CHEM 2011: Introduction to Thermodynamics **Equation 2: First Law of Thermodynamics**
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First Law of Thermodynamics

$$\Delta U = q + W \tag{2.1}$$

Surroundings-Based Work

$$W = -mg\Delta h \tag{2.2}$$

System-Based Work

$$W = \int_{x_1}^{x_2} \vec{F} \cdot d\vec{x} \tag{2.3}$$

Work of Isothermal Reversible Compression of Ideal Gas

$$W = -nRT \log\left(\frac{V_2}{V_1}\right) \tag{2.4}$$

General Equation for Reversible or Irreversible PV Work

$$W = -W_{sur} = -\int_{V_1}^{V_2} P_{ext} dV \tag{2.5}$$

Equation for Electrical Work

$$W = I\phi t \tag{2.6}$$

Definition of Heat Capacity

$$C_T = \lim_{\Delta T \to 0} \frac{q}{T_2 - T_1} = \frac{dq}{dt} \tag{2.7}$$

Relation Between C_P and C_V for Ideal Gas

$$C_P - C_V = nR \qquad C_{P,m} - C_{V,m} = R \tag{2.8}$$

Experimental Determination of ΔH, ΔU, by Measuring Heat Flow

$$\Delta U = q_V \qquad \Delta H = q_P \tag{2.9}$$

Definition of Enthalpy

$$H = U + PV \tag{2.10}$$

Relationship Between T and V or P and V for a Reversible Adiabatic Expansion or Contraction

$$\frac{T_2}{T_1} = \left(\frac{V_2}{V_1}\right)^{1-\gamma} \qquad P_1 V_1^{\gamma} = P_2 V_2^{\gamma} \tag{2.11}$$