Thermodynamics Reference Sheet

Enthalpy

 $\Delta H^{\circ} = \sum n \Delta H_{\rm products} - \sum n \Delta H_{\rm reactants}$ $\Delta H = (\text{energy of bonds broken}) - (\text{energy of bonds formed})$ $(C_p \text{ of water} = 4.18 \text{ J/g}^\circ\text{C})$ $q_{\text{system}} = -q_{\text{water}}$ $\Delta H = q/mol$ $q = mC_p\Delta T$

 $\Delta H < 0$ (exothermic)* $\Delta H > 0$ (endothermic)

Entropy

 $\Delta S^{\circ} = \sum n S_{\text{products}} - \sum n S_{\text{reactants}}$

 $\Delta S > 0$ (entropy or disorder increasing)*

 $\Delta S < 0$ (entropy or disorder decreasing)

- Increase in the # of gas molecules in a man Olinereases entropy
 Lower gas pressure increases entropy
 Increased temperature factorizes
 Bigger

- Increased temperaturchicreases entropy
 Bigger molecules have more increases

Gibb's Free Energy

 $\Delta G = \Delta H - T\Delta S$ $\Delta G^{\circ} = \sum n \Delta G_{\text{products}} - \sum n \Delta G_{\text{reactants}}$ $\Delta G^{\circ} = -RTlnKeq R = 8.314 J/molK$ $K = e^{(-\Delta G/RT)}$

 $\Delta G < 0$ (spontaneous) $\Delta G \ge 0$ (non-spontaneous) $\Delta G = 0$ (equilibrium)

K > 1 (products favored) K < 1 (reactants favored) K = 1 (neither favored

over the other)

ΔH	Δs	Т	∆G	Spontaneous
-	+	All	-	Yes
-	-	Low	-	Yes
-	-	High	+	No
+	+	Low	+	No
+	+	High	-	Yes
+	-	All	+	No