

## Thermodynamics homework due

(1) If the  $\Delta G^\circ$  of the reaction changes by +1.36 kcal/mol what happens to the equilibrium constant?

With a + 1.36 kcal/mol change in  $\Delta G^\circ$  what's the new equilibrium constant if the equilibrium constant was 10 to start with or 0.1 to start with?

(2) What is  $\Delta G^\circ$  if  $K_{eq}$  is  $2.5 \times 10^4$ : what is it if  $K_{eq}$  is  $2.5 \times 10^{-4}$

(3) If  $\Delta G^\circ$  is 0 what is the ratio of reactants to products at equilibrium?

(4) If  $G^\circ$  is 0 what is  $\Delta G$  (the energy needed to make the ratio of reactants/products is  $5.0 \times 10^4$  or if it is  $5.0 \times 10^{-4}$ . (How far out of equilibrium is this mixture?)

(5) The  $\Delta G^\circ$  for binding  $O_2$  to ferromyoglobin is -7.5 kcal/mol.

What is the equilibrium constant ( $K_{eq}$ )?

$\Delta H^\circ$  is -16.4 kcal/mol.

How would you measure  $\Delta H$ ?

What is  $\Delta S^\circ$  at 25°C?

(6) The reaction  $H_2O(l) \rightarrow H_2O(g)$

$\Delta H^\circ = 40.1$  kJ/mol;  $\Delta S^\circ = 107.4$  J/mol-deg

-What is  $\Delta G^\circ$  at 25°C? What is the equilibrium constant at 25°C?

-At what temperature will water spontaneously boil. (when is the gas favored over the liquid)?

-What is  $\Delta G^\circ$ ,  $\Delta H^\circ$ , and  $\Delta S^\circ$  in kcal/mol, in eV, and in  $cm^{-1}$ ?

(7) What is the energy in 1 Einstein of photons at 700 nm? What color is 700 nm?

(8) If the transmembrane electrical potential is 115 mV positive outside made up of a  $\Delta pH$ . What will be the ratio of proton concentrations on the 2 sides of the membrane at equilibrium? What will be the difference in pHs?

(9) If the transmembrane electrical potential gradient across a mitochondrial membrane is 170 mV (positive inside) and the pH inside is 0.75 units higher than outside how much energy is stored in this electrochemical gradient?

(10) One step of muscle motion involves 1.5 pN of force and the step length is 5 nm. How much work is done/molecule. How much work is done/mole.

(11) The  $E_m$  of cytochrome c is +250 mV and the  $E_m$  to put a single electron on Ubiquinone is -145 mV. What is the  $\Delta G^\circ$  of 1 cytochrome c reducing 1 ubiquinone to the semiquinone? Write out the reaction with the proper stoichiometry.

The preferred reduction of ubiquinone in water is to pick up 2 electrons and 2 proton to become  $UQH_2$ . The  $E_m$  for this reaction at pH 7 is 30 mV. What's the  $\Delta G^\circ$  for electron transfer from cytochrome to ubiquinone. Write out the reaction with the proper stoichiometry.

