

Metabolic Biochemistry 3350
Dr. Melissa Kelley
Exam II
October 31, 2005

1. (16 points) Dave, an UCA track star who had not had any biochemistry course yet, celebrated his 100-yards sprint victory by drinking four ounces of whiskey (ethanol) soon after the race. Suddenly he felt weak. Explain his weakness by answering the following questions.

a) In the liver, ethanol is converted to acetaldehyde. Draw the structure of ethanol and acetaldehyde and balance the reaction by putting NAD and NADH in the correct places in the reaction.

b) His muscles become anaerobic after the sprint. What was his liver doing after the race?

c) Why did the ethanol from four ounces of whiskey make it difficult for his liver to do its job?

d) Why did he feel weak? (It had been 4 hours since his last meal)

2. (5 points) Why are transition metals used for biological processes?

3. (11 points) Below is shown a trisaccharide. I have labeled its sugar residues A, B, and C.

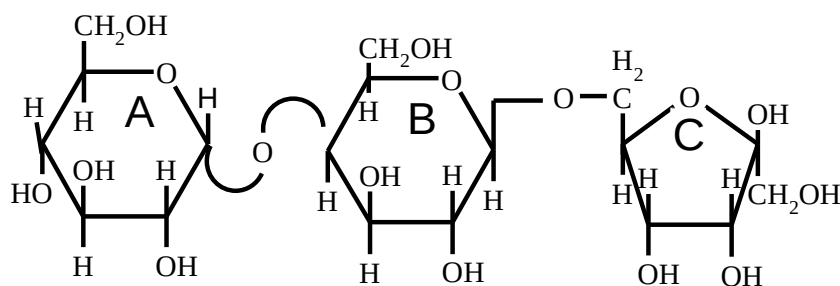
A. On the structure below label the reducing and non-reducing end of the sugar.

B. On the structure below identify each sugar as pyranose or furanose.

C. Identify the sugar that is D-Glucose.

D. Circle all of the anomeric carbons.

E. Place a square around the glycosidic linkage between sugar A and B and identify if this is an α or β linkage.



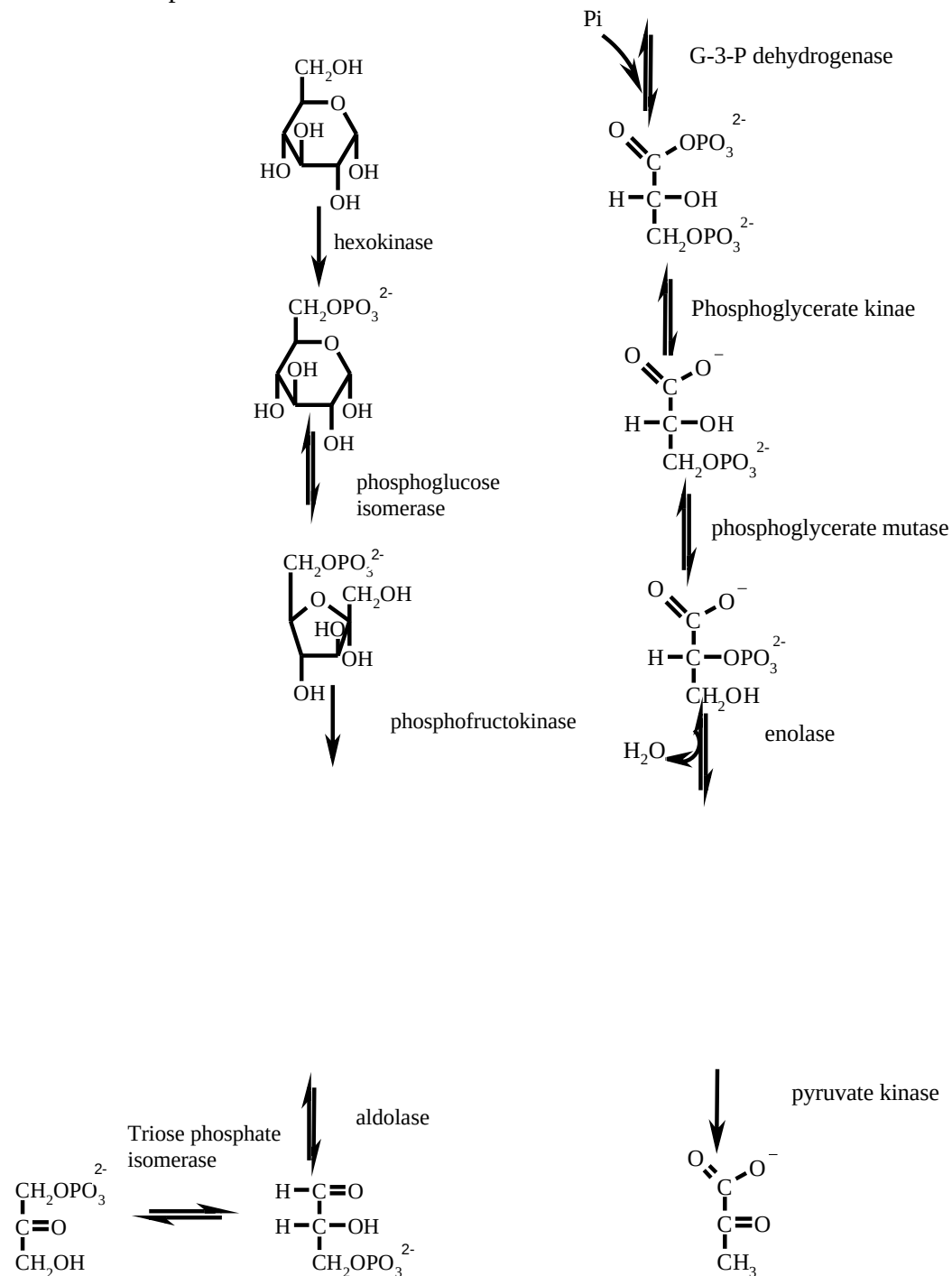
4. (15 points) How would the following conditions affect glycolysis, gluconeogenesis, glycogen synthesis, and glycogen degradation? If the condition has no effect on the pathway, specify that it has no effect on the pathway.

a) Increase in insulin

b) Increase in ATP

c) Increase in glucagon

5. (20 points) Shown below are parts of the glycolytic pathway. Fill in the missing intermediates. On the diagram show where ADP, ATP, NAD and NADH enter and leave the pathway. Identify the major control points in glycolysis. On the glycolytic pathway below, next to the appropriate reaction write the by-pass reaction for gluconeogenesis using the names of the reactants and products.



6. (15 points) A person reports to you as a biochemist that they have a deficiency in pyruvate carboxylase which is the enzyme that converts pyruvate to oxaloacetate in gluconeogenesis.

a) This person reports to you that after not eating anything for 24 hours they suffered hypoglycemia. Briefly explain why this is the case.

b) This person reports to you that they have an increase in lactate. Briefly explain why lactate is accumulating. Your answer should include structures and appropriate cofactors.

c) This person also reports to you that their blood pH has dropped from 7.2 to 7.0 and that they have labored breathing. Briefly explain what factors might cause the pH to drop and why does this person have labored breathing (hint: think about hemoglobin).

7. (6 points) Rat liver is able to metabolize glucose by both the glycolytic and the pentose phosphate pathways. Indicate in the blanks if the following are properties of glycolytic (G), pentose phosphate (P), both (G+P) or neither (N).

_____ NAD is involved

_____ Phosphate ester are intermediates

_____ Glyceraldehyde-3-phosphate is an intermediate

_____ NADPH is produced

_____ Fructose-6-phosphate is an intermediate

_____ Ribulose-5-P is an intermediate

8. (12 points) Calculate the ΔG° values for the following reactions using the data in the table shown below. Show the calculations for each reaction. Your answer should include all chemical equations. Which direction will the reaction proceed toward the products or reactants?

Reaction	ΔG° (kcal/mol)
Phosphoenolpyruvate + H ₂ O? Pyruvate + H ₃ PO ₄ ⁻	-14.8
Creatine phosphate + H ₂ O? Creatine + H ₃ PO ₄ ⁻	-10.3
ATP + H ₂ O? ADP + H ₃ PO ₄ ⁻	-7.3
Glucose-1-phosphate + H ₂ O? Glucose + H ₃ PO ₄ ⁻	-5.0
Glucose-6-phosphate + H ₂ O? Glucose + H ₃ PO ₄ ⁻	-3.3
Glycerol-3-phosphate + H ₂ O? Glycerol + H ₃ PO ₄ ⁻	-2.2

a. ATP + glucose $\leftrightarrow$ glucose-1-phosphate + ADP

b. Glycerol + glucose-6-phosphate $\leftrightarrow$ glucose + glycerol-3-phosphate