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C483 Metabolism Quiz
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.

Glucose + 2 NAD^+ + 2 ADP + 2 P_i → 2 pyruvate + 2 NADH + 2 ATP

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-5-P 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.

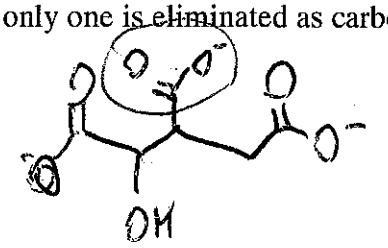
isomerase transaldolase (any 2)
epimerase transketolase

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

lipoamide NAD/$NADH_2$
FAD/$FADH_2$

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 rational for why only one is ~~eliminated~~ as carbon dioxide by isocitrate dehydrogenase.



Only the carboxylate β to the position where the alcohol will be oxidized to a ketone will decarboxylate because the intermediate anion is resonance stabilized.

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. pyruvate carboxylase catalyzes transformation of pyruvate to oxaloacetate

B. hexokinase first irreversible step in glycolysis starting from glucose

C. succinate DH a redox enzyme in the Citric Acid Cycle that does not use NAD^+

D. phosphoglycerate kinase a reversible reaction in glycolysis that produces ATP

E. αKG DH Citiric acid cycle enzyme that decarboxylates with a cofactor

F. malate DH catalyzes transformation of malate to oxaloacetate

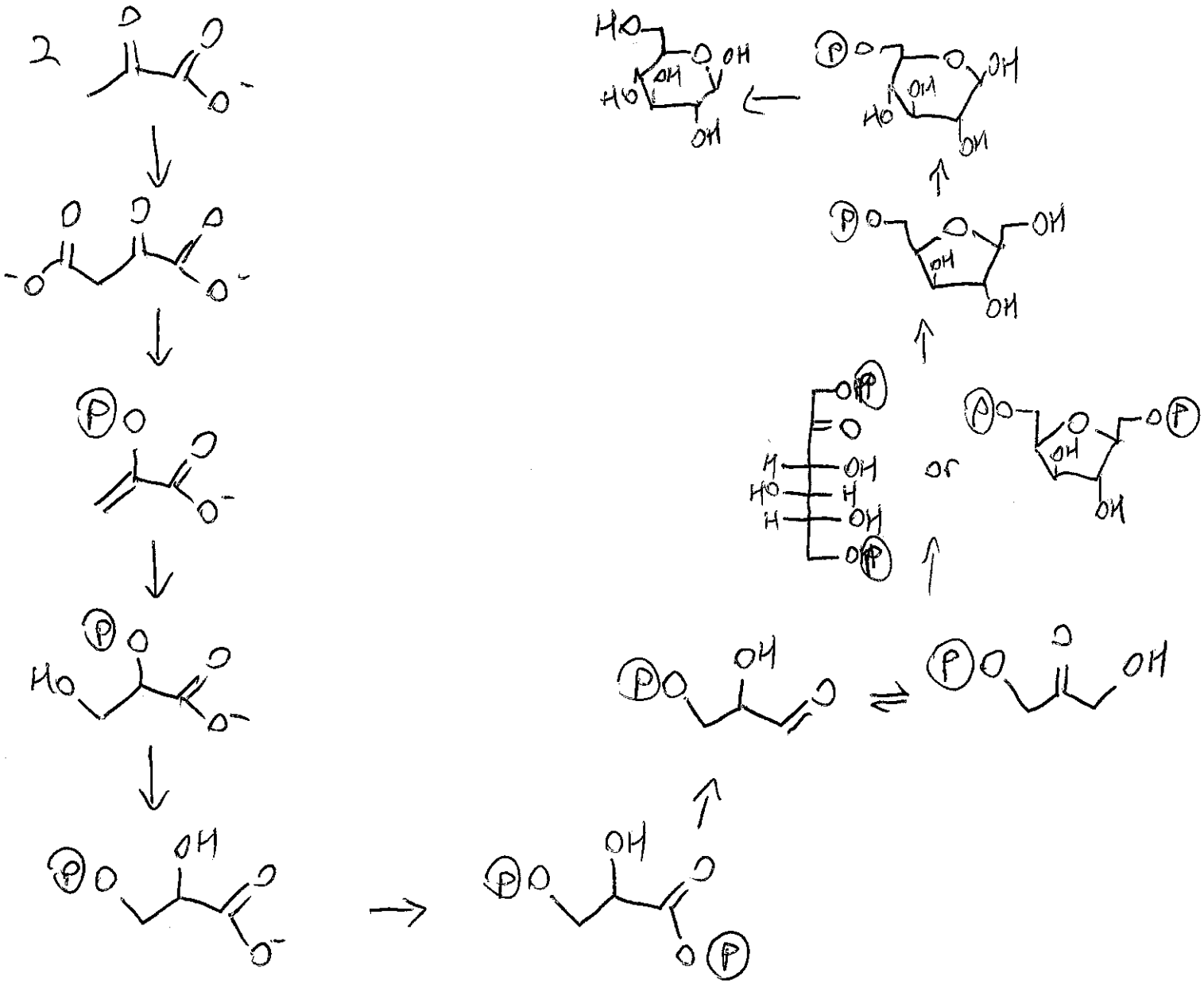
G. Glucose-6-P DH catalyzes transformation of glucose-6-phosphate to a lactone

H. glycogen phosphorylase breaks down glycogen using phosphate

I. succinyl CoA synthetase catalyzes substrate level phosphorylation in the citric acid cycle

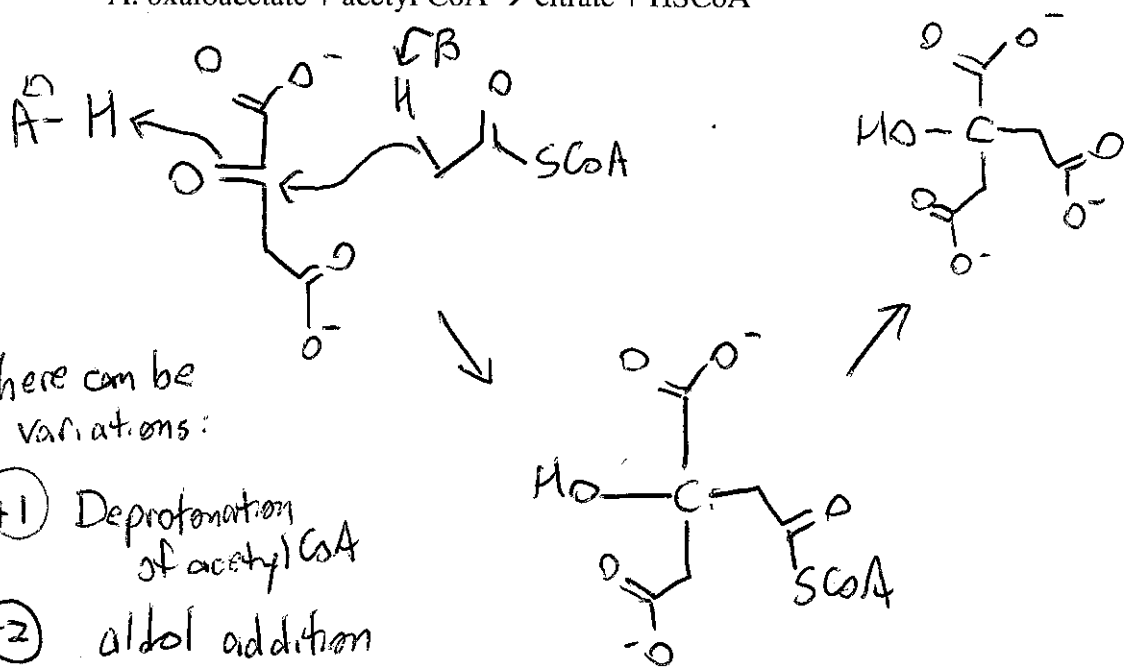
J. pyruvate DH commits the carbon atoms of pyruvate away from carbohydrates

3. (10 pts.) Draw the structures of all intermediates in a pathway for the transformation of two pyruvate molecules to a glucose molecule. You do not have to indicate cofactors, enzymes names, or ATP use/production.



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 → citrate + HSCoA



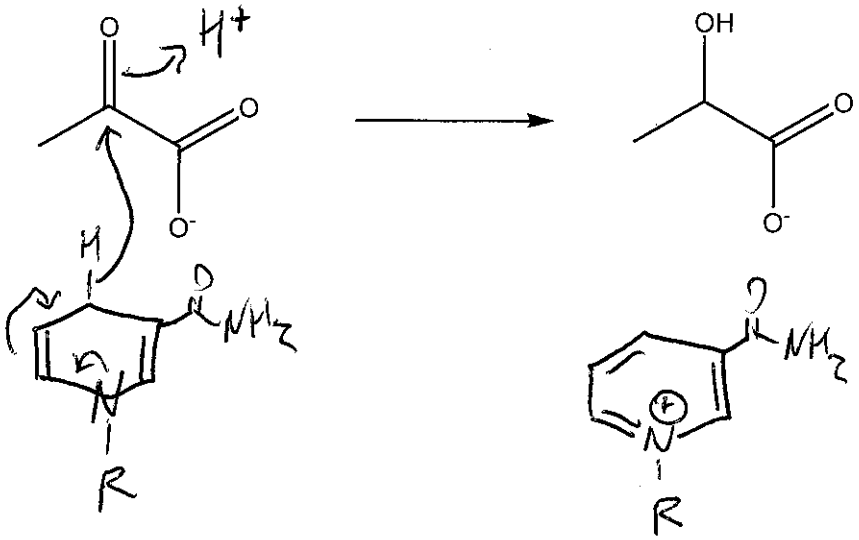
There can be variations:

(+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.