1. Temperature and Zeroth Law

Temperature Scales:

$$T(^\circ\text{C}) = T(\text{K}) - 273.15$$

$$T(^\circ\text{F}) = \frac{9}{5}T(^\circ\text{C}) + 32$$

Thermal Expansion:

$$\Delta L = \alpha L_0 \Delta T$$

$$\Delta A = \beta A_0 \Delta T \quad (\beta \approx 2\alpha)$$

$$\Delta V = \gamma V_0 \Delta T \quad (\gamma \approx 3\alpha)$$

---

2. Heat and Calorimetry

Specific Heat Capacity:

$$Q = mc\Delta T$$

Latent Heat (Phase Change):

$$Q = mL$$

Heat Capacity (C):

$$C = mc = \frac{Q}{\Delta T}$$

---

3. Heat Transfer Mechanisms

1. Conduction (Fourier's Law):

$$H = \frac{dQ}{dt} = -kA\frac{dT}{dx}$$

Thermal Resistance: $R_{\text{th}} = \frac{L}{kA}$

2. Convection (Newton's Law):

$$\frac{dQ}{dt} = hA(T - T_s)$$

3. Radiation (Stefan-Boltzmann Law):

$$E = \sigma e A T^4$$

Net radiation: $E_{\text{net}} = \sigma e A(T^4 - T_s^4)$

Wien's Displacement Law: $\lambda_{\max} T = b$

---

4. Kinetic Theory of Gases

Ideal Gas Law:

$$PV = nRT = Nk_BT$$

RMS Speed of Gas Molecules:

$$v_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{m}}$$

Average Kinetic Energy:

$$E_{\text{avg}} = \frac{3}{2}k_BT \quad \text{(per molecule)}$$

---

5. Thermodynamics

First Law of Thermodynamics:

$$\Delta U = Q - W$$

Work Done by Gas:

$$W = \int P\,dV$$

Specific Heats Relation (Mayer's Relation):

$$C_p - C_v = R$$

$$\gamma = \frac{C_p}{C_v}$$