Chem 352, Fall 2018 - Quiz 3

Use constants: Ideal gas law constant, R = 0.08206 (l•atm)/(mol•K) = 8.314 (J/(mol•K); Faraday's constant, $\mathcal{F}$ = 9.659 x 10^4 J/(V•mol); Planck's constant, h = 6.626 x 10^{-34} J•s.

1. Describe the metabolic purpose for each of the following pathways:
   a. Glycolysis:

   b. Alcohol fermentation:

2. Lactic acid fermentation comprises a single reaction.
   a. Using structural formulas, write the *balanced reaction equation* for this reaction and label the reactants and products.

   b. The enzyme that catalyzes this reaction is *lactate dehydrogenase*. What enzyme class does this enzyme belong to?
   _____

   c. What role does lactic acid fermentation play in mammalian muscle tissue?

   d. Using the appropriate reduction potentials provided in the table to the right, calculate the standard free energy change for this reaction.
   $\Delta G°'$=_____

Table 10.5 Standard reduction potentials of some important biological half-reactions

Reduction half-reaction	$E°'$(V)
Acetyl CoA + CO_2 + $H^{\oplus}$ + $2e^{\ominus}$ → Pyruvate + CoA	−0.48
Ferredoxin (spinach). Fe^{3+} + $e^{\ominus}$ → Fe^{2+}	−0.43
2 $H^{\oplus}$ + $2e^{\ominus}$ → H_2 (at pH 7.0)	−0.42
α-Ketoglutarate + CO_2 + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Isocitrate	−0.38
Lipoyl dehydrogenase (FAD) + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Lipoyl dehydrogenase ($FADH_2$)	−0.34
$NADP^{\oplus}$ + $H^{\oplus}$ + $2e^{\ominus}$ → NADPH	−0.32
$NAD^{\oplus}$ + $H^{\oplus}$ + $2e^{\ominus}$ → NADH	−0.32
Lipoic acid + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Dihydrolipoic acid	−0.29
Thioredoxin (oxidized) + $2H^{\oplus}$ + $2e$ → Thioredoxin (reduced)	−0.28
Glutathione (oxidized) + 2 $H^{\oplus}$ + $2e^{\ominus}$ → 2 Glutathione (reduced)	−0.23
FAD + 2 $H^{\oplus}$ + $2e^{\ominus}$ → $FADH_2$	−0.22
FMN + 2 $H^{\oplus}$ + $2e^{\ominus}$ → $FMNH_2$	−0.22
Acetaldehyde + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Ethanol	−0.20
Pyruvate + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Lactate	−0.18
Oxaloacetate + 2 $H^{\oplus}$ + $2e^{\ominus}$ → Malate	−0.17
Cytochrome b_5 (microsomal). Fe^{3+} + $e^{\ominus}$ → Fe^{2+}	0.02

   e. Is this reaction favorable under standard state conditions? (Y/N) _____
   Explain:

3. If you correctly drew the reaction equation in part a., it should show an NADH + H^+ being oxidizes to NAD^+. One source of the reduced NADH + H^+ for this reaction is a reaction in glycolysis that, in turn, reduces NAD^+ to NADH + H^+ Name the enzyme for this reaction, identify its class, and using structural formulas, write the balanced reaction equation for this reaction with reactants and products labeled.
   Enzyme name _____ Enzyme class: _____
   Reaction equation:

4. Glycolysis means *to slit sugar*, and the glycolytic pathway was given this name because it involves a reaction in which a six-carbon sugar derivative is split into two three-carbon sugar derivatives. Name the enzyme for this reaction, identify its class, and using structural formulas, write the balanced chemical reaction equation for this reaction with reactants and products labeled.
   Enzyme name _____ Enzyme class: _____
   Reaction equation:

5. There are three reactions in glycolysis that are regulated allosterically. Name two of these using their enzyme names and indicate at least one metabolite that regulates each allosterically. Also indicate the cellular condition that the regulation is responding to.

Enzyme Name	Allosteric Regulator	Is it an Activator or Inhibitor	Cellular Condition