

CHEMISTRY 326

NAME \_\_\_\_\_ KEY \_\_\_\_\_

Summer 2005

EXAM 4

1. (10pts) Answer true or false:

- T \_\_\_ a. Glycogen synthase is inactive when it is phosphorylated
- T \_\_\_ b. Glycogen synthase is active when in the presence of high levels of G-6-P
- F \_\_\_ c. Glucagon and epinephrine have opposite effects on glycogen metabolism
- F \_\_\_ d. Glucagon stimulates glycogen synthesis

2. (6pts) Explain the statement that glucagon inhibits EMP and stimulates GNG. Be specific.

Through the enzyme cascade that is initiated by glucagon the Protein Kinase is activated. This enzyme works on PFK-2 by phosphorylating it which changes the enzyme conformation resulting in turning off the kinase and turning on the phosphatase domain which will break down the F2,6BPate to F6P thereby eliminating the allosteric accelerator of PFK1 which favors EMP. Thus EMP will slow down.

In addition, the PK will activate the F1,6BPtase which will remove a phosphate from F1,6BPate and generate F6P. The net result will be to increase GNG and decrease EMP.

3. (5pts) Place the following in the order in which they occur: NO PARTIAL CREDIT:

Using #1 as the first event to #5 for the last event.

- 2 \_\_\_ a. Formation of cAMP
- 3 \_\_\_ b. Activation of Protein kinase by the release of the regulatory units
- 5 \_\_\_ c. Phosphorylation of phosphorylase
- 4 \_\_\_ d. Phosphorylation of synthase and phosphorylase kinase
- 1 \_\_\_ e. Hormone binding to cell receptor

4. (10pts) You are studying a patient with Hers' disease which is a lack of liver glycogen phosphorylase. Explain what you would expect to find when you carry out the following analysis: indicate normal, high, low amounts, or no effect.

a. Fasting level of blood glucose \_\_\_\_\_ low to normal \_\_\_\_\_

b. Structure and amount of liver glycogen \_\_\_\_\_ high \_\_\_\_\_

c. Structure and amount of muscle glycogen \_\_\_\_\_ no effect normal \_\_\_\_\_

d. Change in blood lactate levels after vigorous exercise \_\_\_\_\_ normal \_\_\_\_\_

e. Change in blood glucose levels after administering glucagon \_\_\_\_\_ low \_\_\_\_\_

5. (5pts) Caffeine inhibits PDE. How does this affect metabolic responses to glucagon?

It will keep the cascade going. The cells can respond to glucagon by increasing the response to the hormone and the levels of bld glc will continue to increase.

6. (5pts) People with thiamine deficiency have elevated blood pyruvate, especially after eating a meal rich in carbohydrates. How are these effects related to thiamine deficiency?

Thiamine is the vitamin precursor to TPP. If there is no TPP the PDC will not work and Pyruvate will accumulate.

7. (5pts) Two steps of the oxidative decarboxylation of pyruvate to acetyl-CoA do not involve any of the 3 carbons of pyruvate, yet are essential to the operation of PDC. Explain.

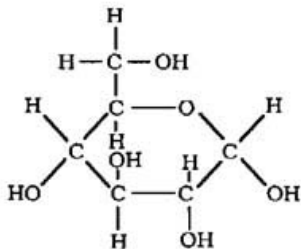
The steps involve regeneration of CoEs so that the PDC can continue to function. These steps involve the oxidation of Lipoic acid, and FAD/NAD

8. (10pts) How much energy is realized from the oxidation of each of the following to acetyl CoA:

- a. Sucrose \_\_\_\_\_ 24/28 \_\_\_\_\_
- b. 5 Acetyl-S-CoA \_\_\_\_\_ 60 \_\_\_\_\_ OMIT \_\_\_\_\_
- c. 4 moles of pyruvate \_\_\_\_\_ 12 \_\_\_\_\_
- d. glucose from glycogen breakdown \_\_\_\_\_ 13/15 \_\_\_\_\_
- e. 1 mole of 3-PGAL \_\_\_\_\_ 7/8 \_\_\_\_\_

9. (6pts) The enzyme UDP-galactose-4-epimerase transforms UDP-D-galactose to its UDP-epimer at position 4. What are the structure and the name of the monosaccharide portion of the UDP-epimer in this reaction?

It results in UDPG or glucose.



10. (20pts) Indicate which of the following statements are True or False:

F  a. EMP is an example of a spiral pathway.

F  b. EMP enzymes are found in the mitochondria.

F  c. Energy produced in glycolysis is primarily from oxidative phosphorylation.

T  d. Glucose-1-phosphate is a direct product of glycogenolysis.

F  e. GNG is totally the reverse of EMP that occurs when blood glucose levels are low.

T  f. The Cori cycle is a combination of EMP and GNG.

T  g. The pentose shunt provides extramitochondrial reducing equivalents.

T  h. Sugar nucleotide carriers are involved in galactose metabolism.

F  i. cAMP is a secondary messenger that directly activates glycogen synthase.

F  j. Glucokinase is inhibited by G-6-P.

11. (6pts) Illustrate the cyclic process by which  $\text{NAD}^+$  is regenerated to keep EMP going.

Anaerobic conditions: Pyruvate accepts the reducing equivalents and becomes Lactate and the  $\text{NAD}^+$  is regenerated.

Aerobic conditions: The reducing equivalents are shuttled to the mitochondrion to Oxygen which is the final electron acceptor. The  $\text{NAD}^+$  is regenerated.

12. (12pts) Following is a list of inborn errors of metabolism that involve carbohydrates, and a list of possible consequences of such defects. Match each defect with its consequence (only one) from the second list.

DEFECTS:

\_\_2\_\_ a. Lack of fructose-1,6-diphosphate phosphatase

\_\_3\_\_ b. Lack of branching enzyme

\_\_4\_\_ c. Lack of protein kinase activity

\_\_6\_\_ d. Lack of glucose-6-phosphatase

\_\_1\_\_ e. Lack of LDH

\_\_5\_\_ f. Lack of UDP-glucose epimerase

CONSEQUENCES:

1. Inability to convert lactate to pyruvate
2. Inability to synthesize glucose-6-P from lactate
3. Production of unbranched glycogen
4. Inability to degrade glycogen and the accumulation of abnormal amounts of glycogen in the liver
5. Inability to use either galactose as an energy source with no effect on the ability to use glycogen
6. Inability to convert either glycogen or lactate to free glucose with no effect on the ability to use galactose as an energy source.