*°C = (°F – 32) \*5/9 °F = °C \* 9/5 + 32 K = °C + 273*

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

N2 + O2 2NO

The reaction occurs at 68oF, the change in heat (∆H) = 43.1 cal and the change in

entropy is (∆S)= 50.4 cal/K

*68 °F = 293 K, therefore the equation is set up in the following way:*

*G =* *H – T**S*

*G = 43.1 cal – (293 K) (50.4 cal/K)*

*G = -14724 cal = –14.7 kcal*

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

glutamate + NH3 glutamine + H2O

The reaction occurs at 68 °F, the change in heat (H) = 4103 cal, and the change in entropy (S) = 2.4 cal/K.

*68 °F = 293 K, therefore the equation is set up in the following way:*

*G =* *H – T**S*

*G = 4103 cal – 293 K (2.4 cal/ K)*

*G = 3399.8 cal = 3.4 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 (∆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 NH3 in #2. The change in ∆G (free energy) is positive, meaning free energy is absorbed, making this reaction endergonic.*

temperature were raised to normal body temperature (98.6 °F)?

*98.6 °F = 310 K. Changing the equations accordingly looks like this:*

*#1*

*G =* *H – T**S*

*G = 19,070 cal – (310 K) (90 cal/K)*

*G = –8830 cal = –8.83 kcal*

*#2*

*G =* *H – T**S*

*G = 4103 cal – 310 K (2.4 cal/ K)*

*G = 3359 cal = 3.359 kcal*

6. Does an increase in reaction temperature make each of these reactions more or less likely to occur spontaneously? Explain your answer.

*#1*

*This reaction now becomes more exothermic and is likely to occur faster/more spontaneously. Although activation energy remains a hurdle, the entropy of the products is dramatically higher, making this reaction more thermodynamically*

*favorable.*

*#2*

*This reaction now becomes less endothermic and requires less energy input to occur. While this is more thermodynamically favorable, the free energy change is*

*still positive, meaning this reaction will still not occur spontaneously.*