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C483 Metabolism Quiz Version 2  
Spring 2017

Name \_\_\_\_\_ Seat Number \_\_\_\_\_

Student ID \_\_\_\_\_

**The last page of this exam contains room for scratchwork and information you might find useful.**

This exam contains 50 points on a total of 6 pages

1. \_\_\_\_\_/20pts

2. \_\_\_\_\_/10pts

3. \_\_\_\_\_/10pts

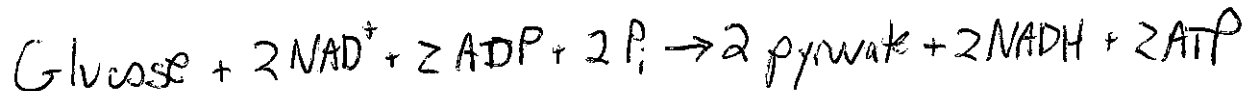
4. \_\_\_\_\_/10pts

Total:

Regrading: All requests for regrades must be submitted in writing within 48 hours of the return of the exam. You must explicitly state what has been misgraded and why it is an error. The entire exam will be regraded, which could result in points being added or deducted overall.

1. 20 pts. Answer the following questions from the reading guides.

A. (3pts) Write the net equation (ignoring water and protons) for glycolysis ending in the production of pyruvate.



B. (2pts) What is the chemical driving force that gives a large standard free energy change to the reaction of phosphoenolpyruvate with ADP to form ATP and pyruvate?

enol tautomerization

C. (3pts) What is the starting material of the pentose phosphate pathway (PPP)? What are the two products of the oxidative phase of the PPP?

- Glucose (or Glucose-6-P)
- NADPH and 5 carbon sugar (or ribose-5P or ribulose-5-P)

D. (2pts) Name two of the four types of enzymes necessary to catalyze the interconversion of sugars in the non-oxidizing phase of the pentose phosphate pathway.

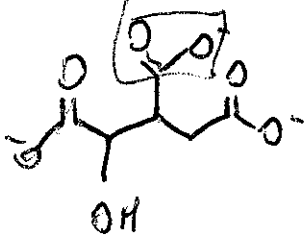
isomerase                      transaldolase                      (any 2)  
epimerase                      transketolase

E. (3pts) List three redox cofactors of the pyruvate dehydrogenase complex.

lipoamide                      NAD/NADH<sub>2</sub>  
FAD/FADH<sub>2</sub>

F. (2pts) Increasing the concentration of citric acid cycle intermediates increases flux through the pathway.

G. (3pts) Draw isocitrate. Isocitrate has three carboxyl groups—give a chemical rationale for why only one is eliminated as carbon dioxide by isocitrate dehydrogenase.



Only one is  $\beta$  to the site where the hydroxyl group will be oxidized to the ketone, allowing for resonance stabilization for decarboxylation

H. (2pts) What is the net cost in ATP equivalents to incorporate glucose-1-phosphate into glycogen?

one

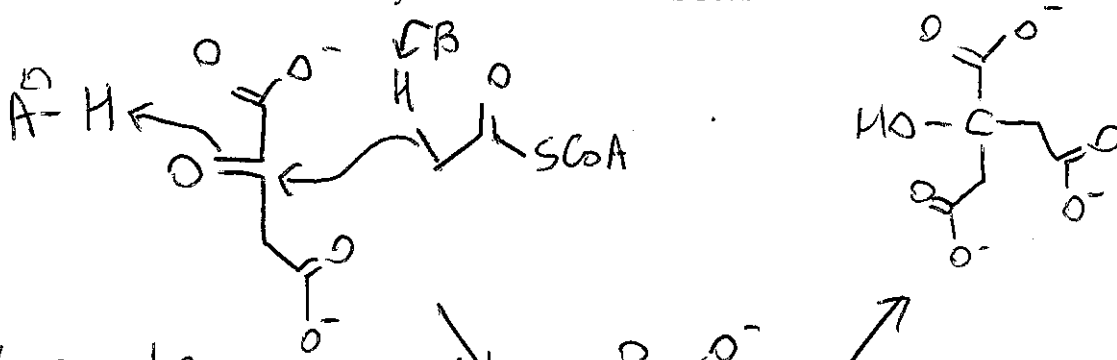
2. (10 pts.) Fill in the appropriate enzyme name. If you think there is more than one enzyme that would answer the question, only write one answer.

- A. hexokinase first irreversible step in glycolysis starting from glucose
- B. succinate DH a redox enzyme in the Citric Acid Cycle that does not use  $\text{NAD}^+$
- C. phosphoglycerate K.ase a reversible reaction in glycolysis that produces ATP
- (also isocitrate DH) D.  $\alpha$  KG DH Citric acid cycle enzyme that decarboxylates with a cofactor
- E. malate DH catalyzes transformation of malate to oxaloacetate
- F. Glucose 6P DH catalyzes transformation of glucose-6-phosphate to a lactone
- G. glycogen phosphorylase breaks down glycogen using phosphate
- H. succinyl CoA synthetase catalyzes substrate level phosphorylation in the citric acid cycle
- I. pyruvate DH commits the carbon atoms of pyruvate away from carbohydrates
- J. pyruvate carboxylase catalyzes transformation of pyruvate to oxaloacetate



4. (10pts) Draw an arrow mechanism for the following enzyme-mediated transformations. You can use generic acids and bases (HA, B:) for the enzyme sidechains. Cofactor structures are on the last page of the exam if you need them.

A. oxaloacetate + acetyl CoA  $\rightarrow$  citrate + HSCoA

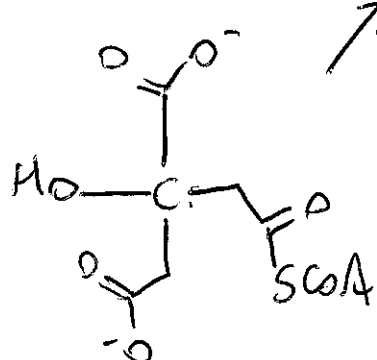


There can be variations:

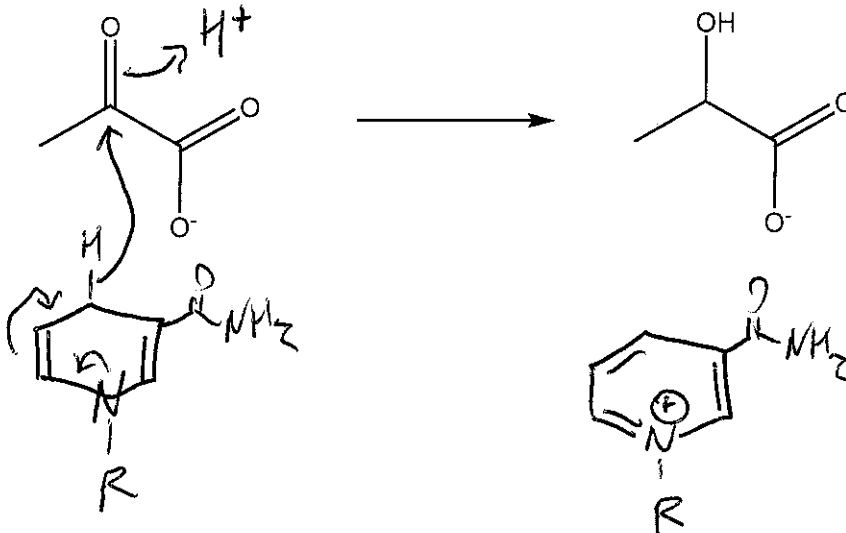
(+1) Deprotonation of acetyl CoA

(+2) aldol addition

(+2) thioester hydrolysis



B.



(+2) use of NADH

(+2) Hydride transfer

(+1) protonation

Cofactors and Scratchwork: Nothing written on this page will be graded.

