

BCHM 463

Your Name: _____

Biochemistry and Physiology

ID #: _____

Exam III, December 11, 2002

Prof. Jason Kahn

You have 55 minutes for this exam.

Exams written in pencil or erasable ink will not be re-graded under any circumstances.

You may use a calculator for this exam. No other study aids or materials are permitted.

Generous partial credit will be given, *i.e.*, if you don't know, guess.

This exam is significantly easier than the previous two. RELAX!

Remember the final is December 18, 8-10 a.m., Chemistry 1402.

Explanations should be concise and clear.

Honor Pledge: Please write out the following sentence and sign it, or talk to me about it:

"I pledge on my honor that I have not given or received any unauthorized assistance on this examination."

Probably non-useful information:

$RT = 2476 \text{ J/mole}$ today

$\Delta G = \Delta G^\circ + RT \ln Q$, where Q has the form of an equilibrium constant

$\Delta G = -nF\Delta E$, where $F = 96500 \text{ J/(V}\cdot\text{mole)}$, n = number of electrons transferred

$\Delta G^\circ = -30.5 \text{ kJ/mole}$ for $\text{ATP}^{4-} + \text{H}_2\text{O} \rightleftharpoons \text{ADP}^{3-} + \text{HPO}_4^{2-} + \text{H}^+$

The new Secretary of the Treasury will probably be John Snow.

For questions 1-3: Glucagon promotes glycogen breakdown: it's the "We're hungry" hormone. Heart muscle cells do not respond to glucagon, but epinephrine similarly stimulates glycogen breakdown in these cells. The effects of glucagon or epinephrine ("Fight or flight") are mediated through the cyclic AMP-dependent protein kinase (cAPK), which phosphorylates the bifunctional phosphofructokinase-2/fructose-bisphosphatase-2 (PFK-2/FBPase-2) enzyme.

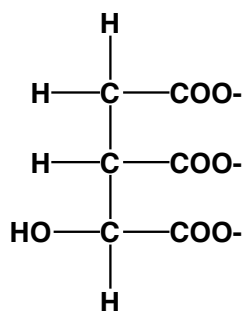
1. (8 pts) What is the physiological rationale behind coordinated activation of gluconeogenesis and glycogen breakdown in the liver, vs. coordination of glycolysis and glycogen breakdown in muscle?
2. (8 pts) In the liver, which activity of PFK-2/FBPase-2 is increased and which activity is decreased upon phosphorylation of the enzyme? How does this eventually lead to the appropriate response to a lack of blood glucose?
3. (3 pts) Heart muscle also responds to elevated cAMP by cAPK-dependent phosphorylation of PFK-2/FBPase-2, but the effect on which activity goes up and which goes down is opposite from the liver. How is this possible? A two word answer would do.

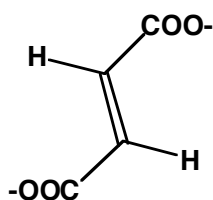
- (8 pts) Red blood cells cannot do gluconeogenesis, but they still have FBPase-1. Give two reasons why this might be important for their metabolism. Hint: consider flux control for one reason, oxidative stress for the other.
- (8 pts) What two enzymes in gluconeogenesis catalyze the reversal of the pyruvate kinase reaction? What cofactor is essential in the first of these reactions? Name a tissue besides the liver in which gluconeogenesis occurs.

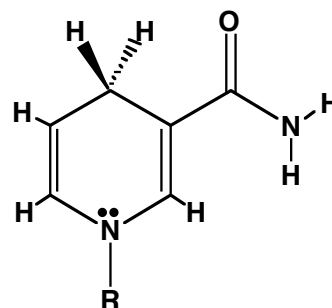
6. (9 pts) For any one reaction of the TCA cycle, write out the structures and names of the reactants and products, and name the enzyme that catalyzes it (you need not draw structures of CoA, NADH, or GTP, but indicate their participation if appropriate).
7. (6 pts) Briefly describe one way in which a high $[NADH]/[NAD^+]$ ratio decreases flux around the TCA cycle. Why is this sensible in terms of cellular physiology?
8. (4 pts) Why do yeast consume much more sugar when growing anaerobically as opposed to aerobically?

9. (8 pts) Most fatty acids cannot support the net synthesis of glucose (in our cells) whereas most amino acids can. Explain why.

10. (7 pts) Which of the three molecules below is chiral, which is prochiral, and which is simply achiral? For either the chiral or the prochiral molecule, sketch recognition by a chiral surface to explain enzymatic discrimination between a pair of chemically identical H's.



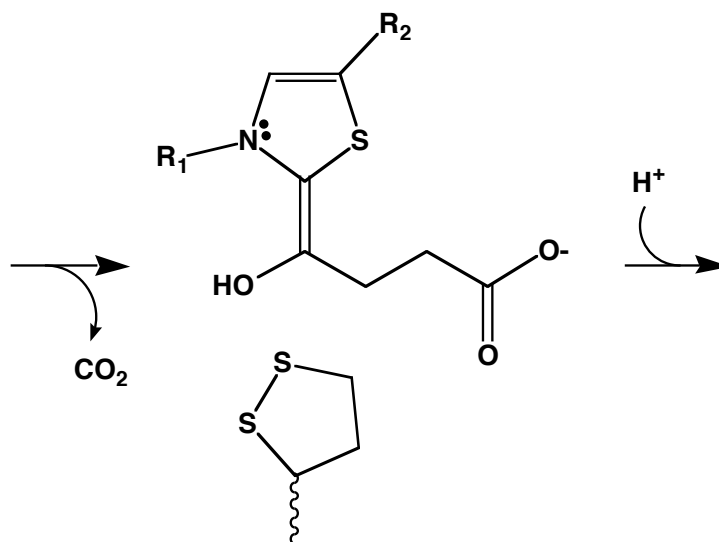




11. (5 pts) Which direction is thermodynamically favorable in the cell, glycogen synthesis or glycogen breakdown? Write the chemical equation for one step of the breakdown reaction.

12. (4 pts) The citrate synthase reaction is strongly exergonic. Why is this essential to maintaining flux through the TCA cycle?

13. (10 pts) One intermediate in the α -ketoglutarate dehydrogenase reaction is shown below. Draw the preceding structure and the next structure in the reaction mechanism, and arrow pushing for both steps.



14. (12 pts) What are the three key features of the process of converting NADH reducing power to ATP energy?

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TOTAL _____ **/100**

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