BIOC 2580 (Fall 2009)
Final Exam Practice Package

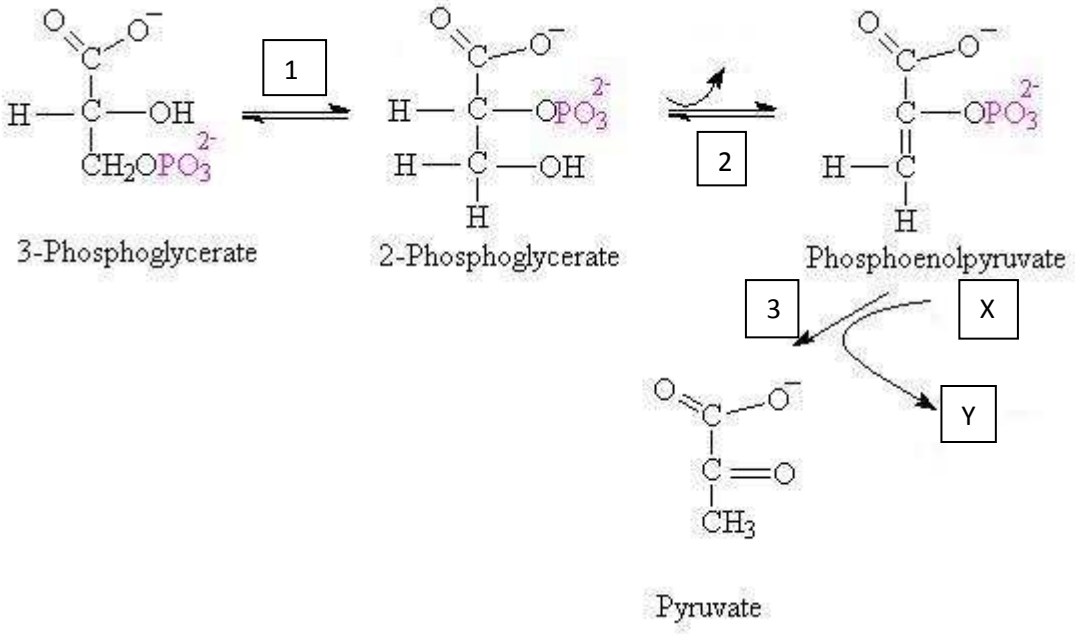
This package will **not** be taken up in session; it is supplemental only. Please work on it with friends, and use your course notes to get the answers (all questions were generated from course notes).

This package was made much longer than a typical final exam – so don't use it to judge your timing. Several questions were simply generated so that you may have additional practice.

Good luck on your final exam!!

1. Which of the following compounds is NOT a carbohydrate?
    a. Glucose
    b. Fructose-1,6-bisphosphate
    c. 2-phosphoglycerate
    d. Citrate
    e. Two (2) of the above

Refer to the figure for the following 5 questions:



2. What is the name of the enzyme that catalyzes Reaction 1?
    a. Enolase
    b. Phosphoglycerate Kinase
    c. Phosphoglycerate Mutase
    d. Pyruvate Kinase
    e. Phosphoglycerate Transaminase

3. Reaction 2 can best be described as a:
    a. Reduction
    b. Dephosphorylation
    c. Phosphorylation
    d. Condensation
    e. Hydrolysis

4. What belongs in box X (what else is required for this reaction to occur)?
    a. ATP
    b. ADP + P_i

c. NAD^+
d. $NADH + H^+$
e. None of the above

5. What belongs in box Y (what is produced as a result of this reaction)?
    a. ATP
    b. $ADP + P_i$
    c. NAD^+
    d. $NADH + H^+$
    e. None of the above

6. Pyruvate, as shown in the figure, represents which form of the compound?
    a. Enol form
    b. Imino form
    c. Keto form
    d. Amino form
    e. All of the above

7. Which of the following best explains how the ATP yield per mole of glucose can be either 30 or 32?
    a. L and D glucose yield different amounts of energy
    b. Without oxygen, only 30 ATP can be produced
    c. The reducing power of NADH can be transferred by 2 different shuttles
    d. Acetyl-CoA is only oxidized sometimes
    e. None of the above

8. Which of the following statements correctly describes the movement of the ATP synthase subunits
    a. The α and β subunits rotate around the stationary γ subunit
    b. The 8 c subunits induce conformational changes in the a and b subunits
    c. 10 c subunits function to rotate the γ subunit which acts as a rotor
    d. ATP combines with H^+ to spin the α subunit, creating ADP
    e. None of the above

9. How many NAD^+ are reduced during 1 cycle of the citric acid cycle?
    a. 0
    b. 1
    c. 2
    d. 3
    e. 4

10. Succinyl-CoA synthetase catalyzes which of the following reactions?
    a. The decarboxylation of α-ketoglutarate into succinyl-CoA
    b. The reduction of succinyl-CoA into succinate
    c. The thioester hydrolysis of succinyl-CoA
    d. The phosphorylation of succinate by succinyl-CoA
    e. 2 of the above

11. Which of the following enzymes catalyze decarboxylation reactions? (may be more than one answer)
    a. Isocitrate dehydrogenase
    b. Enolase
    c. Succinyl-CoA Synthetase
    d. α-ketoglutarate dehydrogenase
    e. Hexokinase

12. If one molecule of stearoyl-CoA underwent β-oxidation and the citric acid cycle, how many NADH would be produced by the activity of succinate dehydrogenase?
    a. 7
    b. 8
    c. 9
    d. 10
    e. 0

13. Which of the following correctly describes the structures formed by lipids in aqueous solutions?
    a. Micelles are unilaminar spheres of phospholipids
    b. Liposomes form by the aggregation of cholesterol into globular proteins
    c. Liposomes have inner and outer lipid bilayers
    d. Micelles form when fatty acids are placed in water
    e. All of the above

14. What name is given to polyhydroxy-aldehydes and polyhydroxy-ketones?
    a. Lipids
    b. Nucleic Acids
    c. Carbohydrates
    d. Co-factors
    e. Cytochrome enzymes

15. How does RNA differ from DNA?
    a. Deoxyguanosine is only found in RNA
    b. The 3’ OH group of ribose is present in DNA but absent in RNA
    c. Thymine is not found in RNA, instead uracil takes its place
    d. RNA has nucleotides while DNA has only nucleosides
    e. 2 of the above

16. Which of the following is NOT a characteristic of B-DNA?
    a. Anti-parallel right handed turns
    b. Approximately 10 base pairs per turn
    c. Strong hydrogen bonding between bases
    d. Double helix
    e. None of the above (all of the above are true)

17. Which DNA strand will be stronger/more resistant to unwinding?
    a. AAATTTTGCGATATACCG
    b. GGGGCCCCCTTGCGAAA
    c. ATCGGCTAGCTAATCGAT
    d. ATATATATATATATATAT
    e. All of the above would have similar strengths

18. Which of the following is the best explanation of your answer to question 17?
    a. Strands with more G & C will be stronger because of hydrogen bonding
    b. Strands with T & A at the termini will be stronger
    c. All strands were similar
    d. A & T make 3 H-bonds with each other, while G & C only make 2
    e. The most diverse strands (G, C, A, & T) are the strongest

19. Metabolic Acidosis is a condition characterized by increase levels of lactic acid build up leading to unfavourable changes in physiology. Some of these changes include a shift in the bicarbonate equilibrium which regulates CO_2, H^+ and HCO_3^- levels in the blood. Which statement adequately explains the reason behind lactate build up in oxygen deprived conditions?
    a. Pyruvate is converted to ethanol which essentially is lactate
    b. NADH is re-oxidized by acetyl-CoA which produces lactate
    c. NAD^+ cannot enter the ETC and returns to cytoplasm for citric acid cycle use
    d. Pyruvate oxidizes NADH + H^+ thus forming lactate
    e. None of the above

20. Which statement best summarizes the reaction catalyzed by phosphohexose isomerase?
    a. Translocation of a PO_4^{3-} from the 5' carbon to 4'
    b. Phosphorylation of glucose to glucose-6-phosphate
    c. Isomerisation of DHAP (dihydroxyacetone phosphate) to G-3-P (glyceraldehydes-3-phosphate)
    d. Decarboxylation of α-ketoglutarate
    e. Conversion of glucose (aldose) into fructose-6-phosphate (ketose)

What is the difference between an aldose and a ketose? Draw an example of each.

What is the difference between a hemiacetal and an acetal? Draw an example of each.

What is the difference between an acetal and a ketal? Draw an example of each.

Draw glucose in Haworth structure and Fischer projection. Circle the anomeric carbon and briefly describe what is significant about this carbon. Put a box around any chiral carbons.

Draw the following DNA strands in the proper orientation relative to one another. Include any hydrogen bonds.

5’-GACT-3’and
5’-AGTC-3’

Indicate the positions of the 5’ phosphate and 3’ hydroxyl group.

What are the four head groups that were discussed in BIOC*2580 regarding lipids?

Draw **each** of these with stearate with an unsaturation at the omega-4 position at the first fatty acid position. Draw the second with C14:2 ($\Delta^{9,12}$).

Draw the complete structure of NADPH, in **both** the reduced and oxidized forms (when it is oxidized is it still called NADPH though? What is the net charge on this molecule?)

It was found that one of the steps in glycolysis produces a certain product which can be uses for the biosynthesis of Ala. Draw and name this product, draw Ala, and suggest a mechanism that an enzyme which catalyzes this mechanism would adopt.

What is the P/O ratio and how is it significant?

Do an ATP “balance” sheet to determine the total yield of ATP during oxidation of one molecule of stearatoy-CoA to CO_2 and H_2O.

To get you started, what is the P/O ratio for $FADH_2$, and what is the P/O ratio for NADH?

The next few questions relate to the ETC and the F1-F0 ATP synthetase.

NADH and $FADH_2$ are reduced electron carries. How do these act on the ETC? Are they equivalent in terms of thermodynamics?

What is the chemiosmotic theory? Use this to **bridge** the ETC and F1-F0 ATP synthetase.

Draw a membrane with BOTH the ETC and F1-F0 ATP synthetase. Label the membrane, label the ETC, label the F1 and F0 ATP synthetase subunits, label each of the environments of the sides of the membrane, label where O_2 acts as a final electron acceptor, label which side has higher or lower pH, label which side is responsible for catalyzing ADP + Pi → ATP.

Draw the F1-F0 ATP synthetase. Be sure to include important details (such as the key amino acid residues discussed in class). Include enough detail to get 10 marks. (A similar question has shown up before on the final!)

Remember the ATP balance sheet from above regarding the oxidation of fatty acids? Now do one for glucose. How are these charts different?

Draw a cartoon of the DNA double helix (don’t draw intricate molecular details; just shapes). Label the following: 5’ end and 3’ end of each strand, the major groove, the minor groove, where the phosphate-sugar backbone is, and where the bases would be. Also indicate how many base pairs per turn, and the distance per turn (in Angstroms).

On the diagram above, show where/how you think a DNA-binding protein would interact. Discuss a potential motif that may be observed in the DNA-binding domain of this protein. (Hint: discuss shape, and residue type). The residues present in this protein probably serve two different functions; one specific and one non-specific. Relate these functions to the structure of the DNA that is(are) applicable.

As a final question, try to make sure that you can **integrate** metabolism. Draw a flow chart relating everything from a fatty acid and from glucose, all the way to substrate-level phosphorylation (if applicable) and if reduced cofactors are generated, follow these all the way to ATP synthesis by the F1-F0 ATP synthetase.

Another good thing to note is the **location** (cellular) of each of these pathways.

GOOD LUCK ON YOUR FINAL EXAM!