Chem153A
Biochemistry: Introduction to Structure, Enzymes and Metabolism
Exam 2

Name: Date:

Instructions: Limit your answers to 2 brief sentences. Graders are not required to grade more than 2 sentences per question. This exam is open notes/ book. Follow the honor code specified in the syllabus.

1. What are the products of beta oxidation of a 21-carbon fatty acid? (Provide the number of each product formed.)

9 molecules of acetyl coA + 1 molecule of propionyl CoA

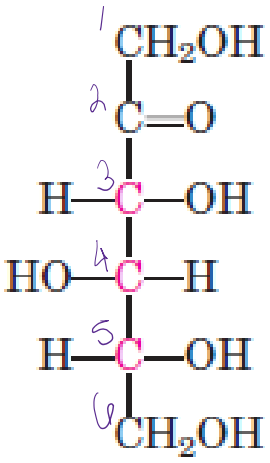
2. How would a deficiency in carnitine affect fatty acid oxidation? Briefly explain why this would be the effect.

A deficiency in carnitine decreases levels of fatty acid oxidation because the oxidation process requires the fatty acyl group to be attached to carnitine in order to be transported into the mitochondria.

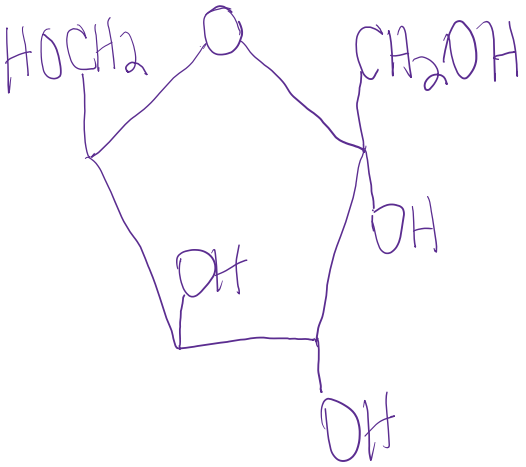
3. If a mutation in the alpha subunit of the G-protein removed its GTPase activity, how would this affect the activity of adenylyl cyclase and subsequently adenylyl cyclase's effect on cAMP?

Adenylyl cyclase will remain active and increase cAMP levels.

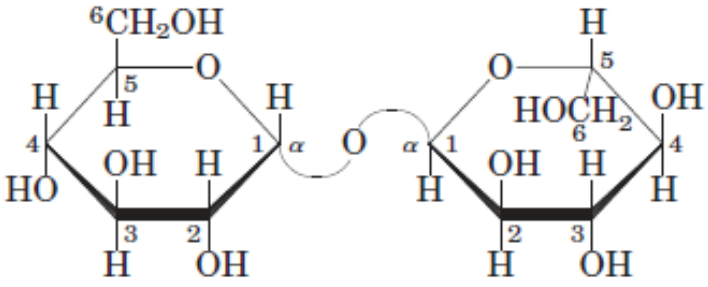
4. Draw the Haworth perspective formula of D-sorbose as an alpha anomer in the furanose form.



D-Sorbose



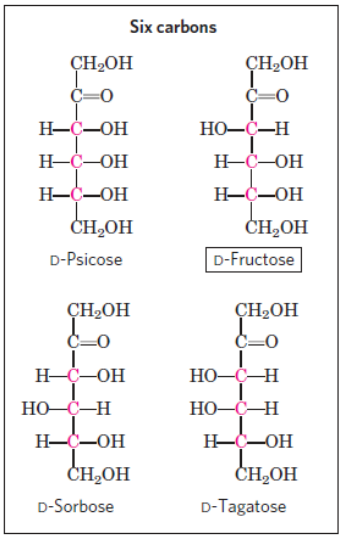
5. Does trehalose sugar have a reducing end?



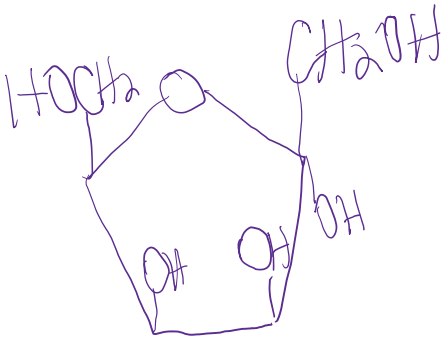
Trehalose

No.

6. Below is the structure of four ketohexoses. Circle the C4 epimer of D-fructose and draw the Haworth perspective formula of the C4 epimer of D-fructose in the furanose ring structure.



D-Tagatose is the c4 epimer.



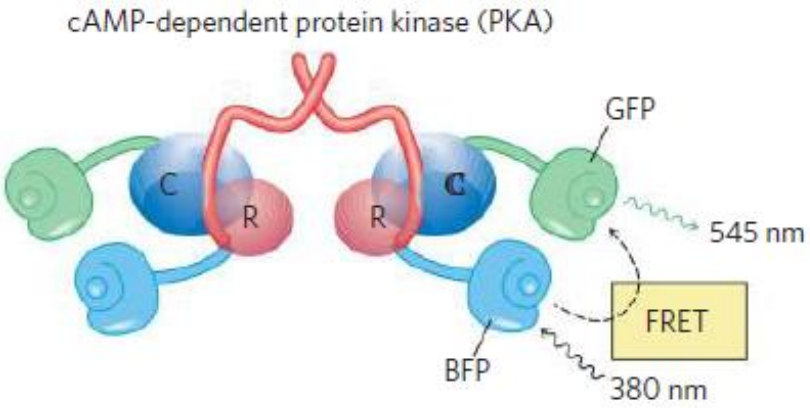
7. Diabetes type I is characterized by an inability to release insulin, which results in prolonged high blood glucose levels. How may the consumption of an alpha-glucosidase (enzyme that cleaves alpha glycosidic bonds found in glucose hetero and homopolymers) inhibitor with a meal, facilitate treatment of diabetes?

Alpha-glucosidase inhibitors would lessen the amount of free glucose from dietary carbohydrates in the blood after a meal and better control blood glucose levels for diabetics.

8. Briefly explain why a flippase is necessary for the translocation of a phospholipid from the outer leaflet to the inner leaflet.

Without flippase the translocation process is slow and unfavorable.

9. FRET can be used to determine cAMP concentrations. BFP has an excitation wavelength of 380nm, and then participates in FRET with GFP, which has an emission wavelength of 545 nm (see diagram below). Will the emission wavelength of 545 nm be present when cAMP is present? Briefly explain why or why not.



No, because the regulatory subunits dissociate from the catalytic subunits when cAMP binds to the regulatory subunits, and FRET can no longer occur.

10. Below is the reduction potential of 2 biological half reactions. Based upon the reduction potentials below, is acetaldehyde or pyruvate more likely to get oxidized?

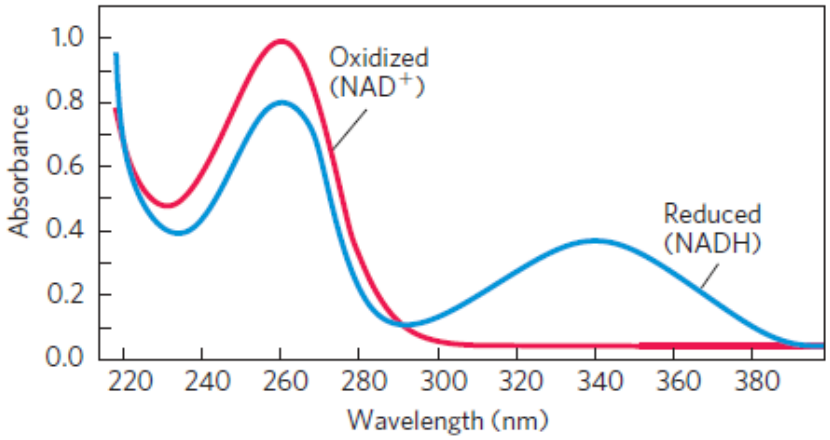
$\text{Pyruvate}^- + 2\text{H}^+ + 2e^- \longrightarrow \text{lactate}^-$	-0.185
$\text{Acetaldehyde} + 2\text{H}^+ + 2e^- \longrightarrow \text{ethanol}$	-0.197

Acetaldehyde is more likely to get oxidized and lose electrons.

11. How is it possible for ATP to be required for PFK1 to catalyze the committed step of glycolysis, yet still function as an inhibitor of PFK-1?

ATP can bind to the active site and allosteric (regulatory) site of PFK1.

12. After glucose is fermented in yeast, ethanol is produced. Based upon the diagram below, will the absorbance at 340 nm likely increase or decrease after fermentation in yeast?



The absorbance for NADH at 340 nm decreases after glucose is fermented to ethanol in yeast.

13. Which one of the following statements is true?
    a. Once in the blood capillary apolipoproteins are degraded by lipoprotein lipase to form fatty acids and glycerol
    b. Once in the blood capillary TAGs are degraded by lipoprotein lipase to form fatty acids and glycerol
    c. Once in the blood capillary cholesterol is degraded by lipoprotein lipase to form fatty acids and glycerol.
    d. None of the above

B

14. Calculate the free energy of transport of solute X from the cytosol to the extracellular space by using the formula below. State whether the transport may require energy in the form of ATP at 37°C. $[\text{Solute X}]_{\text{cytosol}}$ = 9 mM; $[\text{Solute X}]_{\text{extracellular space}}$ = 25 mM. Standard transmembrane potential is 50mV (negative inside) for the plasma membrane.

$$\Delta G_t = RT \ln(C_2/C_1) + Z\mathcal{F}\Delta\psi$$

R = 8.315 J/ mol·K
F = 96,500 J/ V·mol

$\Delta G_t = 8{,}315\,\frac{J}{mol\cdot K} \times 310\,K \times \ln\left(\frac{25\,mM}{9\,mM}\right) =$

$\Delta G_t = 2.6\,\frac{kJ}{mol} \simeq 3\,\frac{KJ}{mol}$

It may require energy in the form of ATP

15. Briefly describe the effect of cholesterol on the lipid bilayer composed primarily of long chain saturated fatty acids. More specifically, does cholesterol increase of decrease the fluidity of such a lipid bilayer

Cholesterol increases the fluidity of the lipid bilayer composed of long chain saturated fatty acids.

16. Provide the names of the phosphoryl donor and acceptor during the substrate level phosphorylation steps of glycolysis.

1st substrate level phosphorylation
Phosphoryl group donor: _____
Phosphoryl group acceptor: _____

Donor: 1,3-bisphosphoglycerate

Acceptor: ADP

2nd substrate level phosphorylation
Phosphoryl group donor: _____
Phosphoryl group acceptor: _____

Donor: Phosphoenolpyruvate

Acceptor: ADP

17. How does a low blood glucose level affect fatty acid synthesis/ degradation? Specifically consider the effect of the hormone glucagon.

Glucagon activates cAMP-dependent PKA, which phosphorylates acetyl CoA carboxylase (ACC), making ACC become inactive. This causes malonyl CoA levels to fall and facilitates fatty acid entry into the mitochondria, where fatty acid beta oxidation occurs.

18. Aspirin is a non-steroidal anti-inflammatory drug that inhibits cyclooxygenase 2. Select the answer choice that details how aspirin inhibits cyclooxygenase 2

    a. By transferring an acetyl group to the active site serine of cyclooxygenase 2
    b. By transferring a phosphoryl group to the active site serine of cyclooxygenase 2
    c. By transferring a DIPF molecule to the active site serine of cyclooxygenase 2
    d. None of the above

A

19. How can a signal transduction cascade that has been activated by epinephrine be terminated?
    a. Decrease the GTPase activity of the alpha subunit of the G protein
    b. Decrease cyclic nucleotide phosphodiesterase activity
    c. Increase the concentration of epinephrine that binds the beta-adrenergic receptor
    d. None of the above

D

20. When the ratio of ATP to AMP is low, PFK-1 is
    a. Activated
    b. Inhibited at an allosteric site
    c. Inhibited at its active site
    d. None of the above

A