

Name: _____ Student ID: _____
CHEM 161 PAL Fall 2026

Worksheet #18: Gibb's Free Energy Calculations

Equations and Constants

$$\Delta G = \Delta G^{\circ'} + RT \ln Q$$

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

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

$$R = 8.315 \text{ J/mol} \cdot \text{K}$$

1. What is the difference between thermodynamic standard conditions and biochemical standard conditions? What is similar?

1. Calculate ΔG for the conversion of Glucose + ATP $\rightarrow$ ADP + Glucose-6-phosphate using the information in the table provided. The concentrations of products and reactants in the cell (not at equilibrium) at 37 °C are provided in a second table.

Reaction	ΔG° (kJ/mol)
Acetic anhydride + H ₂ O $\rightarrow$ 2 acetate	-91.1
ATP + H ₂ O $\rightarrow$ ADP + P _i	-30.5
ATP + H ₂ O $\rightarrow$ AMP + PP _i	-45.6
PP _i + H ₂ O $\rightarrow$ 2P _i	-19.2
UDP-glucose + H ₂ O $\rightarrow$ UMP + glucose 1-phosphate	-43.0
Ethyl acetate + H ₂ O $\rightarrow$ ethanol + acetate	-19.6
Glucose 6-phosphate + H ₂ O $\rightarrow$ glucose + P _i	-13.8
Glutamine + H ₂ O $\rightarrow$ glutamate + NH ₄ ⁺	-14.2
Glycylglycine + H ₂ O $\rightarrow$ 2 glycine	-9.2
Maltose + H ₂ O $\rightarrow$ 2 glucose	-15.5
Lactose + H ₂ O $\rightarrow$ glucose + galactose	-15.9
Glucose 1-phosphate $\rightarrow$ glucose 6-phosphate	-7.3
Fructose 6-phosphate $\rightarrow$ glucose 6-phosphate	-1.7

Compound	Concentration (M)
Glucose	5.54×10^{-2}
ATP	3.52×10^{-3}
ADP	2.13×10^{-4}
Glucose-6-phosphate	8.31×10^{-4}

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2. Answer the following questions using the table in question 1.
- a. Calculate the equilibrium constant for the reaction below at 37 °C. Show your work in the space provided below. Include appropriate units and significant figures.



Equilibrium constant = _____

- b. If the cellular concentrations of maltose and P_i are maintained at 12.00 mM and 4.00 mM respectively, what is the equilibrium concentration of glucose-6-phosphate obtained through phosphorylation with P_i ? Show your work in the space provided below. Include appropriate units and significant figures.

[glucose-6-phosphate] = _____

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- c. Calculate the equilibrium constant for the reaction below at 37.0 °C. Show your work in the space provided below. Include appropriate units and significant figures.



Equilibrium constant = _____

- d. If ATP is used to convert maltose into glucose-6-phosphate instead, what is the equilibrium concentration of glucose-6-phosphate? The cellular concentrations of maltose, ATP and ADP are maintained at 12.00 mM and 4.00 mM and 7.00 μM respectively. Show your work in the space provided below. Include appropriate units and significant figures.

[glucose-6-phosphate] = _____