Chem 1062

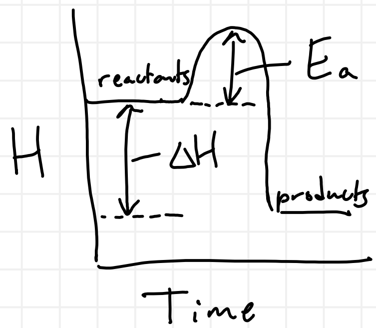
Note Title 7/29/2008

* Exam 4 - Ch. 19 & 20, small segment Ch. 4, Ch 21 Sect. 1 & 2
* ACS Standardized Final Exam

Ch. 19 Thermodynamics & Equilibrium

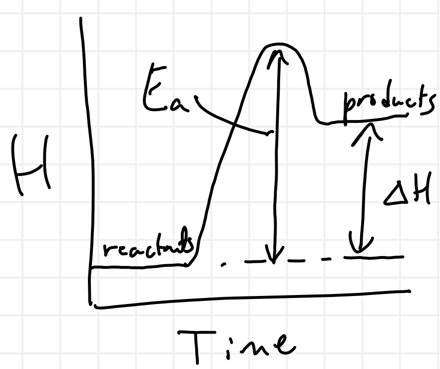
enthalpy (H) — state function

change in enthalpy (ΔH) — extensive property → heat of reaction



exothermic reaction

$\Delta H = (-)$



endothermic reaction

$\Delta H = (+)$

$Ba(OH)_2 \cdot 8H_2O\,(s) + 2NH_4Cl\,(s) \rightarrow BaCl_2\,(aq)(s) + 2NH_3\,(aq)(g) + 10H_2O\,(l)$

system

surroundings ✓

$\Delta S = (+)$ ✓

$\Delta H = (+)$

entropy (S) measure of the disorder or
randomness of system

Spontaniety of reactions

Spontaneous process

nonsponteous process

ethalpy vs entropy

ΔS = change in entropy

$\Delta S = (+)$ ⇒ increasing in entropy

$\Delta S = (-)$ ⇒ decreasing in entropy

$$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$$

$\Delta H = (-)$; $\Delta S = (+)$

Laws of Thermodynamics

1) The change in internal energy of system, U, equals q+w.

2) The total entropy of a system & its surroundings increases in a spontaneous process.

3) The entropy of a perfectly cystalline substance at 0K is equal to zero.

(see p. 775 figure)

$$\Delta S > \frac{q}{T}$$ (spontaneous process) $q_p = \Delta H$

If constant pressure, then

$$\Delta S > \frac{q_p}{T} = \frac{\Delta H}{T}$$

$$\Delta S > \frac{\Delta H}{T}$$ (in a spontaneous process)

$$T\Delta S > \Delta H$$

$$0 > \Delta H - T\Delta S$$

$$\boxed{\Delta H - T\Delta S < 0}$$

(+) (+)

Predicts the sign of ΔS for:

① $N_2(g) + 3H_2(g) \rightarrow 2NH_3(s)$ $\Delta S = (-)$

② $CaCO_3(s) + HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$ $\Delta S = (+)$

③ $N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\Delta S = ?$

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standard entropy change (ΔS°)

standard thermodynamic conditions (1 atm, 298K, if aqueous - 1M)

$$\Delta H^\circ = \sum n\Delta H_f^\circ(\text{products}) - \sum n\Delta H_f^\circ(\text{reactants})$$

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

ΔH_f°, S° found on p. 777 and in Appendix C