CHEM106 Test 3
Monday, November 19, 2018

Name: Key

Follow the directions for each section and answer what you are asked succinctly, neatly and as specifically as you can.

Section 1: Rules

1) (10 points) Write out the following:
   a. Rules for mechanisms that I taught you

1) CHP: These atoms are usually electron deficient and have a partial positive charge (electrophiles)
   NOS: These atoms have lone pairs or negative charges (nucleophiles)
2) Know what you are starting with and what you finish with. look at what is different.
3) Nucleophiles attack electrophiles

   b. Rule for α-D-glucose

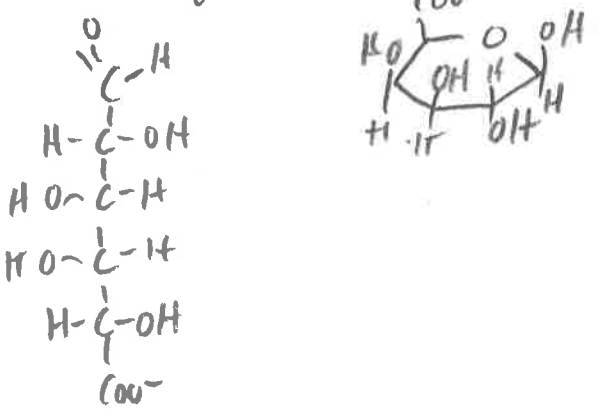
DDU DU
α-D-glucose in the Haworth form

Section 2: Sugars

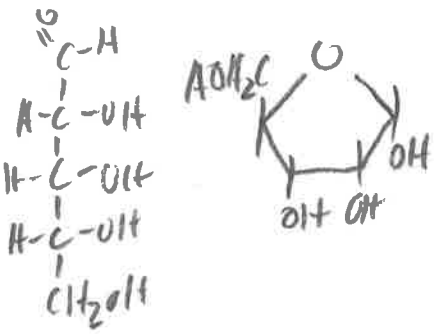
2) (10 points) Draw the Fisher projection and the Haworth projection for one of the following sugars. Write the name of the sugar under the Haworth projection.

Your choices are: β-D-galacturonic acid, α-D-ribose, β-D-mannose

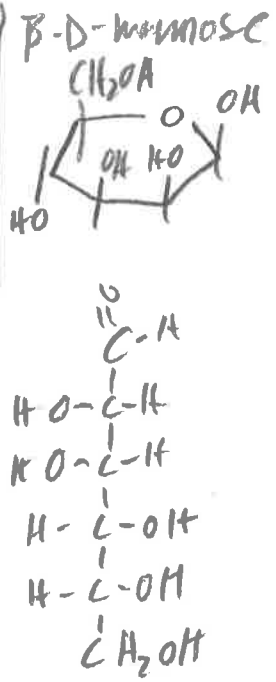
β-D-galacturonic acid



α-D-ribose



β-D-mannose



3) (5 points) What is a glycosidic bond?

A glycosidic bond is a bond linking two monosaccharides together. (Simplest definition)

4) (5 points) Draw **one** of the following disaccharides: maltose, sucrose, trehalose, lactose. Write the name of the disaccharide underneath it.

Maltose = D-glucose (α1,4)-D-glucose

Sucrose = D-glucose (α1,2)-β-D-fructose

Trehalose = D-glucose (β1,1)-β-D-glucose

Lactose = D-galactose (β1,4)-D-glucose

Based upon the names, you can draw the Haworth structures.

5) (10 points) What is the key chemical difference between glycogen and cellulose and what effect does that chemical difference play in the structure of the polymers?

1) Both are polymers of D-glucose

2) Cellulose is a polysaccharide consisting of (β 1→4) linked glucose residues and glycogen is a polysaccharide consisting of (α1,4) linked glucose residues

3) cellulose is unbranched and flat, with many internal hydrogen bonds. Glycogen has (α1,6) glucose linkages every 24-30 residues.

6) (5 points) Is the sugar you drew in question 5 a reducing sugar? Why or why not?

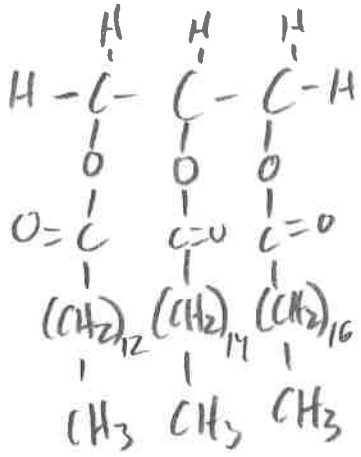
Maltose: yes. Free anomeric carbon on the reducing terminal residue

Sucrose: NO.
Trehalose: NO. The anomeric carbons are in glycosidic bonds.

Lactose: yes. Free anomeric carbon on reducing terminal residue.

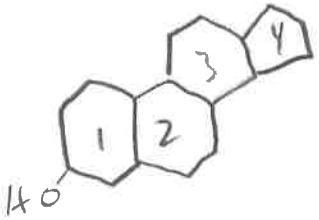
Section 3: Lipids, Membrane and Membrane Proteins

7) (5 points) Draw the structure of a triacylglycerol that has myristic acid, palmitic acid and stearic acid substituents (label each fatty acid under the chain).



Myristic acid = 14 Carbons
Palmitic acid: 16 carbons
Stearic acid: 18 carbons

8) (5 points) Draw the base structure of a sterol molecule. What effect does inserting cholesterol molecules into lipid bilayer have on the membrane?



3 - six membered rings
1 - four membered ring

Cholesterol makes the membrane more rigid (less fluid)

9) (10 points) What do organisms do to the lipids in their cell membranes to keep them from freezing during cold weather? Why does this work?

Introduce unsaturated bonds into the fatty acid chains of the glycerophospholipids of their membranes. This "kinks" the fatty acid chains and reduces London Dispersion Forces, increasing fluidity of the membrane.

10) (10 points) What are the two types of membrane proteins? Briefly describe the chemical features of each that makes them what they are.

1) Integral Membrane Proteins: Frequently all α-helical or all β-strand with hydrophobic amino acid side chains interacting with the lipids (LDF interactions)

2) Peripheral Membrane Proteins: Associated with the Phosphate head groups of the lipids (Ion-Dipole) or may have a fatty acid attached to them that is buried in the bilayer

11) (10 points) It has been said many times that Active Transport of solutes into or out of the cell relies upon the energy of ATP hydrolysis. We have learned that this isn't exactly true. How is ATP used to facilitate active transport in cells?

γ-PO_4^{2-} of ATP is attached to the Protein at Serine or Threonine. This causes a <u>conformational change</u> in the Protein.

Section 4: Glycolysis

12) (10 points) What are the 10 enzymes (in order) of the glycolytic pathway?

Hexokinase
Phosphoglucoseisomerase
Phosphofructokinase
Aldolase
Triose Phosphate Isomerase

6AP Dehydrogenase
Phosphoglyceromutase
Phosphoglycerate Kinase
Enolase
Pyruvate Kinase

Phase 1 | Phase 2

13) (5 points) Why is glucose converted to fructose during glycolysis?

To make a symmetrical molecule that can be split into two 3-carbon sugars with nearly identical reactivities.

14) (5 points) What is meant by the term "coupling" in glycolysis?

Coupling an endothermic reaction to an exothermic reaction to "pull" the endothermic reaction along.

eg: GAPDH and PGM

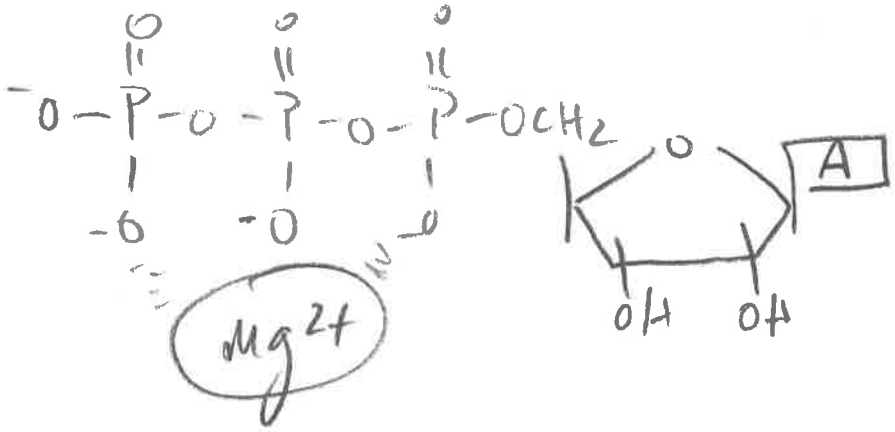
15) (5 points) How many phases are in glycolysis and what happens in each phase?

Two Phases.

Phase 1: Energy investment (2 ATP spent)

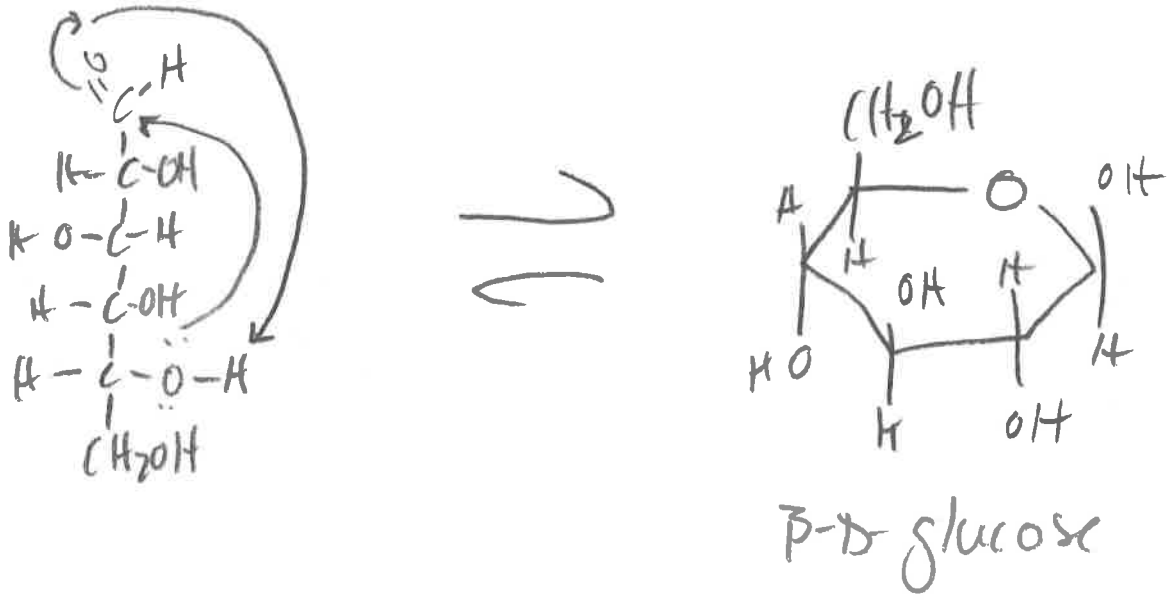
Phase 2: Energy production (4 ATP made)

16) (5 points) Draw the structure of ATP as I have always drawn it on the board in class. You can put the letter "A" in a box attached to carbon one of the ribose sugar. What metal cation is always associated with ATP? Draw it interacting with the ATP molecule you have drawn.

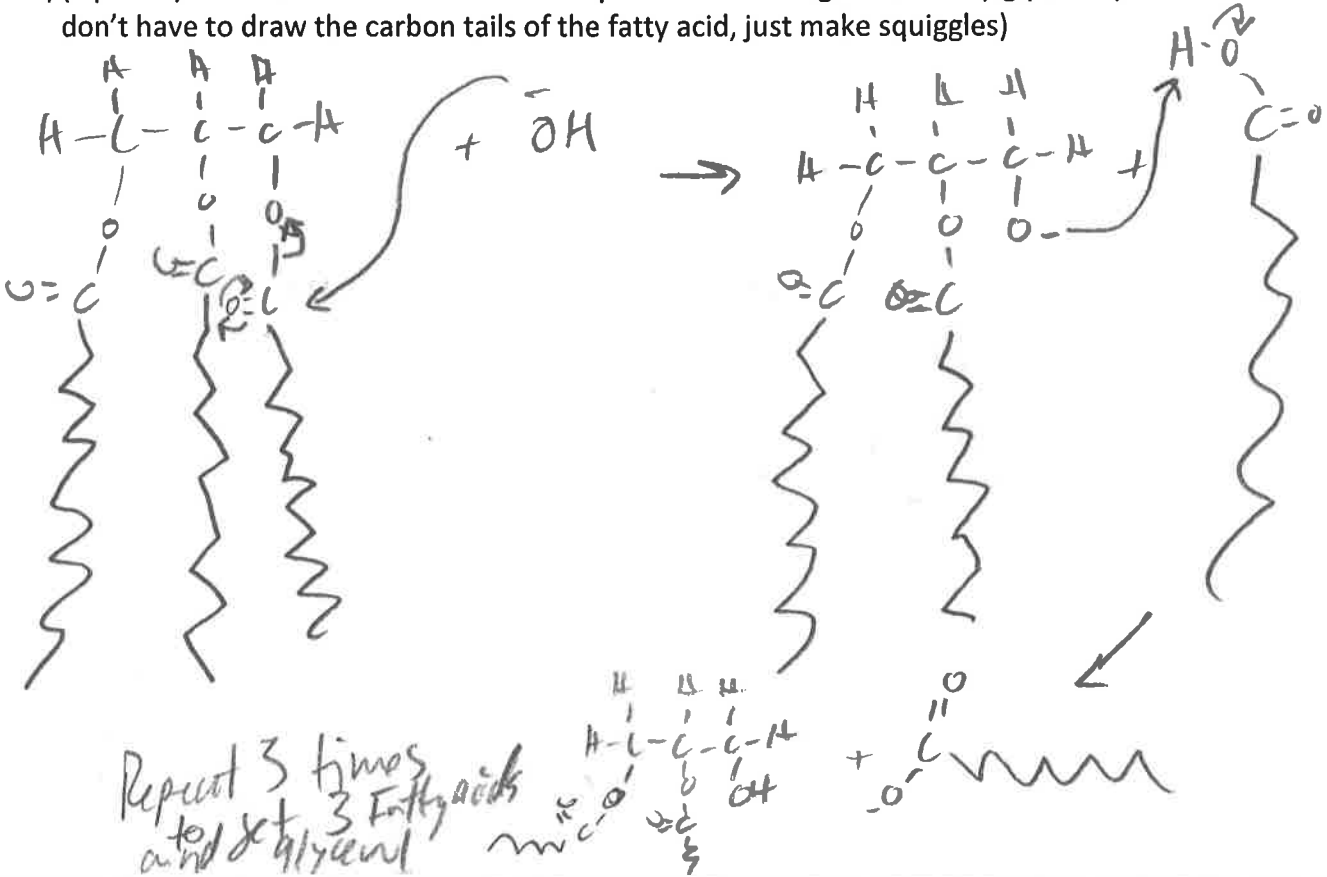


Section 4: Reaction Mechanisms

17) (5 points) Draw the mechanism by which a linear D-glucose molecule self-converts to the hemiacetal form (From the Fisher projection to the Haworth form).



18) (5 points) Draw the mechanism for the saponification of a generic triacylglycerol (You don't have to draw the carbon tails of the fatty acid, just make squiggles)



19) (10 points) Draw the reaction mechanism for ANY enzyme-catalyzed reaction you have learned. Start by writing the name of the enzyme, then carry out the mechanism stepwise.

your choice. Consult the notes.