

## Things to Know for Exam 2

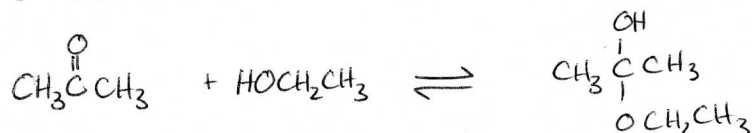
Chem 30B, Spring 2019

### Chapter 14

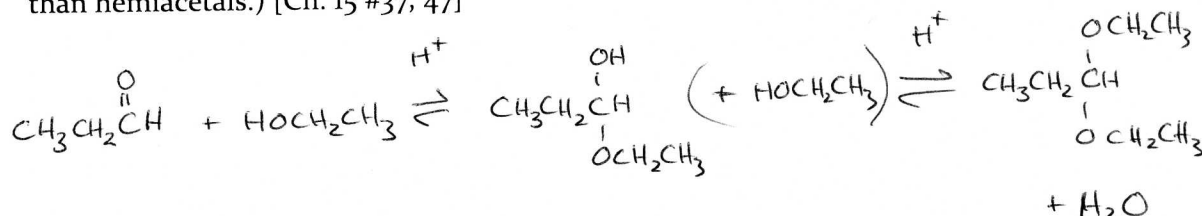
1. Identify any chiral carbon atoms in a structure. [Ch. 14 #58, 59]

### Chapter 15

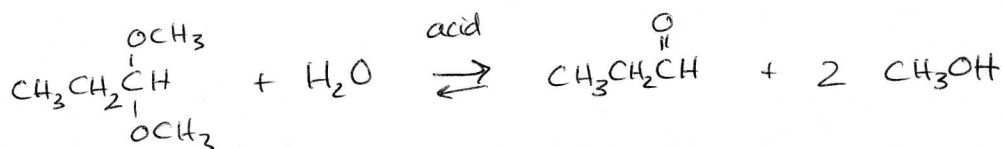
1. From the structure, determine whether a compound is a hemiacetal or an acetal (or neither).
2. Show the reaction of an aldehyde or ketone with an alcohol to form a hemiacetal. (An aldehyde or a ketone will react with an alcohol, undergoing an addition reaction to form a hemiacetal. A hemiacetal has an -OH group and an -OR group on the same carbon. This is an equilibrium reaction. The oxygen of the alcohol adds to the carbonyl carbon, and the carbonyl group is converted to an -OH group.) [Ch. 15 #36, 42ab, 43ab]



3. Show the reaction of an aldehyde or ketone with an alcohol to form an acetal. Include reaction conditions. (In the presence of an acid catalyst, an aldehyde or ketone can react with two molecules of an alcohol to form an acetal and water. The acetal has two -OR groups on the same carbon. Acetals are much more stable than hemiacetals.) [Ch. 15 #37, 47]

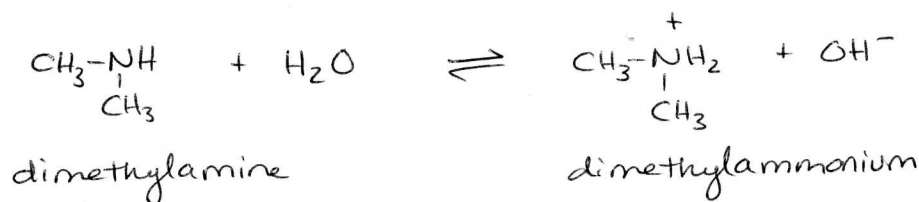


4. Write the reaction and predict the products that would be formed if a given acetal is hydrolyzed. What are the reaction conditions? (Acetals can be hydrolyzed in the presence of lots of water and an acid catalyst. The products are an aldehyde or ketone and 2 molecules of alcohol.) [Ch. 15 # 42cd, 43cd, 44, 45, 46]

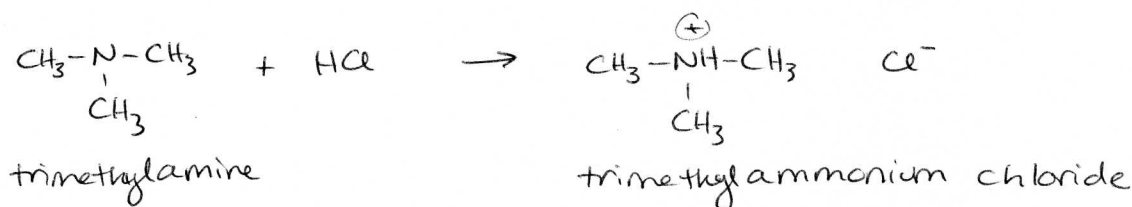


## Chapter 16

1. Name amines using common names or IUPAC names. [Ch. 16 #31, 32]
2. Given the name of any amine, draw the condensed structural formula or line structure. [Ch. 16 #29, 30]
3. Classify any amine as either primary ( $1^\circ$ ), secondary ( $2^\circ$ ), or tertiary ( $3^\circ$ ). [Ch. 16 #29-32]
4. Properties of amines: basicity, polarity, ability to H-bond (some of them), smell
5. Boiling points and solubility: rank compounds in order of bp or solubility and explain based on intermolecular forces. [Ch. 16 #54, 59, 60, 50]
6. Identify heterocyclic compounds (is it heterocyclic or not?)
7. Write the reaction for an amine reacting with water (acting as a weak base). Name products. [Ch. 16 #28b, 42b, 53e]



8. Write the reaction for an amine reacting with a strong acid. (This is an acid-base or neutralization reaction.) Name the products. [Ch. 16 #28cd, 41ac, 42a, 53f]



9. Write the equation for an amine salt with a strong base. [Ch. 16 #28a, 41b, 42c, 53g]



10. Amine salts: water soluble. Why?
11. Name amine salts. [Ch. 16 #35, 36]

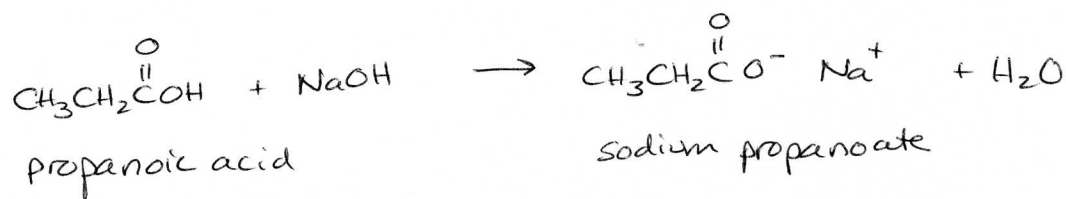
## Chapter 17

1. Name carboxylic acids, esters, and amides using IUPAC rules or common rules. [Ch. 17 #37, 42, 43, 54, 55, 58, 59]
2. Given the name (either common or IUPAC), draw the condensed structural formula and/or the line structure of carboxylic acids, esters, and amides. [Ch. 16 #46-49, 58, 59]
3. Name carboxylate salts. [Ch. 16 #44, 45]

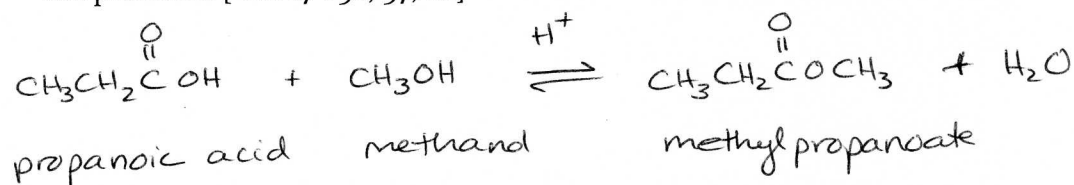
4. Properties of carboxylic acids, esters, and amides.
5. Rank compounds in order of boiling point or solubility in water. Explain your reasoning. (Intermolecular forces) [Ch. 17 #76, 78]
6. Write the equation for the reaction of a carboxylic acid in water (acting as a weak acid). Name the products. [Ch. 17 #38]



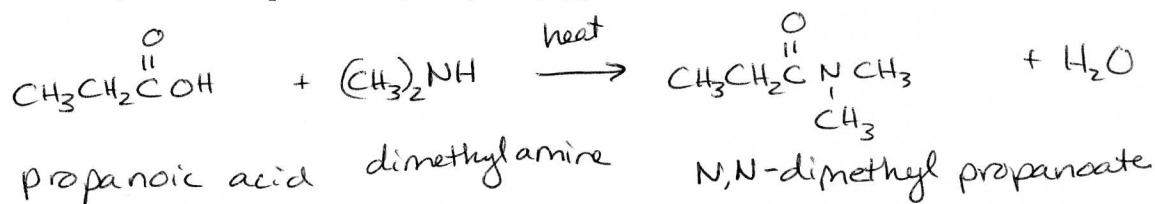
7. Write the equation for the reaction of a carboxylic acid with a strong base. (This is an acid-base or neutralization reaction.) Name the products. [Ch. 17 # 39]



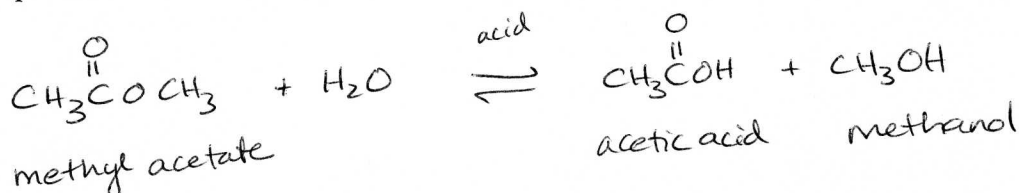
8. Write the reaction and predict the product for an esterification reaction. (A carboxylic acid and an alcohol react in acid to produce an ester and water.) Name the products. [ Ch. 17 #56, 57, 62]



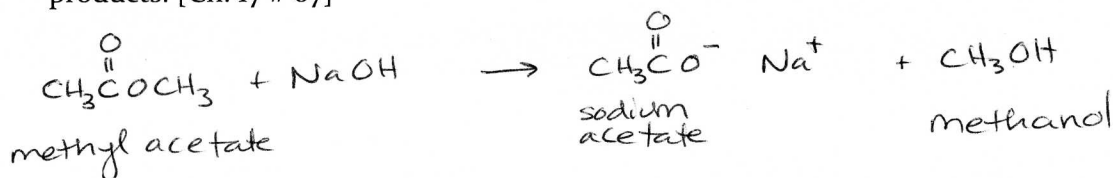
9. Write the reaction and predict the product for an amidation reaction. (A carboxylic acid and an amine react (requires heat) to produce an amide and water.) Name the products. [Ch. 17 #60, 63]



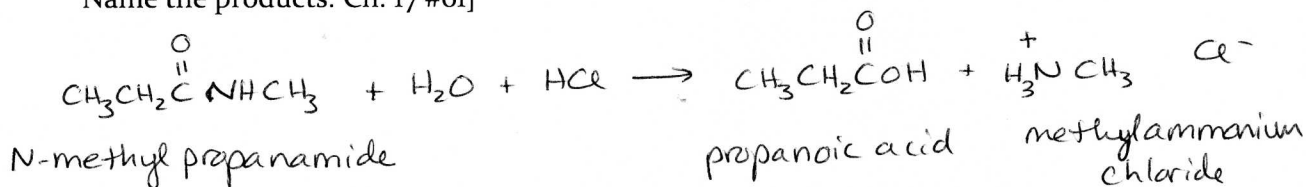
10. Write the reaction and predict the products for the acid hydrolysis of an ester. (An ester + water in acid react to give a carboxylic acid and an alcohol). Name the products.



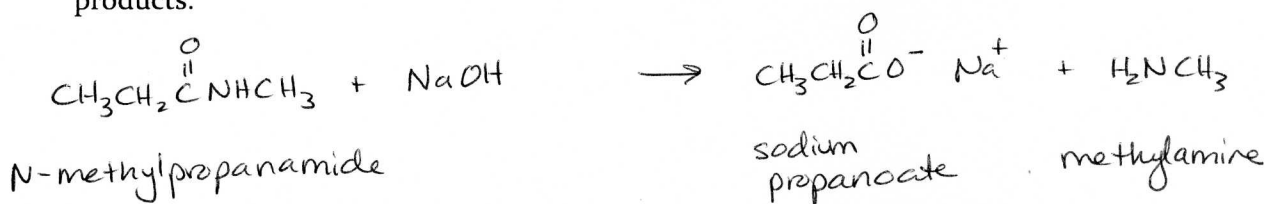
11. Write the reaction and predict the products for the base hydrolysis of an ester. (An ester + strong base react to give a carboxylate salt and an alcohol). Name the products. [Ch. 17 # 67]



12. Write the reaction and predict the products for the acid hydrolysis of an amide. (An amide + water + acid react to give a carboxylic acid and an ammonium salt). Name the products. Ch. 17 #61]



13. Write the reaction and predict the products for the base hydrolysis of an amide. (An amide + strong base react to give a carboxylate salt and an amine). Name the products.



## Chapter 18

- List the six different types/functions of proteins. Be able to briefly explain each one. [Ch. 18 #40]
- Draw the structure of an amino acid, given the structure of the side chain. [Ch. 18 # 42, 43, 48, 49] (You will be given the list of side chains and the list of pK values, without explanations.)
- Draw the structure of an amino acid in its predominant form at a given pH: find the pK of each ionizable group, and determine whether each group will be in its acid form or base form. Draw the entire structure, with every group in its correct form. [Predominant forms of amino acids worksheet #1-7]
- Draw a dipeptide or a tripeptide in its predominant form at any pH. (Find the pK of each ionizable group, and determine whether each group will be in its acid form or base form. Draw the entire structure, with every group in its correct form. You will be given the list of side chains and the list of pK values, without explanations.) [Predominant forms of amino acids worksheet #8-11]
- Draw a longer polypeptide. [Ch. 18 #61, 62, 63, 68, 99]

6. What is the N-terminal aa? The C-terminal aa? What direction are protein and peptide sequences shown in? What is a "residue"?
7. Name a dipeptide or tripeptide ("alanylglycine" or "glycylalanine", for example.) [Ch. 18 #60, 64, 65]
8. What is the primary structure of a protein? What are the interactions/bonds that hold it together? [Ch. 18 # 66, 67, 68]
9. What is secondary structure? What are the interactions/bonds that hold it together? Explain and sketch an alpha-helix and a beta-sheet. [Ch. 18 #70-75]
10. What is tertiary structure? What are the interactions/bonds that hold it together? [Ch. 18 #78, 82]
11. Given a pair of amino acids (the abbreviations), state what type of interaction would occur between them. (Take a look at the structures to decide.) [Ch. 18 # 35, 76, 77]
12. Explain each type of interaction: hydrogen bonding, salt bridge, disulfide bridge, hydrophobic interactions, hydrophilic interactions. [Ch. 18 #98, 99]
13. Difference between globular and fibrous proteins. [Ch. 18 # 37, 102]
14. What is quaternary structure? What are the interactions/bonds that hold it together? [Ch. 18 # 84 - 89]
15. Be able to explain the similarities and the differences between 1°, 2°, 3°, and 4° structure.
16. What happens when a protein is hydrolyzed? What conditions are needed for hydrolysis? Proteins can be hydrolyzed to peptides and amino acids by digestive enzymes or acid or base. This is the same as amide hydrolysis, covered in Chapter 17. [Ch. 18 #94, 95]
17. What happens when a protein gets denatured? [Ch. 18 #92]
18. List all of the things that can denature proteins.
19. Explain in detail how adding acid or base or a nonpolar organic solvent can denature proteins. [Ch. 18 # 93]

## Chapter 19

1. What are enzymes, and what do they do?
2. Be able to draw and explain an activation energy diagram.
3. What is the active site of an enzyme?
4. What is a cofactor? What is a coenzyme? [Ch. 19 # 32- 35]
5. Given a biochemical reaction, determine which of the six categories of enzymes would catalyze it, and explain your reasoning. (Categories: oxidoreductase, transferase, hydrolase, lyase, isomerase, ligase.) [Ch. 19 #42, 43, 46, 47]
6. How do enzymes work? Why are they so specific? [Ch. 19 # 48-53]
7. General equation for enzyme action. Lock-and-key vs. induced-fit models [Ch. 19 #48, 49]
8. Be able to explain the four ways in which enzymes speed up reactions.
9. Explain the effect of [S] or [E] on rate of reaction (and be able to draw a graph and explain it). [Ch. 19 #54, 55]
10. Explain the effect of temp and pH on enzyme activity (and be able to draw a graph and explain it). [Ch. 19 #56, 57, 86]

11. Inhibition: competitive vs. noncompetitive. Be able to explain each. How are they different? What is/are the difference(s) between reversible and irreversible inhibition? [Ch. 19 #58, 59, 62, 63, 83, 87]
12. Be able to explain "feedback control" and "allosteric control". [Ch. 19 # 66-69]
13. What is a zymogen? (What is the purpose of producing a zymogen rather than the active form of the enzyme?) [Ch. 19 # 70-72]
14. Vitamins – what are they? [Ch. 19 # 74-77]
15. What do antioxidants do?
16. Given the structure of a vitamin, predict whether it is water-soluble or fat-soluble and explain your reasoning. [Ch. 19 # 80]

## Chapter 20

1. What functional groups do carbohydrates contain?
2. Be able to classify monosaccharides by the number of carbons (triose, pentose, etc.) and by type of functional group (aldose, ketose) and by combining both types of classification (aldohexose, etc.).
3. What does "optically active" refer to?
4. Most carbohydrates are chiral (what does that mean?). The reference compound is glyceraldehyde, which can be D or L. Know which is which.
5. When we draw carbohydrates vertically, we are drawing Fischer projections. What is a Fischer projection? What is implied about the arrangement of atoms in space?
6. Know how to identify whether a sugar is D or L based on its Fischer projection.
7. Given the Fischer projection of a monosaccharide, be able to draw its enantiomer and a diastereomer. (What is an enantiomer? What is a diastereomer?) How are the names of enantiomers related? Are the names of diastereomers related?
8. Be able to draw the structures (Fischer projections) of D-glucose, D-galactose, and D-fructose.
9. In solution, most monosaccharides exist as the cyclic form. What type of reaction is the ring formation reaction? What type of compound is the resulting ring?
10. Given the Fischer projection of a D-aldohexose, be able to draw the corresponding cyclic structure.
11. Be able to distinguish between  $\alpha$  and  $\beta$  anomers and be able to draw them.
12. What is mutarotation? What types of sugars can undergo mutarotation? Why?
13. Be able to draw the cyclic structures of D-glucose, D-galactose, and D-fructose.
14. All monosaccharides are reducing sugars. Why? Why are ketoses reducing sugars? Remember (from Chapter 16), ketones cannot be oxidized! What is going on?
15. What is an experimental test for a reducing sugar and what does it look like?
16. Hemiacetal + alcohol  $\rightarrow$  acetal. How does this relate to carbohydrates?
17. What is a disaccharide? To form a disaccharide from 2 monosaccharides, what type of reaction must occur?

18. Know the structures of maltose, lactose, and sucrose, and know the type of glycosidic bond in each.
19. Which disaccharides are reducing sugars? What is required in the structure?
20. Given 2 monosaccharides and the type of glycosidic bond, be able to draw the structure of the disaccharide they would form.
21. Be able to identify the type of glycosidic linkage in a given (unfamiliar) disaccharide structure.
22. Disaccharides can be hydrolyzed. What is required? What are the products?
23. What is a polysaccharide? What are the products of the hydrolysis of polysaccharides? What is needed to hydrolyze them?
24. Be able to explain the differences and similarities between cellulose, amylose, amylopectin, and glycogen.
25. What is an experimental test for starch and what does it look like?