

50 pts -in class
Exam 2 454-2008

NAME

KEY

"Let us rise up and be thankful, for if we didn't learn a lot today, at least we learned a little, and if we didn't learn a little, at least we didn't get sick, and if we got sick, at least we didn't die; so, let us all be thankful."

- Buddha

3 even
reductase
3 odd isomerase

1. DHA; 22:6(ω -3), *all-cis*-docosa-4,7,10,13,16,19-hexaenoic acid; (trivial name cervonic acid) is an omega-3 fatty acid that is abundant in the nervous system and some believe it should be considered an essential fatty acid. It is reputed to have major positive health effects. Estimate the number (show work) of ATP's obtainable from complete oxidation of this fatty acid.(10)



so

-3 FADH₂

$$20C = 11 \frac{AcCoA}{TCA} \times 10 = 110 \text{ ATP}$$

$$10 \text{ NADH} \times 2.5 = 25$$

$$10 \cdot 3 \Rightarrow FADH_2 \times 1.5 = 10.5$$

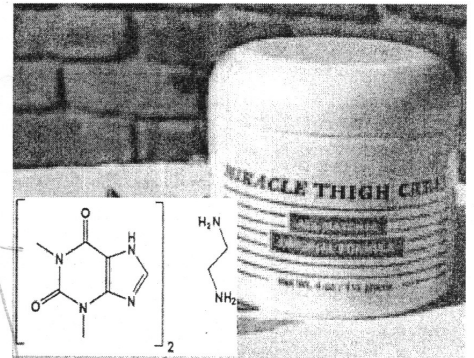
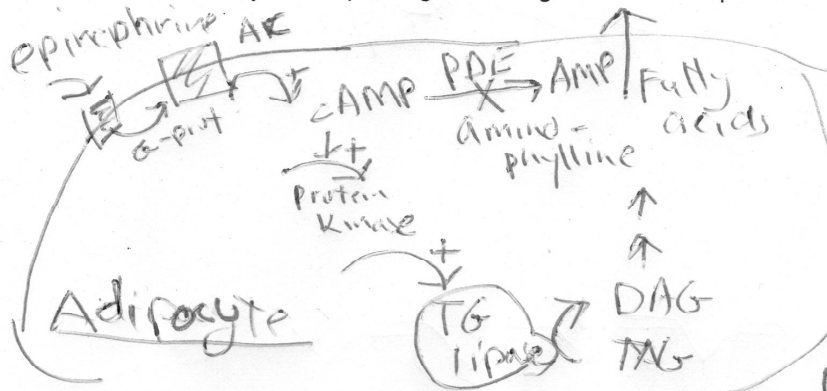
$$- 2 \text{ activation} = -2$$

143.5 ATP

Note 3 NADPH's used. Even though NADH \neq NADPH, I will give you credit for explicitly considering the loss

2. Aminophylline, found in Miracle Thigh Cream, inhibits cAMP phosphodiesterase. (10)

A. Explain how this product might help mobilize fats from your ample thighs. A diagram would help.



Aminophylline blocks cAMP hydrolysis and lengthens release time of fats \equiv more fat mobilized

B. Now explain why one might be skeptical of the claims that your thighs will become thinner by rubbing this stuff on even if you just sit around and eat as much as you want. Explain two reasons to be skeptical.

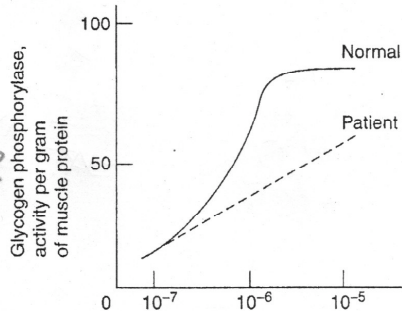
- 1) IF Fatty acids are unused, they will be redeposited
- 2) Extra unused fats from food will be deposited
- 3) Aminophylline may not even get across the skin!!

C. Assume for a moment that the claims are true. What might be the metabolic result of using this product with an extremely low carb diet? Explain what you might expect concerning blood sugar and fatty acid and ketone body levels.

IF extra fats were mobilized it might be expected to cause an increase in ketone bodies since a low carb diet will compromise the TCA, we would expect serum fatty acid to also increase. Blood sugar levels will likely remain the same, at least for a while, because you would already be in gluconeogenesis mode.

3. A patient can perform nonstrenuous tasks but becomes fatigued with physical exertion. Assays from a muscle biopsy reveal that glycogen levels are slightly elevated relative to normal. Crude extracts from muscle are used to determine the activity of glycogen phosphorylase at various levels of Ca^{2+} ion for the patient and for a normal control. The results of the assay are shown below. Briefly explain the clinical and biochemical symptoms. Speculate on the nature of the mutation that might cause this disorder and the specific protein affected. (5)

Response of glycogen phosphorylase to calcium ion in a patient and in a normal person.

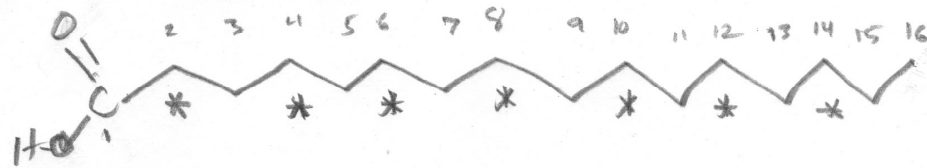


Most likely, the Ca^{2+} is acting by way of phosphorylase kinase which is activated by Ca^{2+} . Either the δ subunit (calmodulin) or PK

binding site for the δ -subunit is altered.

Since muscle phosphorylase is affected, overall blood glucose should be normal. But, local glucose release in muscle is hampered meaning that strenuous activity would cause a depletion of muscle ATP.

4. Malonyl CoA labeled with ^{14}C in the methylene carbon can be used in excess as a substrate in an *in vitro* system for synthesizing labeled palmitoyl CoA by a yeast fatty acyl synthase complex. Unlabeled Acetyl CoA and other substrates are also present *but not acetyl CoA carboxylase*. Draw a palmitic acid molecule below (16:0) with stars (*) to show which carbons will be labeled. (5)



all even carbons

except (important exception) # 16
(from Acetyl CoA)

Multiple Choice (2 each). Write in letter of best answer. (20pts)

1. **B** In animals, the carbon backbone of glucose _____ be metabolically converted and stoichiometrically utilized for synthesis of fatty acids; in animals, the carbon backbone of fatty acids _____ be metabolically converted and stoichiometrically utilized for synthesis of glucose.
 - a. Can; can
 - b. Can; cannot
 - c. Can only; can only
 - d. Cannot; can
 - e. Cannot; cannot

2. **C** Which of the following is an incorrect association between a metabolic pathway and the intracellular compartment within which it primarily occurs?
 - a. Beta-oxidation of fatty acids; mitochondrial matrix
 - b. Citric acid cycle; mitochondrial matrix
 - c. Fatty acid synthesis; mitochondrial matrix
 - d. Glycolysis; cytoplasm
 - e. Pentose phosphate pathway; cytoplasm

3. **B** Which of the following best describes the biochemical role of carnitine in fatty acid metabolism?
 - a. It accepts electrons from FADH_2 to regenerate the FAD reduced during fatty acid oxidation.
 - b. It acts as a carrier of fatty acids across the inner mitochondrial membrane.
 - c. It acts as a direct source of malonyl groups for fatty acid synthesis.
 - d. It is decarboxylated to provide a thermodynamic driving force for fatty acid synthesis.
 - e. It solvates the elongating hydrophobic chain produced during fatty acid synthesis.

4. **C** Which of the following is an enzyme whose activity is reduced as a result of direct phosphorylation by cAMP-dependent protein kinase?
 - a. Glycogen phosphorylase
 - b. Glycogen phosphorylase kinase
 - c. Glycogen synthase
 - d. Inhibitor 1
 - e. Protein phosphatase 1

5. **C** During beta-oxidation, the carbon backbone of fatty acids is converted into which of the following?
 - a. Carbon dioxide
 - b. Pyruvate
 - c. Acetyl groups
 - d. Malonyl groups
 - e. Succinyl groups

6. **B** Which of the following best describes, in order, the complete series of catalyzed reactions that occurs as a molecule of acyl-CoA is shortened by one two-carbon unit during fatty acid degradation?
 - a. Hydration; oxidation; thiolysis
 - b. Oxidation; hydration; oxidation; thiolysis
 - c. Oxidation; hydration; reduction; thiolysis
 - d. Oxidation; hydration; thiolysis
 - e. Reduction; hydration; oxidation; thiolysis

7. A Which of the following best describes the activated acyl intermediate formed prior to production of acyl-CoA in the reaction catalyzed by acyl-CoA synthetase?
- Acyl-adenylate
 - Acyl-glutarate
 - Acyl-ornithine
 - Acyl-pyridoxal phosphate
 - Acyl-uridylate
8. E The purpose of the pentose phosphate pathway is to
- | | |
|--------------------------------|-------------|
| A) generate ATP. | D) a and b. |
| B) generate NADPH. | E) b and c. |
| C) synthesize 5-carbon sugars. | |
9. B Two critical hormones that signal for glycogen breakdown are
- insulin and epinephrine.
 - glucagon and epinephrine.
 - glucagon and insulin.
10. B Light absorbed by a chlorophyll *a* causes
- an electron to move from the photon to the chlorophyll.
 - an electron to move from ground state to an excited state.
 - an electron to move to a neighboring water molecule.
 - an electron to move from chlorophyll to ADP.
 - none of the above.