

Formula Sheet

Mechanics

$$m \frac{d\mathbf{v}}{dt} = \mathbf{F} \quad K_2 - K_1 = \bar{W}$$

$$K = \frac{1}{2} m v^2 \quad \bar{W} = - \int_{x_1}^{x_2} \mathbf{F} \cdot d\mathbf{x}$$

Circular motion

$$a^* = \omega^2 r, \quad v = \omega r, \quad \omega = \frac{2\pi}{T}$$

$$v = a t + v_0, \quad v^2 = v_0^2 + 2ax$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$m_e = 9.1 \times 10^{-31} \text{ Kg}$$

$$m_p = 1.67 \times 10^{-27} \text{ Kg}$$

harmonic motion

$$\ddot{x} + \omega^2 x = 0$$

Electrostatics

$$\mathbf{E} = \epsilon' \mathbf{E}, \quad U = \epsilon' V$$

$$\mathbf{E} = \frac{q}{4\pi\epsilon_0} \frac{\hat{r}}{r^2} \text{ pt charge}$$

$$V = \frac{q}{4\pi\epsilon_0} \frac{1}{r} \text{ pt charge}$$

$$\mathbf{E} = \frac{\lambda}{2\pi\epsilon_0} \frac{\hat{r}}{r} \text{ line charge}$$

$$E = \frac{\sigma}{\epsilon_0} \text{ surface conductor}$$

$$E = \frac{\sigma}{2\epsilon_0} \text{ sheet charge}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}, \quad \epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}$$

$$e = 1.6 \times 10^{-19} \text{ C}, \quad \text{lev} = 1.6 \times 10^{-19} \text{ J}$$

$$P = qd \text{ dipole}, \quad \boldsymbol{\tau} = \mathbf{P} \times \mathbf{E} \text{ dipole}$$

$$U = -\mathbf{P} \cdot \mathbf{E} \text{ dipole}$$

$$E = P / 4\pi\epsilon_0 r^3 \text{ dipole}$$

Rotational Motion

$$\frac{dL}{dt} = \frac{d}{dt} I\omega = \tau$$

$$\tau = Fl$$

$$K = \frac{1}{2} I \omega^2$$

$$I = \sum_i m_i r_i^2$$

$$L = mvl$$

Taylor Series

$$f(\epsilon) \approx f(0) + f'(0)\epsilon$$

$$+ \frac{1}{2} f''(0)\epsilon^2$$

$$+ \dots$$

$k = \text{dielectric const.}$

$$\oint \mathbf{K} \cdot d\hat{\mathbf{A}} = \frac{Q}{\epsilon_0}$$

$$V_2 - V_1 = - \int_{x_1}^{x_2} \mathbf{E} \cdot d\mathbf{x}$$

$$V = -E x \text{ uniform } \mathbf{E}$$

$$\mathbf{E} = -\nabla V$$

$$E_x = -\partial V / \partial x$$

$$E_y = -\partial V / \partial y$$

$$E_z = -\partial V / \partial z$$

~~Math~~
~~(x^2 + y^2) P / (2(P-x)(P-y))~~

Circuits

$$R = \rho \frac{L}{A}$$

$$J = ne v_e = I/A$$

$$I = dQ/dt$$

$$V = IR$$

$$P = I^2 R$$

$$R = R_1 + R_2 + \dots \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{series}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \dots \left. \begin{array}{l} \\ \\ \end{array} \right\}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{parallel}$$

$$C = C_1 + C_2 + \dots \left. \begin{array}{l} \\ \\ \end{array} \right\}$$

$$\sum_{in} I_{in} = \sum_{out} I_{out} \text{ pt rule}$$

$$\sum_i V_i = 0 \text{ loop rule}$$

$$C = \frac{Q}{V} \quad C = \frac{\epsilon_0 A}{d} \text{ parallel plate cap.}$$

$$U = \frac{1}{2} CV^2$$

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

$$\tau = RC \text{ for R-C circuit}$$

$$Q = Q_0 (1 - e^{-t/RC})$$

$$I = I_0 e^{-t/RC}$$

$$L = \frac{N \Phi}{I} \quad L = \frac{\mu_0 N^2 A}{l} \text{ solenoid}$$

$$U = \frac{1}{2} LI^2$$

$$U_B = \frac{1}{2\mu_0} B^2$$

$$V = -L dI/dt$$

$$\tau = \frac{L}{R} \text{ for L-R circuit}$$

$$I = \frac{\mathcal{E}}{R} (1 - e^{-tR/L}) \text{ L-R circuit}$$

$$\omega^2 = \frac{1}{LC} \text{ L-C circuit}$$

Magnetostatics

$$d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^2}$$

$$\oint \vec{B} \cdot d\vec{A} = 0 \text{ closed surface}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r} \text{ wire}$$

$$B = \mu_0 \frac{NI}{l} \text{ solenoid}$$

$$B = \frac{\mu_0 \lambda}{2} \text{ sheet}$$

$$U = -\vec{m} \cdot \vec{B}$$

$$m = IA$$

$$u = B^2 / 2\mu_0$$

$$\vec{\tau} = \vec{m} \times \vec{B}$$

$$\vec{F}_m = q \vec{v} \times \vec{B} \text{ charge}$$

$$\vec{F}_m = I \vec{L} \times \vec{B} \text{ wire}$$

$$\frac{\mu_0}{4\pi} = 10^{-7} \frac{Tm}{A}$$

$$\omega = eB/m$$

Induction

$$\mathcal{E} = \oint \vec{E} \cdot d\vec{l}$$

$$= -\frac{d\Phi}{dt}$$

$$\Phi = \oint \vec{B} \cdot d\vec{A}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$+ \epsilon_0 \mu_0 \frac{d}{dt} \oint \vec{E} \cdot d\vec{A}$$