

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Gibbs Free Energy Practice Problems

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) * 5/9$$

$$^{\circ}\text{F} = ^{\circ}\text{C} * 9/5 + 32$$

$$\text{K} = ^{\circ}\text{C} + 273$$

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1. Calculate the Gibbs free energy change ( $\Delta G$ ) for the following chemical reaction:



The reaction occurs at 68  $^{\circ}\text{F}$ , the change in heat ( $\Delta H$ ) = 19,070 cal, and the change in entropy ( $\Delta S$ ) = 90 cal/K.

*68  $^{\circ}\text{F}$  = 293 K, therefore the equation is set up in the following way:*

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

$$\Delta G = 19,070 \text{ cal} - (293 \text{ K}) (90 \text{ cal/K})$$

$$\Delta G = -7300 \text{ cal} = -7.3 \text{ kcal}$$

2. Calculate the Gibbs free energy change ( $\Delta G$ ) for the following chemical reaction:



The reaction occurs at 68  $^{\circ}\text{F}$ , the change in heat ( $\Delta H$ ) = 4103 cal, and the change in entropy ( $\Delta S$ ) = 2.4 cal/K.

*68  $^{\circ}\text{F}$  = 293 K, therefore the equation is set up in the following way:*

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

$$\Delta G = 4103 \text{ cal} - 293 \text{ K} (2.4 \text{ cal/K})$$

$$\Delta G = 3399.8 \text{ cal} = 3.4 \text{ kcal}$$

3. Would either of the reactions above occur spontaneously? If so, which one(s) and why?

*The reaction with ATP in #1. The change in Gibbs free energy ( $\Delta G$ ) is negative for exothermic reactions and can only be negative for spontaneous reactions. However, the activation energy required would still cause this reaction to occur slowly.*

4. Are either of the above reactions endergonic? If so, which one(s) and why?

*The reaction with glutamate and  $\text{NH}_3$  in #2. The change in  $\Delta G$  (free energy) is positive, meaning free energy is absorbed, making this reaction endergonic.*

# Energy Practice Problems And Answers

**Jessica J Manson**



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