Constants

$c = 3.0 \times 10^8 \frac{\text{m}}{\text{s}}$ $\qquad$ $e = 1.6 \times 10^{-19}\text{C}$ $\qquad$ $\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{Nm}^2}$ $\qquad$ $\mu_0 = 4\pi \times 10^{-7} \frac{\text{Tm}}{\text{A}}$

$m_p = 1.67 \times 10^{-27}\text{kg}$ $\qquad$ $m_e = 9.11 \times 10^{-31}\text{kg}$

## Chapter 15

$v = f\lambda$ $\qquad$ $k = \frac{2\pi}{\lambda}$ $\qquad$ $\omega = 2\pi f = \frac{2\pi}{T}$ $\qquad$ $\frac{\partial^2 y(x,t)}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y(x,t)}{\partial t^2}$

$\frac{\partial y(x,t)}{\partial t} = \mp v \frac{\partial y(x,t)}{\partial x}$ $\qquad$ $v = \sqrt{\frac{F}{\mu}}$ $\qquad$ Power $= F_y(x,t)v_y(x,t)$ $\qquad$ $P_{\text{av}} = \frac{1}{2}\sqrt{\mu F}\omega^2 A^2$

$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$ $\qquad$ $y(x,t) = A_{\text{sw}}\sin(kx)\cos(\omega t)$

## Chapter 16

$p(x,t) = -B\frac{\partial y(x,t)}{\partial x}$ $\qquad$ $p_{\max} = BkA$ $\qquad$ $v = \sqrt{\frac{B}{\rho}}$ $\qquad$ $v = \sqrt{\frac{\gamma RT}{M}}$

$T_{\text{kelvin}} = T_C + 273.15$ $\qquad$ $v = \sqrt{\frac{Y}{\rho}}$ $\qquad$ $I = \langle p(x,t)v_y(x,t)\rangle_t$ $\qquad$ $I = \frac{1}{2}\sqrt{\rho B}\omega^2 A^2$

$\beta = (10\text{dB})\log\frac{I}{I_0}$ $\qquad$ $I_0 = 10^{-12}\frac{W}{m^2}$ $\qquad$ $f_{\text{beat}} = f_a - f_b$ $\qquad$ $f_L = \frac{v+v_L}{v+v_S}f_S$

## Chapter 21

$F = k\frac{|q_1 q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1 q_2|}{r^2}$ $\qquad$ $\epsilon_0 = 8.85 \times 10^{-12}\frac{\text{C}^2}{\text{Nm}^2}$ $\qquad$ $k = 8.988 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$ $\qquad$ $\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\hat{r}$

$p = dq$ $\qquad$ $\vec{\tau} = \vec{p}\times\vec{E}$ $\qquad$ $U = -\vec{p}\cdot\vec{E}$

## Chapter 22

$\Phi_E \equiv \int \vec{E}\cdot d\vec{A}$ $\qquad$ $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{\text{encl}}}{\epsilon_0}$

## Chapter 23

$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$ $\qquad$ $-\Delta V = V_a - V_b = \int_a^b \vec{E}\cdot d\vec{l}$ $\qquad$ $\vec{E} = -\left(\hat{\text{i}}\frac{\partial V}{\partial x} + \hat{\text{j}}\frac{\partial V}{\partial y} + \hat{\text{k}}\frac{\partial V}{\partial z}\right)$

## Chapter 24

$C = \frac{Q}{V_{ab}}$ $\qquad$ $\frac{1}{C_{\text{series}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ...$ $\qquad$ $C_{\text{parallel}} = C_1 + C_2 + C_3 + ...$ $\qquad$ $U = \frac{1}{2}CV^2 = \frac{1}{2}QV$

$u = \frac{1}{2}\epsilon_0 E^2$ $\qquad$ $C = KC_0$ $\qquad$ $u = \frac{1}{2}K\epsilon_0 E^2$ $\qquad$ $\oint K\vec{E}\cdot d\vec{A} = \frac{Q_{\text{encl-free}}}{\epsilon_0}$

## Chapter 25

$I = \frac{dQ}{dt} = n|q|v_d A$ $\qquad$ $\vec{J} = nq\vec{v}_d$ $\qquad$ $\rho = \frac{E}{J}$ $\qquad$ $\rho(T) = \rho_0[1 + \alpha(T - T_0)]$

$V = IR$ $\qquad$ $R = \frac{\rho L}{A}$ $\qquad$ $V_{ab} = \mathcal{E} - Ir$ $\qquad$ $P = V_{ab}I$

$P_{\text{resistor}} = V_{ab}I = I^2 R$

## Chapter 26

$R_{\text{eq}} = R_1 + R_2 + R_3 + ...$ $\qquad$ $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$ $\qquad$ KCR $\sum I = 0$ $\qquad$ KVR $\sum V = 0$

$V_C = \frac{q}{C}$ $\qquad$ $q_C(t) = C\mathcal{E}\left(1 - e^{-t/RC}\right)$ $\qquad$ $i = \frac{dq}{dt}$

## Chapter 27

$\vec{F} = q\vec{v}\times\vec{B}$ $\qquad$ $\Phi_B = \int \vec{B}\cdot d\vec{A}$ $\qquad$ $\oint \vec{B}\cdot d\vec{A} = 0$ $\qquad$ $R = \frac{mv}{|q|B}$ $\qquad$ $\vec{F} = I\vec{l}\times\vec{B}$

$d\vec{F} = Id\vec{l}\times\vec{B}$ $\qquad$ $\mu = IA$ $\qquad$ $\vec{\tau} = \vec{\mu}\times\vec{B}$ $\qquad$ $U = -\vec{\mu}\cdot\vec{B}$

## Chapter 28

$\vec{B} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2}$ $\qquad$ $d\vec{B} = \frac{\mu_0}{4\pi}\frac{Id\vec{l}\times\hat{r}}{r^2}$ $\qquad$ $B_{\text{straight wire}} = \frac{\mu_0 I}{2\pi r}$ $\qquad$ $\frac{F}{L} = \frac{\mu_0 II'}{2\pi r}$

$B_{x\text{hoop}} = \frac{\mu_0 I a^2}{2(x^2+a^2)^{3/2}}$ $\qquad$ $B_x = \frac{\mu_0 NI}{2a}$ $\qquad$ $\oint \vec{\mathbf{B}}\cdot d\vec{l} = \mu_0 I_{\text{encl}}$

Chapter 29

$$\mathcal{E} = -\frac{d\Phi_B}{dt} \qquad \mathcal{E} = vBL \qquad \mathcal{E} = \oint \left(\vec{\mathbf{v}} \times \vec{\mathbf{B}}\right) \cdot d\vec{\mathbf{l}}$$

$$\oint \vec{\mathbf{E}} \cdot d\vec{\mathbf{A}} = \frac{Q_{\text{encl}}}{\epsilon_0} \quad \oint \vec{\mathbf{B}} \cdot d\vec{\mathbf{A}} = 0 \quad \oint \vec{\mathbf{B}} \cdot d\vec{\mathbf{l}} = \mu_0 \left(i_{\text{C}} + \epsilon_0 \frac{d\Phi_E}{dt}\right)_{\text{encl}} \quad \oint \vec{\mathbf{E}} \cdot d\vec{\mathbf{l}} = -\frac{d\Phi_B}{dt}$$

Chapter 30

$$\mathcal{E}_2 = -M\frac{di_1}{dt} \quad \mathcal{E}_1 = -M\frac{di_2}{dt} \quad M = \frac{N_2\Phi_{B2}}{i_1} = \frac{N_1\Phi_{B1}}{i_2} \quad \mathcal{E} = -L\frac{di}{dt}$$

$$L = \frac{N\Phi_B}{i} \qquad U = \frac{1}{2}LI^2 \qquad u = \frac{B^2}{2\mu_0} \qquad\qquad u = \frac{B^2}{2\mu}$$

$$V_L = L\frac{di}{dt} \qquad \tau = \frac{L}{R} \qquad \omega = \sqrt{\frac{1}{LC}}$$

Chapter 31

$$I_{\text{rms}} = \frac{I}{\sqrt{2}} \qquad\qquad V_{\text{rms}} = \frac{V}{\sqrt{2}} \qquad\qquad i = I\cos\omega t \quad v = V\cos\left(\omega t + \phi\right) \qquad V_R = IR$$

$$V_L = IX_L = I\omega L \quad V_C = IX_C = \frac{I}{\omega C} \quad V = IZ \qquad Z = \sqrt{R^2 + (X_L - X_C)^2} \quad \tan\phi = \frac{X_L - X_C}{R}$$

$$P_{\text{av}} = \frac{1}{2}VI\cos\phi \qquad \frac{V_2}{V_1} = \frac{N_2}{N_1} \qquad\qquad V_1I_1 = V_2I_2$$

Chapter 32

$$E = cB \qquad\qquad\qquad c = \frac{1}{\sqrt{\epsilon_0\mu_0}} \qquad\qquad B = \epsilon_0\mu_0 cE \qquad\qquad \vec{\mathbf{E}}\left(x, t\right) = \hat{\mathbf{j}}E_{\text{max}}\cos\left(kx - \omega t\right)$$

$$\vec{\mathbf{B}}\left(x, t\right) = \hat{\mathbf{k}}B_{\text{max}}\cos\left(kx - \omega t\right) \quad E_{\text{max}} = cB_{\text{max}} \quad v = \frac{1}{\sqrt{\epsilon\mu}} = \frac{1}{\sqrt{K\epsilon_0 K_m\mu_0}} \quad \vec{\mathbf{S}} = \frac{1}{\mu_0}\vec{\mathbf{E}}\times\vec{\mathbf{B}}$$

$$I = S_{\text{av}} = \frac{E_{\text{max}}B_{\text{max}}}{2\mu_0} = \frac{E_{\text{max}}^2}{2\mu_0 c} \qquad \frac{1}{A}\frac{dp}{dt} = \frac{S}{c} = \frac{EB}{\mu_0 c}$$

Chapter 33

$$n = \frac{c}{v} \quad \lambda = \frac{\lambda_0}{n} \quad n_a\sin\theta_a = n_b\sin\theta_b \quad \sin\theta_{\text{acrit}} = \frac{n_b}{n_a} \quad I = I_{\text{max}}\cos^2\phi \quad \tan\theta_p = \frac{n_b}{n_a}$$