1) Calculate the standard free-energy changes of the following metabolically important enzyme-catalyzed reactions at 25oC and pH 7.0 from the equilibrium constants given

Glutamate + oxaloacetate ⇔ aspartate + a-ketoglutarate K'eq = 6.8

3) Consider the following interconversion, which occurs in glycolysis:

Fructose-6-phosphate ←→ Glucose-6-phosphateK'eq = 1.97

a. What is the ΔG°' for the reaction at 25°C?

b. If the concentration of fructose-6-phosphate is adjusted to 1.5 M and the concentration of glucose-6-phosphate is adjusted to 0.5M what is the ΔG?

4) Malate Dehydrogenase catalyzes the following reaction in liver mitochondria:

$$\text{Malate} + NAD^+ \rightarrow \text{Oxaloacetate} + NADH + H^+$$

Consider the free energy changes for the following reactions:

Malate → Oxaloacetate + 2e- ΔG°' = 249 kJ/mol

$NADH + H^+ \rightarrow NAD+ + 2H^+ + 2e-$ ΔG°' = 220 kJ/mol

a. What is the ΔG°' for the following coupled reaction: (Show your work)

Measured malate in mitochondria is 0.20 mM, NAD+ 1.0 mM and NADH 0.01 mM. oxaloacetate = $1x10^{-7}$M (ignore the H+ for this problem)…

b. What is the Keq for the reaction?

c. What is the ΔG for the reaction?

d. MDH is crucial for mitochondrial function. Using the calculations you've conducted, would you expect for a mitochondria and its host cell to survive using the standard state free energy? What happens to allow cells to function? What reaction is coupled to MDH to allow this physiological condition to exist? Explain how this coupled reaction supports MDH reaction proceed in mitochondria. (5 pts)

5) You find a mutation in one of the key proteins in Alzheimer's disease called an amyloid and want to understand how this mutation impacts the folding stability of the amyloid protein. To test for the impact of this mutation in the stability of protein folding you perform a melting curve and find the melting point of the amyloid protein to be has a melting point of 342K and the mutant's melting point was 365K. You calculate the DH of folding for the wild-type protein to be 189.3 kcal/mol. (10 points)

- Calculate (show all steps) the DG and DS for the wild-type protein at its melting point.

Determine if the mutation has made the amyloid protein more or less stable.