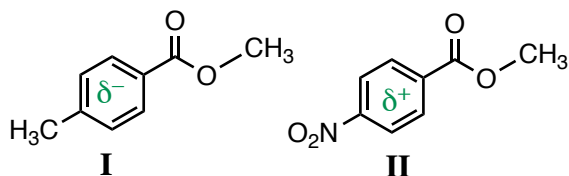
10. Provide the IUPAC name for the following compound:



11. Draw the reaction mechanism and provide the product of the following reaction:

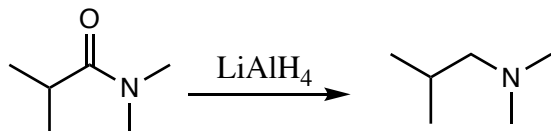


12. Which ester below would you expect to undergo hydrolysis with KOH/H₂O the fastest? Briefly explain.

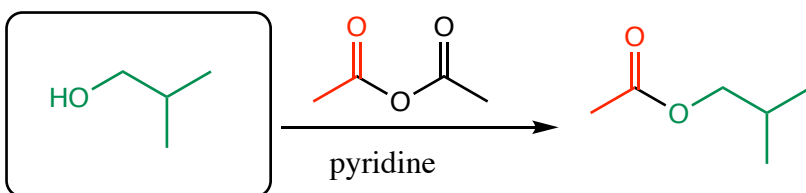


- the rate of attack of a nucleophile on the carbonyl group of an ester is determined by the attraction of the electron-rich nucleophile to the partial positive charge on the C=O group of the ester
- an electron-withdrawing nitro group imparts a δ^+ charge into the benzene ring which will **enhance** the partial positive charge on the C=O of the ester and **increase** reactivity
- an electron-donating methyl group imparts a δ^- charge into the benzene ring which will **decrease** the partial positive charge on the C=O of the ester and **decrease** reactivity
- therefore, ester II will react faster than ester I under hydrolysis conditions

13. Provide the product from the following reaction:



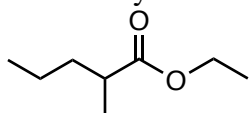
14. What starting material is required to complete the following reaction?



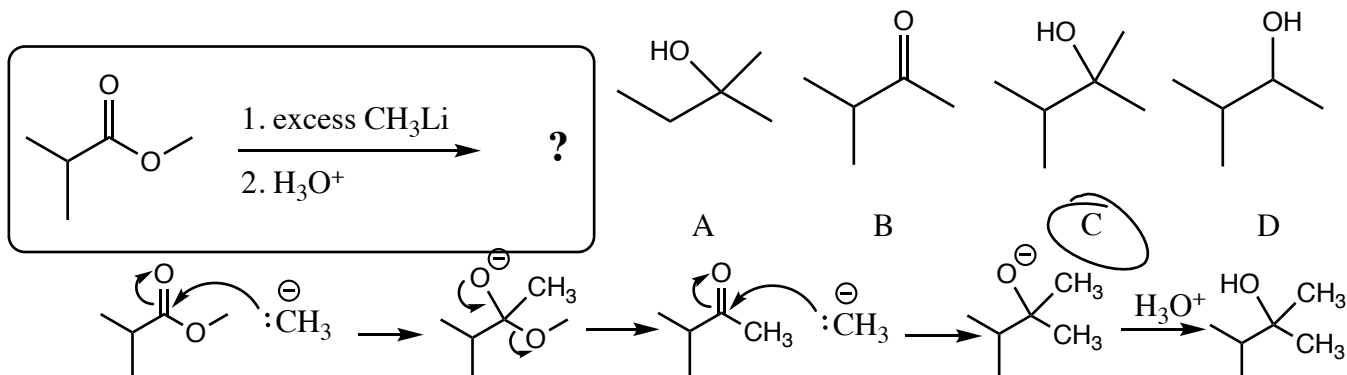
15. Which one of the following compounds will undergo hydrolysis fastest with KOH/H₂O/heat?

- a. butanoic anhydride acid anhydrides are reactive acid derivatives towards hydrolysis!
- b. methyl butanoate esters are poorly reactive acid derivatives towards hydrolysis
- c. 2-chlorobutane alkyl halides do not undergo hydrolysis like acid derivatives
- d. N-methyl butanamide esters are especially poorly reactive acid derivatives towards hydrolysis

16. Provide the structure of ethyl 2-methylpentanoate:



17. Which of the following is the expected product of the reaction below?



18. Which of the following is NOT a characteristic of a typical naturally-occurring oil (may be more than one answer)?

- A. It contains fatty acid chain lengths of 12-20 carbons
- B. It has a melting point above 25°C
- C. It has fatty acid chains that often have unsaturation
- D. The double bonds have trans stereochemistry

19. After studying for the organic exam for a whole hour (including a short break to update his Instagram), Jimmy says that cholesterol is mainly used in the human body as a source of energy for cells. Is Jimmy correct? If not, what is the primary function of cholesterol?



Jimmy

cholesterol's main function is to provide structural rigidity to the cell membrane and to serve as a template for the synthesis of other important steroidal compounds

20. What are three ways by which the rate of reaction of oxygen with triglycerides in foods (leading to foods becoming rancid and/or stale) can be slowed?

- a. refrigeration
- b. protect from oxygen (packaging)
- c. use of preservatives