Instructions: This exam is out of 100 points, you should allot 1 min/2 pts. Please use the space provided or the back of the previous page. On questions with more than one choice, all of your attempts will be graded and you will receive the grade for your best attempt.

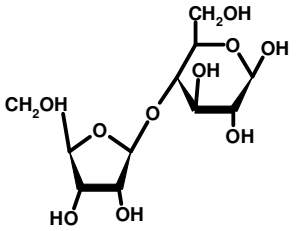
1. (4 pts) Briefly explain why the scattering of X-rays by electrons can be used to determine the structure of proteins.

2. (5 pts) Please do one of the following two choices.

   Choice A: How do the chair and boat forms of a sugar differ (a diagram is a suitable answer) (2 pts)? Why might one chair form be more stable than the other chair form (3 pt)?

   Choice B: Label the anomeric carbons in the dissacharide shown on the right (1 pt). Circle the correct name for this disaccharide. If you would like partial credit for an incorrect answer, justify your answer (4 pts).

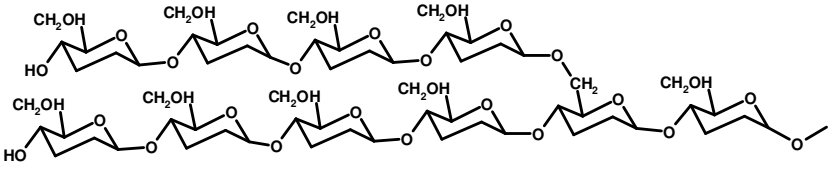
   a. β-glucopyranosyl-(4-1) β-ribofuranose
   b. α-ribofuranosyl-(1-4)-β-glucopyranose
   c. β-ribofuranosyl-(1-4)-β-glucofuranose
   d. β-ribofuranosyl-(1-4)-β-glucopyranoside
   e. β-ribofuranosyl-(1-4) β-glucopyranose



3. (4 pts) The structure on the right represents a glycogen molecule.

   i) Name and identify the glycosidic bond(s) found in this polysaccharide (3 pts)

   ii) Circle the glucose that would be released as glucose-1-P by glycogen phosphorylase (1 pt)



4. (6 pts) Please do one of the following choices.

Choice A: What is the overall structure of a bacterial cell wall? How does the structure explain the high mechanical strength of the cell wall?

Choice B: What is the polysaccharide that plays a structural role in plants? Name the monosaccharide used to form the polysaccharide and the linkage between the individual units.

5. (8 pts) Please answer both parts of this question

i) Using the partial structure below, draw **either** a triglyceride **or** a phospholipid. Take care to add any missing atoms to the existing diagrams (2 pts)

ii) What type of structure is formed when **phospholipids** are mixed with water? What thermodynamic force drives the formation of this structure? (6 pts).

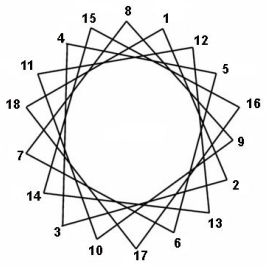
6. (6 pts) Please do one of the following choices.

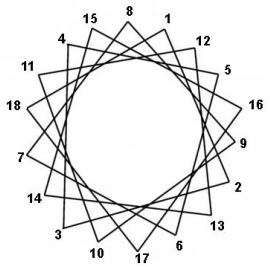
Choice A: Which of the following fatty acids would show the lowest critical micelle concentration (CMC): a) hexanoic acid (C_6) or b) decanoic acid (C_{10}). *Briefly justify your answer* (6 pts).

Choice B: Briefly describe why introducing a cis double bond into a fatty acid leads to a large drop in the melting temperature.

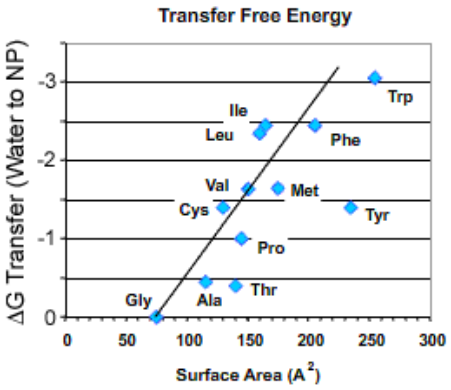
7. (3 pts) Which of the following features of cholesterol are *incorrect* (circle **all** that apply)
   a) It contains rigid non-polar rings.
   b) It contains a flexible non-polar tail.
   c) It is part of the electron transport chain
   d) It contains a polar –OH group.
   e) It causes membranes to be more rigid at all temperatures.

8. (12 pts) An integral membrane protein consists of two α-helical segments that are imbedded in the membrane. A "top view" of this protein is shown on the right. Briefly discuss the following aspects of the structure of this protein.





   i) What other type of secondary or super-secondary structures are seen in membrane proteins. *Why?*
   ii) What is the distribution of polar and non-polar residues along the polypeptide sequence and how does this distribution relate to the interaction of the protein with the membrane?
   iii) Residues that contact the lipid are generally large and non-polar. Why are small non-polar seldom found? The diagram on the right may be useful.



9. (6 pts) Please do one of the following choices.
   Choice A: Briefly explain why the potassium channel is selective for potassium.
   Choice B: The potassium channel has been referred to as an enzyme. In which ways is it similar to other enzymes (e.g. serine proteases), in which ways is it different?
   Choice C: The concentration of potassium outside the cell is 1 mM and the concentration inside is 1 mM. The voltage potential across the membrane is +0.1V, with the inside positive. What direction will potassium flow, into the cell, or out of the cell? *Justify your answer using (but not necessarily calculating) the Gibbs free energy, ΔG.*

10. (10 pts) The conversion of A to B in a metabolic pathway (A→B→C) has a standard energy change (ΔG^o) of +20 kJ/mol. Propose a method that could be used to make this reaction spontaneous (+8 pts). Give an example of this method in an actual metabolic pathway (+2 pts).

11. (8 pts) Please do one of the following choices:

Choice A: Give a brief overview of the fate of carbon atoms in the metabolism of glucose **or** a fatty acid, **your answer should include**:

i) the names of the pathways
ii) changes to the number of carbons atoms in the intermediates of the pathways.
iii) the final fate of carbon atoms.
iv) the cellular location of the pathways.

Choice B: How are allosteric effects related to ATP synthesis during oxidative phosphorylation in the mitochondria?

12. (5 pts) Correct these sentences (if necessary).

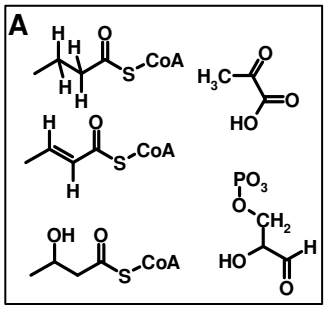
i) A feedback inhibitor resembles the product of the reaction that it regulates.

ii) A phosphatase adds a phosphate group to a protein, generating ADP.

iii) In yeast cultures grown under low oxygen conditions, three moles of ethanol are produced per mole of glucose. This process conserves less than half of the original energy in the glucose.

13. (10 pts) Please complete **all** parts of this question:

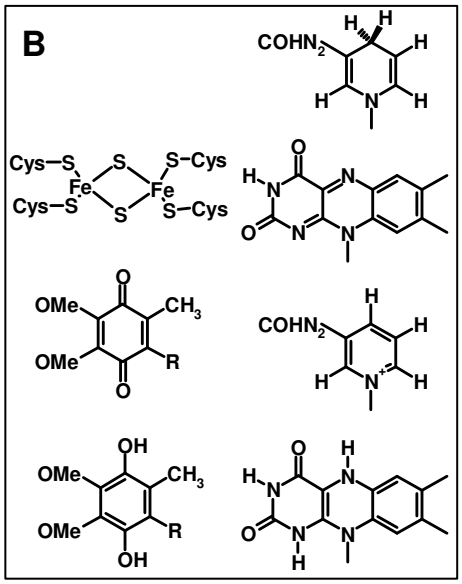
i) Give an example of an oxidation reaction in any metabolic pathway. State the pathway that the reaction occurs and either describe the reaction or draw the reactant and product. A few possible **reactants** are shown in box A (2 pts).



ii) Give the *general* name for enzymes that catalyze such reactions (1 pts).

iii) Box B shows the structure of a number of electron donors and acceptors. Circle the compound which would be the immediate product of the reaction you chose as an example (1 pts).

iv) The electrons from the compound you circled in box B progress through the electron transport pathway. State the cellular location of this pathway, and list the steps in the pathway (in the correct order), ending with the final electron acceptor (5 pts).



v) The energy that is released during electron transport is stored as _____ (complete the sentence) (1 pts)?

14. (5 pts) Why are an individual's glycogen levels generally lower if they are on a high fat diet?

15. (8 pts) Please do **one** of the following choices (choices A & B involve glucolysis/gluconeogenesis regulation, choice C involves regulation of glycogen storage and degradation).

Choice A: Briefly describe how the regulation of glycolysis and gluconeogenesis in a liver cell is responsive to the energy needs of the cell.

Choice B: Briefly describe how the glycolysis and gluconeogenesis in a liver cell is responsive to hormonal signals that regulate blood glucose levels. Select one hormone as an example.

Choice C: Briefly describe how glycogen synthesis and degradation in the liver cell is responsive to hormonal signals that regulate blood glucose levels. Select one hormone as an example.

[You don't need to use all of this space for this question.]