FORMULA SHEET

- Vectors:

$$\vec{A} \cdot \vec{B} = AB\cos\theta = A_x B_x + A_y B_y + A_z B_z$$

$$\left|\vec{A} \times \vec{B}\right| = AB\sin\theta$$

- Physics I Formulae:

$$\sum \vec{F} = m\vec{a}$$

$$W = \vec{F} \cdot \Delta\vec{x} \quad \text{or} \quad W = \int \vec{F} \cdot d\vec{x}$$

$$W_{tot} = \Delta K$$

$$W_{cons} = -\Delta U$$

$$K = \frac{1}{2}mv^2$$

$$K_i + U_i = K_f + U_f$$

$$\vec{F} = -\vec{\nabla}U \quad \text{where} \quad \vec{\nabla}f = \frac{\partial f}{\partial x}\hat{i} + \frac{\partial f}{\partial y}\hat{j} + \frac{\partial f}{\partial z}\hat{k}$$

- Electric Forces and Fields:

$$e = 1.6 \times 10^{-19}\ \text{C}$$

$$k = 8.99 \times 10^{9}\ \frac{\text{Nm}^2}{\text{C}^2}$$

$$\epsilon_0 = 8.85 \times 10^{-12}\ \frac{\text{F}}{\text{m}}$$

$$Q = \Delta N e$$

$$F = k\frac{q_1 q_2}{r^2}$$

$$E = k\frac{q}{r^2}$$

$$\vec{F} = q\vec{E}$$

$$\Phi_E = \vec{E} \cdot \vec{A} \quad \text{or} \quad \Phi_E = \int \vec{E} \cdot d\vec{A}$$

$$\Phi_{tot} = \frac{q_{enc}}{\epsilon_0}$$

- Electric Potential Energy and Electric Potential:

$$U = k\frac{q_1 q_2}{r}$$

$$\phi = k\frac{q}{r}$$

$$U = q\phi \quad \text{and} \quad \Delta U = q\Delta\phi$$

$$\vec{\nabla} f = \frac{\partial f}{\partial x}\hat{i} + \frac{\partial f}{\partial y}\hat{j} + \frac{\partial f}{\partial z}\hat{k}$$

$$\vec{F} = -\vec{\nabla} U$$

$$\vec{E} = -\vec{\nabla}\phi$$

$$U = -\int \vec{F}\cdot d\vec{x} \quad \text{or} \quad \Delta U = -\int_S \vec{F}\cdot d\vec{x}$$

$$\phi = -\int \vec{E}\cdot d\vec{x} \quad \text{or} \quad \Delta\phi = -\int_S \vec{E}\cdot d\vec{x}$$

$$V = \Delta\phi$$

- Capacitance and Dielectrics:

$$Q = CV$$

$$\left.\begin{array}{l} C = \epsilon_0\dfrac{A}{d} \\ E = \dfrac{\sigma}{\epsilon_0} \end{array}\right\} \text{ Parallel plate capacitors}$$

$$U = \frac{Q^2}{2C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$$

$$u = \frac{1}{2}\epsilon_0 E^2$$

$$C = \kappa C_0$$

$$\epsilon = \kappa\epsilon_0$$