Exam I **Name:_____**

1.) An alternate method for bookkeeping of redox reactions involves quantification and classification of bond types. During the catabolism of many biomolecule, all C-C and C-H bonds will be replaced by C=O bonds during redox events.

a.) How many C-C and C-H bonds are found in glucose?

b.) Glycolysis produces 2 pyruvate molecules. **How many C-C and C-H bonds are found in <u>two</u> pyruvate molecules?**

c.) Compare the number of C-C and C-H bonds in the two pyruvate to the number in glucose. This is your predicted number of redox events during glycolysis.

d.) How many total redox events actually occur as one glucose molecule moves through the process of glycolysis?

e.) Name the enzyme (or enzymes) that catalyze this (or these) event(s). Be specific.

f.) Predict how many total redox events we will study for the complete catabolism of one glucose molecule.

2.)

a.) Describe how to make 100 mL of 0.13 M 3-phosphoglycerate solution starting from a jar of solid 3-phosphoglycerate. Assume all ionizable groups are protonated in the solid form.

b.) Describe how to make 50 mL of 50 mM 3-phosphoglycerate using your 0.13 M stock solution.

3.) **How many ATP are produced during the following conversions?**

a.) Eight $\alpha(1\rightarrow4)$ linked glucose residues of glycogen $\rightarrow$16 pyruvate

b.) Eight glucose $\rightarrow$16 pyruvate

4.) You incubate a sample of glycogen from a patient with liver disease in a test tube with P_i, normal glycogen phosphorylase, and normal debranching enzyme. The ratio of glucose-1-phosphate to glucose formed in the reaction mixture is 100. **What is the patient's most probably enzymatic deficiency? Explain how you know.**

5.) The half-reactions involved in the lactate dehydrogenase reaction are:

Pyruvate + $2H^+ + 2e^-$ → lactate €^{o} = -0.185 V

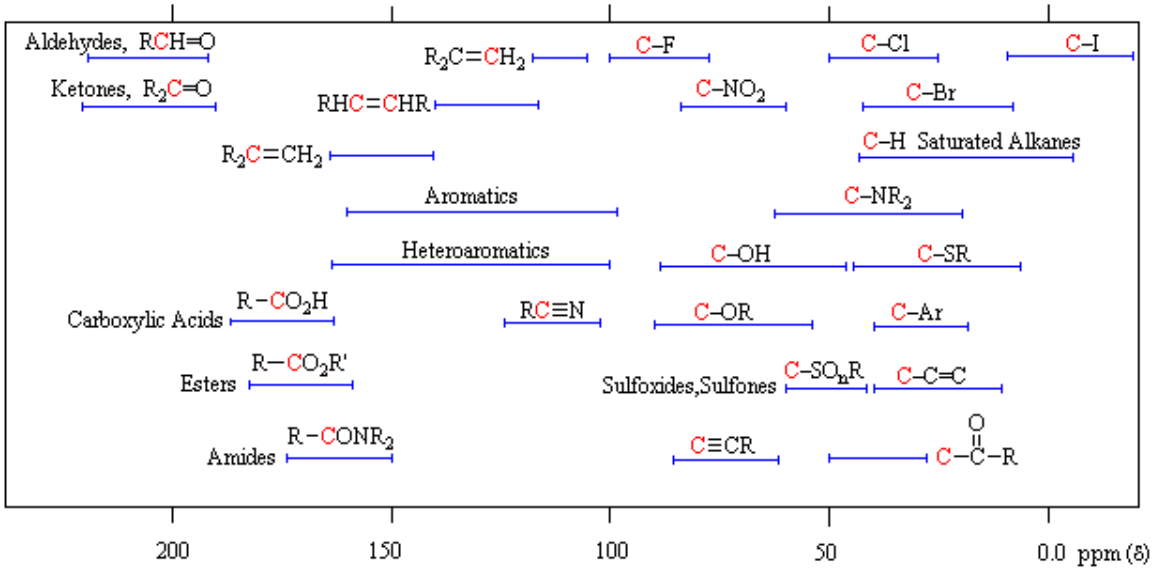
$NAD^+ + 2\ H^+ + 2e^-$ → NADH €^{o} = -0.315 V

a.) Calculate ΔG^o for the conversion of pyruvate to lactate as catalyzed by lactate dehydrogenase.

b.) Calculate ΔG for the conversion of pyruvate to lactate as catalyzed by lactate dehydrogenase when $\frac{[lactate]}{[pyruvate]} = 20.0$ *and* $\frac{[NADH]}{[NAD^+]} = 0.0500$.

6.) Imagine that you have just discovered a new species of yeast!!!!! Once you start breathing again from all the excitement, you decide to test whether the glycolysis pathway within your newly found organism follows that of most other organisms. You feed your organism glucose labeled with ^{13}C at positions C1 and C6 and grow it in the presence of O_2.

^{13}C-NMR chemical shift ranges for various chemical functionalities



You isolate the contents of the cytoplasm for your growth culture, run ^{13}C-NMR, and observe peaks centered at 2 ppm (short and sharp); 75 ppm (tall and wide, possibly multiple peaks); and 112 ppm (short and sharp). **Is the process of glycolysis in your organism identical to most other organisms?** If yes, explain your reasoning. If no, explain which enzyme you expect is missing or functioning differently in your organism. Your discussion should include what portion of molecules you propose compose each peak.

7.) Imagine that you have just discovered a new species of monkey!!!!! Once you start breathing again from all the excitement, you decide to test whether insulin/glucagon regulation of glycolysis within your newly found monkey follows that of most other primates. After isolating liver cells from the monkey, you divide them into four cultures and feed each culture "regular" glucose and ATP with the γ-phosphate replaced by the radioactive ^{32}P isotope (assume ATP is transported into the cytoplasm of the cells of each culture). Next, you treat each culture as follows (9-CPA is 9-cyclopentyladenine, a known inhibitor of adenylate cyclase):

Culture A:	(+)insulin	(-)glucagon	(-)9-CPA
Culture B:	(+)insulin	(-)glucagon	(+)9-CPA
Culture C:	(-)insulin	(+)glucagon	(-)9-CPA
Culture D:	(+)insulin	(+)glucagon	(+)9-CPA

You harvest the contents of the cytoplasm of each culture and utilize HPLC to purify the fructose-2,6-bisphosphate from each. The following are the results for the analysis of radioactive decay from the purified product of each culture:

	^{32}P decays per minute (CPM)
Culture A:	100
Culture B:	102
Culture C:	4
Culture D:	90

Is insulin and glucagon regulation of glycolysis similar to that of other primates? Explain. Your answer should include the detailed signaling cascades.