

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$k = 1.381 \times 10^{-23} \text{ J/K}$$

$$1 \text{ L}\cdot\text{atm} = 101.325 \text{ J}$$

$$PV = nRT$$

$$\Delta E = q + w \quad H = E + PV$$

$$\Delta E = \Delta H - P\Delta V$$

$$\Delta E = \Delta H - \Delta nRT$$

$$\Delta E = q_v = n C_v \Delta T$$

$$\Delta H = q_p = n C_p \Delta T$$

$$w = -P\Delta V \quad w = -\Delta nRT$$

$$w = -nRT \ln \frac{V_2}{V_1} \quad q = +nRT \ln \frac{V_2}{V_1}$$

$$\Delta S = nR \ln \frac{V_2}{V_1} \quad \Delta S = q_{\text{rev}}/T$$

$$\Delta S = n C_v \ln \frac{T_2}{T_1} \quad \Delta S = n C_p \ln \frac{T_2}{T_1}$$

$$\Delta H_{\text{rxn}}^{\circ} = \sum \Delta H_f^{\circ}(\text{prod}) - \sum \Delta H_f^{\circ}(\text{react})$$

$$\Delta G_{\text{rxn}}^{\circ} = \sum \Delta G_f^{\circ}(\text{prod}) - \sum \Delta G_f^{\circ}(\text{react})$$

$$\Delta S_{\text{rxn}}^{\circ} = \sum S^{\circ}(\text{prod}) - \sum S^{\circ}(\text{react})$$

$$S = k \ln W \quad \Delta S_{\text{trans}} = \Delta H_{\text{trans}}/T_{\text{trans}}$$

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