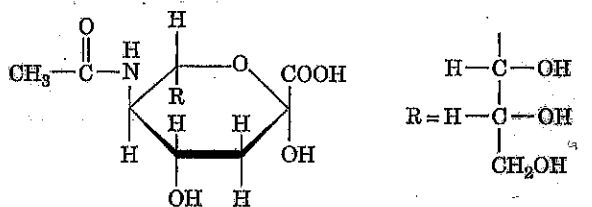


**BIOSC 1820**  
**Metabolic Pathways and Regulation**  
**Spring, 2012**  
**Prof. Jeffrey L. Brodsky**  
**Quiz #1**  
**January 25, 2012**

NAME: \_\_\_\_\_

1. The following image depicts a sugar known as sialic acid, which is a component of the polysaccharides that are attached to proteins at the plasma membrane of cells. In fact, the influenza virus binds to sialic acid at the surface of lung epithelial cells, thus “tricking” these cells into taking-up the virus.

A. Draw the open (non-cyclized) form of this sugar:



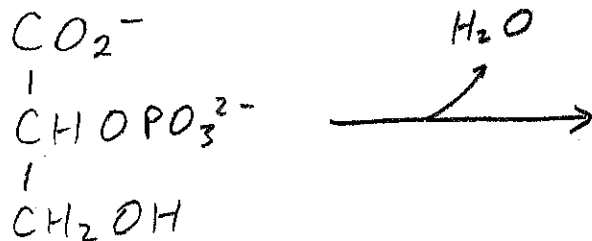
B. Sialic acid is a derivative of mannose. Based on the open-chain structure, name a “unit” (there are 2 choices) that has been appended onto mannose to form sialic acid:

2. In brief, how does insulin increase glucose transport in insulin-responsive tissues? And, which kinetic parameter of the glucose transporter is changed by insulin action?

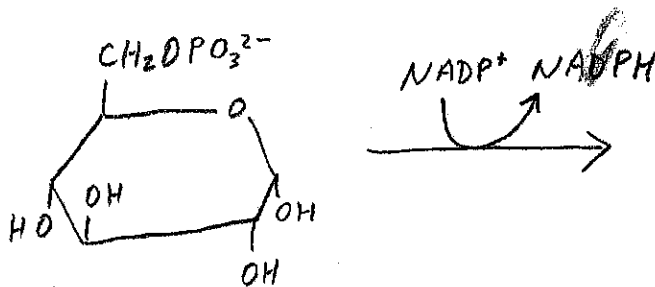
3. What is the name of the enzyme that interconverts glucose-1-phosphate and glucose-6-phosphate?

4. Draw the products AND give the names of the products of the following reactions:

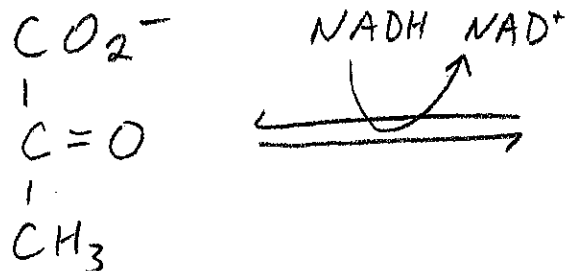
A.



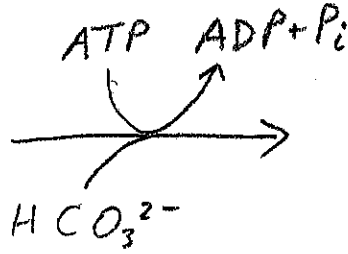
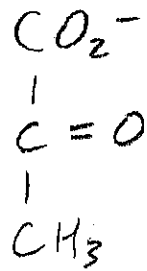
B.



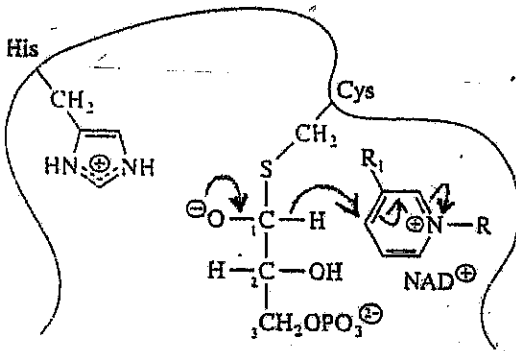
C.



D.

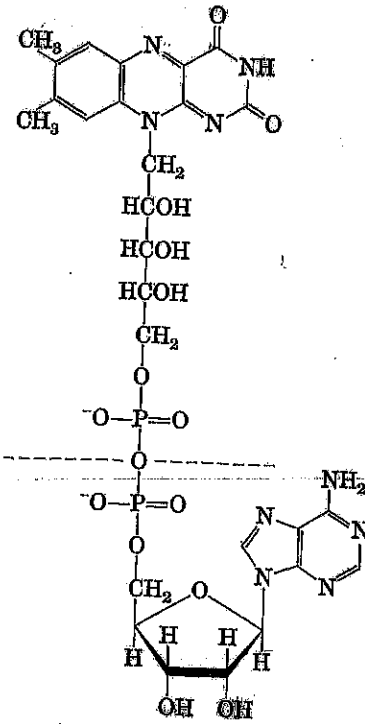


5. The following is an intermediate in the reaction catalyzed by which enzyme?



6. Assume that a molecule of pyruvate, with a radiolabeled carbon on the CH<sub>3</sub> group, was fed into a liver cell extract that was competent to perform each of the reactions in gluconeogenesis. Which carbon(s) would be radiolabeled in the resulting molecule of fructose-1,6-*bis*-phosphate (draw the structure of fructose-1,6-*bis*-phosphate and indicate the radioactive carbon(s) with an arrow) (2 points):

7. What is the FULL NAME of the following cofactor?



8. If a person had a mutation in the gene encoding triose kinase, what is the name of the metabolite that would accumulate? Also, draw the structure of this molecule.

9. Under starvation conditions,  $\beta$ -hydroxybutyrate can be used as an alternate energy source to “feed” the brain. By using the Table on the next page, calculate the  $\Delta E'^{\circ}$  for the delivery of 2 electrons from  $\beta$ -hydroxybutyrate to oxygen as acetoacetate and water are produced:

Assuming that Faraday's constant ( $F$ ) is  $100 \text{ kJ/V}\cdot\text{mol}$ , what is the  $\Delta G^\circ$  for this reaction? In theory, how many ATPs can be generated from this reaction?

Half-reaction	$E^\circ$ (V)
$\frac{1}{2}\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{O}$	0.816
$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	0.771
$\text{NO}_3^- + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{NO}_2 + \text{H}_2\text{O}$	0.421
Cytochrome $f$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $f$ ( $\text{Fe}^{2+}$ )	0.365
$\text{Fe}(\text{CN})_6^{3-}$ (ferricyanide) + $\text{e}^- \rightarrow \text{Fe}(\text{CN})_6^{4-}$	0.36
Cytochrome $a_3$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $a_3$ ( $\text{Fe}^{2+}$ )	0.35
$\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{O}_2$	0.295
Cytochrome $a$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $a$ ( $\text{Fe}^{2+}$ )	0.29
Cytochrome $c$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $c$ ( $\text{Fe}^{2+}$ )	0.254
Cytochrome $c_1$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $c_1$ ( $\text{Fe}^{2+}$ )	0.22
Cytochrome $b$ ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ cytochrome $b$ ( $\text{Fe}^{2+}$ )	0.077
Ubiquinone + $2\text{H}^+ + 2\text{e}^- \rightarrow$ ubiquinol + $\text{H}_2$	0.045
Fumarate $^{2-}$ + $2\text{H}^+ + 2\text{e}^- \rightarrow$ succinate $^{2-}$	0.031
$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ (at standard conditions, pH 0)	0.000
Crótoryl-CoA + $2\text{H}^+ + 2\text{e}^- \rightarrow$ butyryl-CoA	-0.015
Oxaloacetate $^{2-}$ + $2\text{H}^+ + 2\text{e}^- \rightarrow$ malate $^{2-}$	-0.166
Pyruvate $^-$ + $2\text{H}^+ + 2\text{e}^- \rightarrow$ lactate $^-$	-0.185
Acetaldehyde + $2\text{H}^+ + 2\text{e}^- \rightarrow$ ethanol	-0.197
$\text{FAD} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{FADH}_2$	-0.219
Glutathione + $2\text{H}^+ + 2\text{e}^- \rightarrow$ 2 reduced glutathione	-0.23
$\text{S} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{S}$	-0.243
Lipoic acid + $2\text{H}^+ + 2\text{e}^- \rightarrow$ dithiolipic acid	-0.29
$\text{NAD}^+ + \text{H}^+ + 2\text{e}^- \rightarrow \text{NADH}$	-0.320
$\text{NADP}^+ + \text{H}^+ + 2\text{e}^- \rightarrow \text{NADPH}$	-0.324
Acetoacetate + $2\text{H}^+ + 2\text{e}^- \rightarrow \beta$ -hydroxybutyrate	-0.346
$\alpha$ -Ketoglutarate + $\text{CO}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow$ isocitrate	-0.38
$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ (at pH 7)	-0.414
Ferredoxin ( $\text{Fe}^{3+}$ ) + $\text{e}^- \rightarrow$ ferredoxin ( $\text{Fe}^{2+}$ )	-0.432

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