

## Possibly Useful Information

$$F = \frac{1}{4\pi\epsilon_0} \frac{|q_1||q_2|}{r^2}$$

$$e = 1.6 \times 10^{-19} \text{ C}, m_e = 9.11 \times 10^{-31} \text{ Kg}$$

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

$$E = \frac{|q|}{4\pi\epsilon_0 r^2}$$

$$\Delta x = x_2 - x_1, \Delta t = t_2 - t_1$$

$$\bar{s} = (\text{total distance}) / \Delta t$$

$$\bar{a} = \Delta v / \Delta t$$

$$v = v_0 + at$$

$$x - x_0 = v_0 t + (1/2)at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x - x_0 = 1/2(v_0 + v)t$$

$$x - x_0 = vt - 1/2at^2$$

$$\bar{a} = d\bar{v} / dt$$

$$\Delta U = U_f - U_i = -W$$

$$\Delta V = V_f - V_i = -W/q_0 = \Delta U/q_0$$

$$V_f - V_i = -\int_i^f \vec{E} \cdot d\vec{s}$$

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

$$E = \sigma/\epsilon_0$$

$$E_s = \frac{\partial V}{\partial s}$$

$$E = \frac{\Delta V}{\Delta s}$$

$$Q = CV$$

$$C = 2\pi\epsilon_0 \frac{l}{\ln(b/a)}$$

$$C = 4\pi\epsilon_0 R$$

$$\frac{1}{C_{eq}} = \sum \frac{1}{C_j} \text{ (series)}$$

$$u = 1/2 \epsilon_0 E^2$$

$$\epsilon_0 = 8.85 \times 10^{-12} (\text{C}^2 / \text{N} \cdot \text{m}^2)$$

$$\vec{E} = \vec{F}/q_0$$

$$\epsilon_0 \Phi = \epsilon_0 \oint \vec{E} \cdot d\vec{A} = q_{enc}$$

$$\bar{v} = \Delta x / \Delta t$$

$$v = dx/dt$$

$$a = dv/dt = d^2x/dt^2$$

$$g = 9.8 \text{ m/s}^2$$

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\Delta \vec{r} = \vec{r}_2 - \vec{r}_1$$

$$\Delta \vec{r} = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$$

$$\bar{\vec{v}} = \Delta \vec{r} / \Delta t, \Delta \vec{r} = \vec{r}_2 - \vec{r}_1$$

$$\bar{\vec{a}} = \Delta \bar{\vec{v}} / \Delta t$$

$$U = -W_\infty$$

$$V = -W_\infty/q_0$$

$$V = -\int_i^f \vec{E} \cdot d\vec{s}$$

$$V = \sum_{i=1}^n V_i = \frac{1}{4\pi\epsilon_0} \sum_{i=1}^n \frac{q_i}{r_i}$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r}$$

$$E_x = \frac{\partial V}{\partial x}; E_y = \frac{\partial V}{\partial y}; E_z = \frac{\partial V}{\partial z}$$

$$U = -W = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r_{12}}$$

$$C = \frac{\epsilon_0 A}{d}$$

$$C = 4\pi\epsilon_0 \frac{ab}{b-a}$$

$$C_{eq} = \sum C_j \text{ (parallel)}$$

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

$$C = \kappa C_0$$

$$I = dQ/dt$$

$$\rho = 1/\sigma$$

$$R = \rho L/A$$

$$P = IV$$

$$P_{\text{emf}} = I\mathcal{E}$$

$$\frac{1}{R_{\text{eq}}} = \sum \frac{1}{R_j} \text{ (parallel)}$$

$$I = (\mathcal{E}/R)e^{-t/RC}$$

$$I = (Q/RC)e^{-t/RC}, I_0 = (Q/RC)$$

$$\vec{F} = q\vec{v} \times \vec{B}$$

$$d\vec{F} = Id\vec{s} \times \vec{B}$$

$$\vec{\mu} = NI\vec{A}$$

$$B = \mu_0 I/2 \pi r$$

$$F/l = (\mu_0 I_1 I_2)/2\pi a$$

$$I_d = \mathcal{E}_0 d\Phi_E/dt$$

$$L = N\Phi / I$$

$$\mathcal{E} = -L dI/dt$$

$$I = I_0 e^{-t/\tau}$$

$$\mu_B = B^2/(2 \mu_0)$$

$$E = E_{\text{max}} \cos(kx - \omega t)$$

$$I = E_{\text{max}}^2/(2c \mu_0) = S_{\text{av}}$$

$$P = S/c$$

$$n = c/v$$

$$I = \frac{1}{2} I_0, I = I_0 \cos^2(\theta)$$

$$\theta_c = \sin^{-1}(n_2/n_1)$$

$$1/f = 1/p + 1/q = 2/R$$

$$1/f = (n-1)(1/R_1 - 1/R_2)$$

$$n = \lambda_0/\lambda$$

$$\sin(\theta) = y/L$$

$$2nt = (m + 1/2) \lambda, 2nt = m \lambda,$$

$$V = IR$$

$$P = I^2 R = V^2/R$$

$$I = \mathcal{E}/(R + r)$$

$$R_{\text{eq}} = \sum R_j \text{ (series)}$$

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

$$q(t) = Qe^{t/RC}$$

$$\vec{F} = I\vec{L} \times \vec{B}$$

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

$$d\vec{B} = \mu_0/4\pi \frac{Id\vec{s} \times \vec{r}}{r^3}, \mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$$

$$B = \mu_0 nI \text{ (solenoid)}$$

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{enc}}$$

$$B = (\mu_0 IN)/(2\pi r) \text{ (toroid)}$$

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

$$\mathcal{E} = \oint \vec{E} \cdot d\vec{s} = -N d\Phi_B/dt$$

$$L = \mu_0 n^2 A l$$

$$I = (\mathcal{E}/R)(1 - e^{-t/\tau}), \tau = L/R$$

$$U_B = (1/2)LI^2$$

$$c = \omega/k = E/B = 1/(\mu_0 \epsilon_0)^{1/2} = 3.0 \times 10^8$$

$$\text{m/s} = \lambda f, \omega = 2\pi f$$

$$\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$$

$$I = P_s/4\pi r^2$$

$$p_r = I/c, p_r = 2I/c$$

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

$$n_1/p + n_2/q = (n_2 - n_1)/R$$

$$M = -q/p, |M| = h'/h$$

$$\beta = 2\pi a \sin(\theta)/\lambda$$

$$d \sin(\theta) = m \lambda, d \sin(\theta) = (m+1/2) \lambda$$

$$I = I_{\text{max}} \cos^2(\phi/2) \sin^2(\beta/2)/(\beta/2)^2$$

$$\delta/\phi = \lambda/2\pi$$

$$E = hf$$

$$\lambda' - \lambda_0 = (h/m_e c)(1 - \cos(\theta))$$

$$eVs = K_{\max} = hf - \phi$$

$$\Delta x \Delta p_x \geq h/2\pi, \Delta y \Delta p_y \geq h/2\pi, \Delta z \Delta p_z \geq h/2\pi$$

$$\lambda = h/p$$

$$h = 6.63 \times 10^{-34} \text{ J s}$$

$$I = I_{\max} \cos^2(\phi/2) = I_{\max} \cos^2(\pi d \sin(\theta)/\lambda)$$

$$p = hf/c = h/\lambda$$

$$\lambda = h/p$$

$$a \sin(\theta) = m \lambda$$

$$n = \tan(\theta_p)$$

$$E_n = -13.6n^2$$

$$hc = 1240 \text{ eV} \cdot \text{nm}$$