Name_____

Use complete sentences when requested. There are 115 possible points on this exam. Therefore, there are 15 bonus points.

Exam Memory Bank

$$V_0 = \frac{V_{max} \times [S]}{K_m + [S]}$$

$$V_{max} = k_{cat} \times E_t$$

$$k_{cat} = \frac{kT}{h} \times e^{\frac{-G^*}{RT}}$$

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G^{\circ\prime} = -nF\Delta E^{\circ\prime}$$

$$\Delta G^{\circ\prime} = -RT \ln K_{eq}^{\circ\prime}$$

$$\Delta G_t = RT \ln \frac{c_2}{c_1}$$

$$\Delta G_t = RT \ln \frac{c_2}{c_1} + ZF\Delta \psi$$

$R = 8.314 J/mol \times K$

$F = 96{,}500 J/V \times mol$

Boltzman constant, $k = 1.381 \times 10^{-23} J/K$

Plank's constant, $h = 6.626 \times 10^{-34} J \times sec$

Avogadro's number, $6.02 \times 10^{23}/mol$

$\ln x = 2.303 \log_{10} x$

calorie = 4.184J

1. (20 points) Complete the following table:

Signal	G protein	What does the G protein affect? Does it stimulate or inhibit?	What is the 2nd messenger? What happens to the concentration of the 2nd messenger?	Effect(s) in the cell
Epinephrine			Increased [cAMP]	
Light				
Seratonin	Gq			
Sweet taste				
Vasopressin				

2. (20 points) Describe how the epinephrine (or glucagon) signal is amplified inside a cell. (pictures are ok.)

3.   (25 points) Using complete sentences, fully describe the effects of insulin binding to its receptor.   You may include pictures as appropriate, but there must be sentences to describe your pictures. Use the following subtopics for your organization:

   a. How does insulin regulate glucose uptake by myocytes and adipocytes.

   b. How is glycogen synthesis is regulated by insulin?

   c. How is protein synthesis regulated by insulin?

4.   (20 points) See the Light:
A.   Fully describe how light results in a signal to the brain. Please use complete sentences.

B. Fully describe the mechanism involved in terminating the light signal and what happens to the light
   receptor system after the signal. Please use complete sentences.

5. (15 points) The hydrolysis of ATP is spontaneous and has a negative $\Delta G'^{\circ}$ (-30.5kJ/mole)

    a. Why does ATP have more potential energy than ADP and Pi? Please use complete sentences.

    b. ATP is quite stable and can last in the refrigerator for months, how is this possible. Why doesn't it hydrolyze quickly?

Standard Reduction Potentials for Several Biological Reduction Half-Reactions Reduction Half-Reactions

	$E_o°(V)$
$O_2 + 2H^+ + 2\ e^- \rightarrow H_2O$	0.816
$FAD + 2\ H^+ + 2\ e^- \rightarrow FADH_2$ (FAD is bound to proteins, so E° is variable)	0.003 to -.0091
Lipoic acid + 2 H^+ + 2 $e^- \rightarrow$ dihydrolipoic acid	-0.290
1 ,3-Bisphosphoglycerate + 2 H^+ + 2 $e^- \rightarrow$ glyceraldehyde-3-phosphate+P_i -	-0.290
$NAD^+ + 2\ H^+ + 2\ e^- \rightarrow NADH + H^+$	-0.320
α-Ketoglutarate + CO_2 + 2 H^+ + 2 $e^- \rightarrow$ isocitrate	-0.3802

6. (15 points) Use the table above to answer the following questions:
   a. What is the free energy change for the glycolysis reaction shown below at standard conditions? (Calculate $\Delta G°'$)

glyceraldehyde-3-phosphate   1,3- bisphosphoglycerate
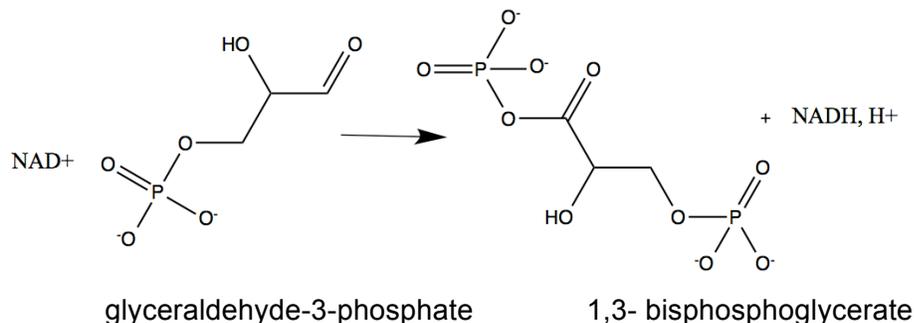
   b. What effect does glyceraldehyde-3-phosphate dehydrogenase have on the value of $\Delta G°'$?

   c. Dihydrolipoic acid can be used to reduce a flavin adenine dinucleotide. Show the two half reactions. Clearly label the oxidation reaction and the reduction half reaction. Calculate $\Delta G°'$.