

## Things to Know for Exam 3

Chem 30B, Spring 2019

### Chapter 20

1. 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.). [Ch. 20 # 31]
2. Draw the structure of a monosaccharide, given the classification. [Ch. 20 #34]
3. Identify a monosaccharide as either D or L, given the Fischer projection.
4. What are the functional groups present in monosaccharides?
5. Are monosaccharides water-soluble or fat-soluble? Explain why.
6. Identify any chiral carbon atoms in a monosaccharide. [Ch. 20 #32, 33]
7. For a Fischer projection - which way are the groups on the sides pointing? Which way is the backbone pointing?
8. Given the Fischer projection of a monosaccharide, be able to draw the enantiomer. Name the enantiomer and label it as D or L. [Ch. 20 #38, 39, 40, 21]
9. Given the Fischer projection of a monosaccharide, be able to draw a diastereomer (often, there are several possibilities). [Ch. 20 # 40, 21]
10. Draw the Fischer projection of D-glucose, D-galactose, and D-fructose.
11. 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?
12. Draw the ring form (in the Haworth projection) for D-glucose, D-galactose and D-fructose.
13. Given the Fischer projection for any D-aldohexose, draw it in its ring form. [Ch. 20 #50, 51]
14. Identify or draw alpha ( $\alpha$ ) and beta ( $\beta$ ) anomers. [Ch. 20 # 47, 49, 21, 74]
15. What is the anomeric carbon?
16. Explain what mutarotation is. [Ch. 20 #46 ]
17. What is a reducing sugar? How can you tell if a sugar is a reducing sugar? [Ch. 20 #44, 45]
18. Hemiacetal + alcohol  $\rightarrow$  acetal. How does this relate to carbohydrates?
19. What is a disaccharide? To form a disaccharide from 2 monosaccharides, what type of reaction must occur?
20. Which disaccharides are reducing sugars? What is required in the structure?
21. What happens when sugars react with Benedict's reagent? [Ch. 20 #54]
22. Why are ketose monosaccharides also reducing sugars? (Ketones normally cannot be oxidized.)
23. What is a glycosidic bond?
24. Be able to draw the structures of the disaccharides maltose, lactose, and sucrose. Identify the type of glycosidic bond in each.
25. Given a di- or trisaccharide, identify the type(s) of glycosidic bond(s) present. Decide whether it is a reducing sugar or not.
26. Draw the following types of glycosidic bonds between ring forms of sugars:  $\alpha$ -1,4-,  $\beta$ -1,4-, and  $\alpha$ -1,6-.
27. What happens when disaccharides or starches are hydrolyzed? [Ch. 20 # 66, 68]

28. What is a polysaccharide? What are the products of the hydrolysis of polysaccharides? What is needed to hydrolyze them?
29. Explain the similarities and differences between any of the 4 types of polysaccharides/starches: cellulose, amylose, amylopectin, and glycogen. [Ch. 20 # 63, 64, 70]
30. What is an experimental test for starch and what does a positive test look like?

## **Chapter 21 (The Generation of Biochemical Energy)**

1. Why do living things need energy? Where do they get energy?
2. What is "free energy"?
3. Draw an energy diagram for an exergonic reaction or an endergonic reaction. What is more stable for each, reactants or products? What types of reactions are spontaneous?
4. What is a mitochondrion? What happens inside of mitochondria?
5. Sketch a mitochondrion, labeling the matrix, the intermembrane space, the inner membrane, and the outer membrane.
6. What are catabolic reactions? Anabolic reactions?
7. What is ATP? What are the qualities of ATP that make it a good energy storage molecule?
8. Add two related reactions, cancel things that are the same on both sides, and add the  $\Delta G$  values. Are the coupled reactions spontaneous or nonspontaneous overall? (How can you tell?) [Ch. 21 # 31, 32, 46]
9. Redox reactions often involve  $\text{NAD}^+$  or FAD or NADH or  $\text{FADH}_2$ . Which ones are the oxidized coenzymes? Which are the reduced coenzymes? [Ch. 21 #49, 50]
10. Identify whether or not something is being oxidized or reduced. (Oxidation: addition of O and/or removal of H. Reduction: addition of H and/or removal of O.)
11. What is acetyl CoA?
12. Citric acid cycle: other names for it? Where does it happen? [Ch. 21 #51, 52 ]
13. The Citric Acid Cycle handout will be given for the test and the quiz.
14. By careful examination each step on the citric acid cycle handout, describe what is happening to the structure of the substrate in each step and what type of reaction it is. [Ch. 21 #25, 55]
15. Which steps involve  $\text{NAD}^+$ ? FAD? ATP?  $\text{CO}_2$ ? [Ch. 21 #55-58]
16. What happens to the carbons from acetyl CoA in the citric acid cycle? [Ch. 21 # 54]
17. What is the purpose of the electron transport chain? [Ch. 21 # 59, 60]
18. Where does the electron-transport chain happen?
19. Explain in general terms how the electron transport chain works. What are the general steps?
20. How is ATP produced in the electron transport chain?
21. What is ATP Synthase?
22. What is "oxidative phosphorylation"? [Ch. 21 #69]
23. What is a "proton gradient" and how is it formed? How is it then used?
24. How many ATP can be made for each NADH? For each  $\text{FADH}_2$ ?
25. What are the final products of the electron transport chain? [Ch. 21 #62]
26. What is a free radical? How are free radicals destroyed in the body? What could happen if some of them are not destroyed?

## **Chapter 22 (Carbohydrate Metabolism)**

1. What does digestion involve, in general? [Ch. 22 #31, 34]
2. In the digestion of carbohydrates, where in the body does digestion start, what enzymes are involved, and what happens?
3. Where does digestion continue? What enzymes are involved, and what happens? [Ch. 22 #32, 33]
4. Be able to explain the entire process of digestion of carbohydrates.
5. What happens to glucose when it first enters the cell? Why?
6. What are some things that could happen to glucose-6-phosphate? [Ch. 22 #23]
7. Glycolysis: where does it occur in the cell?
8. The glycolysis handout will be given on tests and quizzes.
9. For any of the steps in glycolysis or the formation of acetyl CoA, state what is happening to the structure of the substrate and the type of reaction. [Ch. 22 #46]
10. What category of enzyme would catalyze each step in glycolysis? [Ch. 22 #26, 45]
11. What is the overall result of glycolysis? Starting with 1 glucose, how many of each product are formed? [Ch. 22 # 51, 52]
12. How many ATP and NADH are made during glycolysis?
13. What happens to other sugars when they are broken down/oxidized in order to get energy?
14. What happens to pyruvate under anaerobic conditions? [Ch. 22 #25, 36, 48]
15. What happens to pyruvate under anaerobic conditions in yeast? [Ch. 22 #25, 36]
16. What happens to pyruvate under aerobic conditions? [Ch. 22 #25, 36]
17. Starting from glucose, determine the total number of ATP molecules formed and in what steps when it is completely oxidized. [Ch. 22 #47]
18. Starting from any intermediate in glycolysis or the citric acid cycle, determine how many ATP, NADH, and FADH<sub>2</sub> molecules would be formed, and then how many total ATPs would be formed (including the electron transport chain). [Ch. 22 #47, additional problems]
19. Memorize: 2.5 - 3 ATP per NADH and 1.5 - 2 ATP per FADH<sub>2</sub>. The lower number is a realistic estimate ("best estimate"). the higher number is the maximum.
20. How is the level of glucose maintained in the blood? [Ch. 22 #72]
21. Explain the effects of insulin and glucagon. When is each one released? [Ch. 22 # 53]

## **Chapter 23 (Lipids)**

1. What do lipids have in common?
2. What is a fatty acid? Be able to draw the structure.
3. Saturated, unsaturated, monounsaturated, polyunsaturated, etc.
4. If there are double bonds in a fatty acid, they are almost always *cis*.
5. What is the general structure of a wax? Be able to draw one.
6. What are waxes used for in nature?
7. What is the general structure of a fat or oil?

8. Triacylglycerol/triglyceride : what do these names tell you about the structure of the molecule?
9. Be able to draw a triglyceride.
10. What is the difference between a fat and an oil?
11. Understand the meaning of the chart on p. 719. Naturally occurring fats and oils are mixtures.
12. How do fats and oils differ in their melting points? WHY? Be able to explain this thoroughly.
13. How can fats/oils become rancid? How can it be prevented or slowed?
14. Hydrogenation of triglycerides: what are the reactants? What catalyst is needed? What is the effect of hydrogenation? Be able to write the reaction.
15. What is partial hydrogenation? What is the problem with partial hydrogenation?
16. Saponification of triglycerides: what are the reactants? What are the products? Be able to write the reaction.
17. How do soaps clean greasy things? Be able to explain.
18. Which types of lipids are present in cell membranes?
19. What are the structural components of phosphoglycerides, sphingomyelins, and glycolipids?
20. Which of the above are phospholipids? Which are sphingolipids?
21. Be able to recognize each of the above. Be able to recognize and label sphingosine and the other components on a given lipid structure.
22. What is a lecithin? What is a cerebroside? What is a ganglioside?
23. Recognize cholesterol. What is it used for? What are sources of cholesterol?
24. What are the components of cell membranes? How are the lipid molecules arranged in the membrane?
25. What does the term "fluid mosaic model" refer to?
26. What happens if a membrane tears?
27. What affects the fluidity of a membrane?
28. What does the term "semipermeable" refer to?
29. What is the difference between passive transport and active transport?
30. What are the mechanisms of passive transport?
31. What types of molecules can pass through the membrane unassisted?
32. What types of molecules can pass through channels?
33. What types of substances cannot pass through the membrane?
34. What is facilitated diffusion? How does it work?
35. What is an example of active transport? What happens in active transport?

## Chapter 24 (Lipid Metabolism)

1. Where does digestion of lipids occur? What are the steps, in general?
2. What are lipoproteins and what are they used for?
3. When are triglycerides synthesized and when are they broken down?
4. Triglycerides can be hydrolyzed. What are the products?
5. What happens to the glycerol? Be able to figure out how many ATP are produced from the oxidation of the glycerol.

6. Steps in the oxidation of fatty acids:
7.       1. activation (Where does this occur?)
8.       2.  $\beta$ -oxidation (several cycles) (Where does this occur?)
9.       3. Acetyl CoA that forms  $\rightarrow$  Krebs cycle (Where does this occur?)
10. State the type of reaction that occurs in each step of  $\beta$ -oxidation. Describe how the structure is changing in each step.
11. Be able to figure out the yield of NADH,  $\text{FADH}_2$ , and acetyl CoA from the  $\beta$ -oxidation of any fatty acid.
12. Be able to figure out the total yield of ATP from the complete oxidation of any fatty acid. (This will include ATP formed from the Krebs cycle and the electron transport chain.)
13. Remember that for the electron transport chain, the maximum yield of ATP is
14.       3 ATP/1 NADH and 2 ATP/1  $\text{FADH}_2$ . The current "best estimates" are
15.       2.5 ATP/1 NADH and 1.5 ATP/1  $\text{FADH}_2$ .
16. When are fatty acids synthesized and when are they broken down?