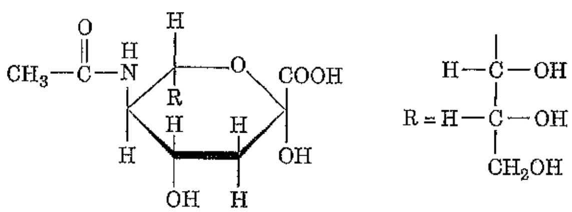
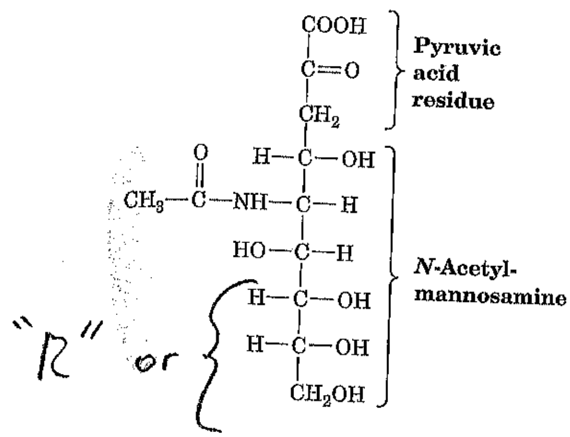
BIOSC 1820
Metabolic Pathways and Regulation
Spring, 2012
Prof. Jeffrey L. Brodsky
Quiz #1
January 25, 2012

NAME: KEY

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:





+1

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:

pyruvate or acetyl (or N-acetyl)

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?

+1

Insulin triggers the movement of glucose transporter-containing to the plasma membrane, which increases the number (Vmax) of glucose transporters.

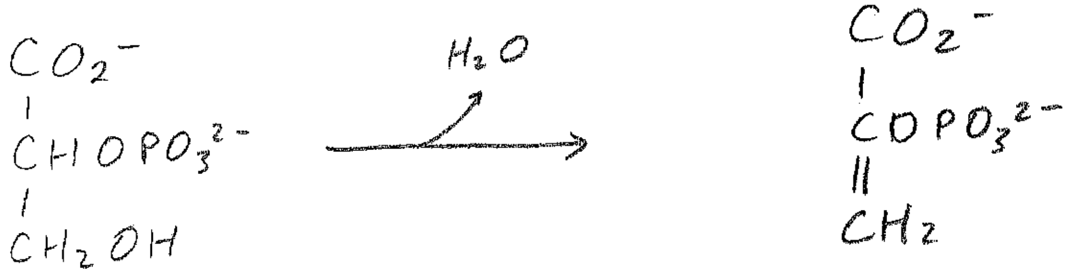
+1

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

phosphoglucomutase (+1)

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

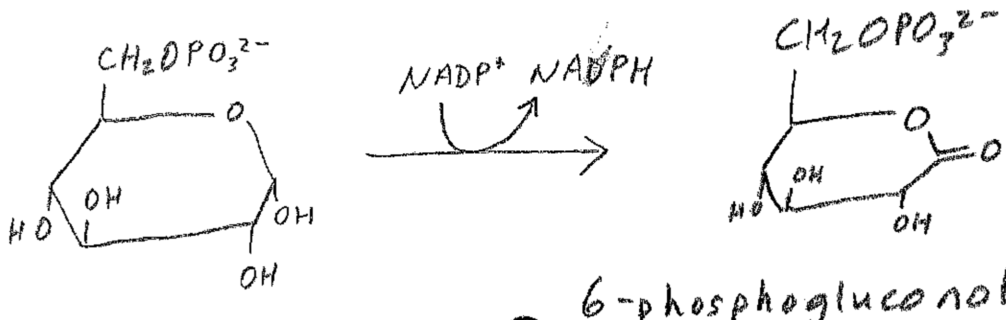
A.



(+1/2)

phosphoenol pyruvate (+1/2)

B.

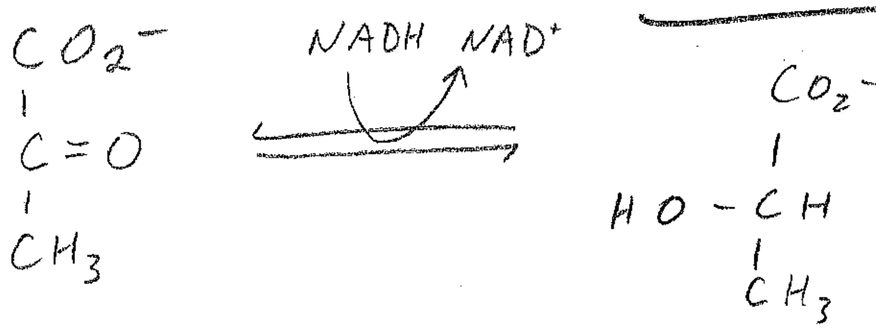


(+1/2)

6-phosphogluconolactone (+1/2)

(6-phosphogluconate, & the open form, is also OK)

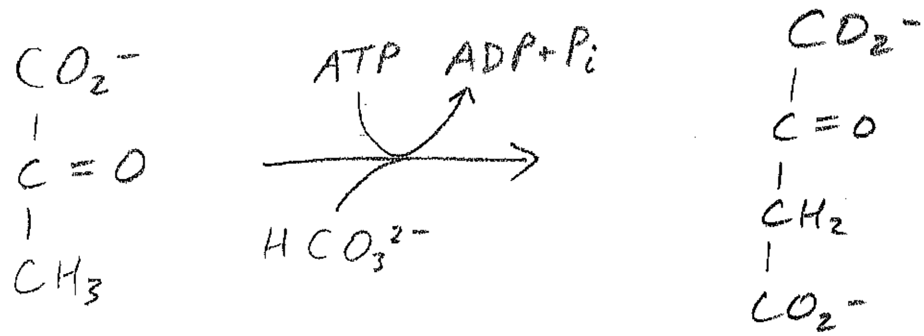
C.



(+1/2)

L-lactate (+1/2)

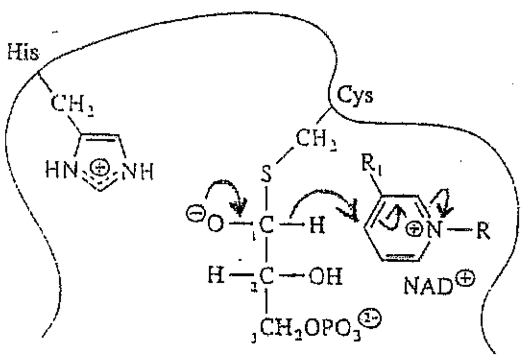
D.



(+ 1/2)

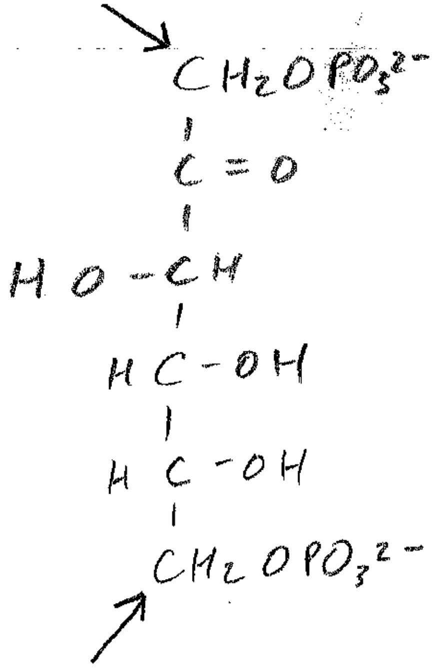
Oxaloacetate (+ 1/2)

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

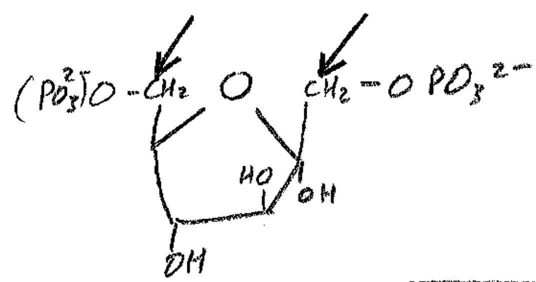


glyceraldehyde-3-phosphate dehydrogenase (+1)

6. Assume that a molecule of pyruvate, with a radiolabeled carbon on the CH_3 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):

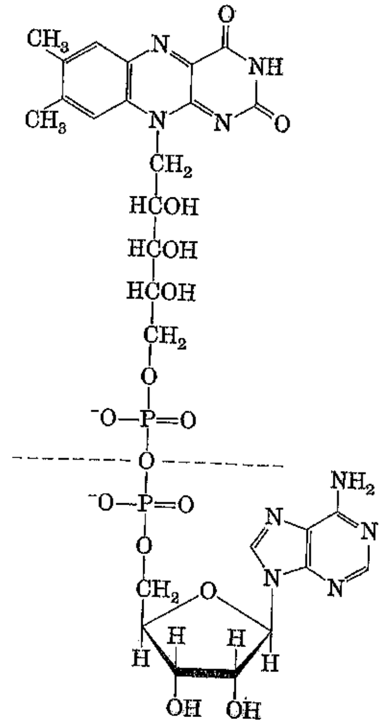


or



Structure (+1)
Carbons (+1)

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



(+1)

Flavin adenine dinucleotide

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.

glyceraldehyde (+1/2)

CHO
|
CHOH
|
CH_2OH

(+1/2)

9. Under starvation conditions, β-hydroxybutyrate can be used as an alternate energy source to "feed" the brain. By using the Table on the next page, calculate the ΔE'° for the delivery of 2 electrons from β-hydroxybutyrate to oxygen as acetoacetate and water are produced:

β hydroxy butyrate ⟶ acetoacetate + $2e^-$

$E'^\circ = +.346$

$\frac{1}{2} O_2 + 2e^- + 2H^+ \longrightarrow H_2O$

$E'^\circ = +.816$

1.162

(+1)

Assuming that Farraday's constant ($\mathcal{F}$) is 100 kJ/V•mol, what is the ΔG'° for this reaction? In theory, how many ATPs can be generated from this reaction?

$$\Delta G'^{\circ} = -n\mathcal{F}(\Delta E'^{\circ})$$

$$= -(2)(100)(1.2)$$

$$= -240 \text{ kJ/mol}$$

(+½)

Divided by 30, you get ~8 ATPs

(7 ATPs is also OK).

(+½)

Half-reaction	E'° (V)
$\frac{1}{2}O_2 + 2H^+ + 2e^- \longrightarrow H_2O$	0.816
$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	0.771
$NO_3^- + 2H^+ + 2e^- \longrightarrow NO_2^- + H_2O$	0.421
Cytochrome *f* (Fe^{3+}) + e^- ⟶ cytochrome *f* (Fe^{2+})	0.365
$Fe(CN)_6^{3-}$ (ferricyanide) + e^- ⟶ $Fe(CN)_6^{4-}$	0.36
Cytochrome a_3 (Fe^{3+}) + e^- ⟶ cytochrome a_3 (Fe^{2+})	0.35
$O_2 + 2H^+ + 2e^- \longrightarrow H_2O_2$	0.295
Cytochrome *a* (Fe^{3+}) + e^- ⟶ cytochrome *a* (Fe^{2+})	0.29
Cytochrome *c* (Fe^{3+}) + e^- ⟶ cytochrome *c* (Fe^{2+})	0.254
Cytochrome c_1 (Fe^{3+}) + e^- ⟶ cytochrome c_1 (Fe^{2+})	0.22
Cytochrome *b* (Fe^{3+}) + e^- ⟶ cytochrome *b* (Fe^{2+})	0.077
Ubiquinone + $2H^+ + 2e^-$ ⟶ ubiquinol + H_2	0.045
Fumarate^{2-} + $2H^+ + 2e^-$ ⟶ succinate^{2-}	0.031
$2H^+ + 2e^- \longrightarrow H_2$ (at standard conditions, pH 0)	0.000
Crotonyl-CoA + $2H^+ + 2e^-$ ⟶ butyryl-CoA	−0.015
Oxaloacetate^{2-} + $2H^+ + 2e^-$ ⟶ malate^{2-}	−0.166
Pyruvate^- + $2H^+ + 2e^-$ ⟶ lactate^-	−0.185
Acetaldehyde + $2H^+ + 2e^-$ ⟶ ethanol	−0.197
FAD + $2H^+ + 2e^-$ ⟶ $FADH_2$	−0.219
Glutathione + $2H^+ + 2e^-$ ⟶ 2 reduced glutathione	−0.23
$S + 2H^+ + 2e^- \longrightarrow H_2S$	−0.243
Lipoic acid + $2H^+ + 2e^-$ ⟶ dihydrolipoic acid	−0.29
$NAD^+ + H^+ + 2e^-$ ⟶ NADH	−0.320
$NADP^+ + H^+ + 2e^-$ ⟶ NADPH	−0.324
Acetoacetate + $2H^+ + 2e^-$ ⟶ β-hydroxybutyrate	−0.346
α-Ketoglutarate + CO_2 + $2H^+ + 2e^-$ ⟶ isocitrate	−0.38
$2H^+ + 2e^- \longrightarrow H_2$ (at pH 7)	−0.414
Ferredoxin (Fe^{3+}) + e^- ⟶ ferredoxin (Fe^{2+})	−0.432

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