CHAPTER 17

$F = k\,|q_1 q_2|/r^2$ $\quad k = 8.99\times10^{9}\ N.m^2/C^2$

$e = 1.602\times10^{-19}\ C$ $\quad$ mass of an electron: $9.1\times10^{-31}kg$

$E = k\,|Q|/r^2$ $\quad$ mass of a proton: $1.675\times10^{-27}kg$

$F=qE$ $\quad \Phi_E = EA\cos\theta$ $\quad \Phi_E = Q_{encl}/\varepsilon_o$

$\varepsilon_o = 8.854\times10^{-12}C^2/(N.m^2)$

$F=ma$ $\quad v^2 = v_o^2 + 2a(x-x_o)$ $\quad K=(1/2)mv^2$

CHAPTER 18

$PE = kq_1q_2/r$ $\quad V = kQ/r$ $\quad$ (PE) $U=qV$

$E=V/d$ $\quad V=Ed$ $\quad C = Q/V_{ab}$ $\quad C = \varepsilon_0 A/d$

Capacitors in series $\quad 1/C_{eq} = 1/C_1 + 1/C_2$

Capacitors in parallel $\quad C_{eq} = C_1 + C_2$

$U_{capacitor} = (1/2)\,CV^2$

Dielectric constant: $\quad K=C/C_0$

CHAPTER 19

$I = (\Delta Q)/(\Delta t)$ $\quad V = RI$ $\quad R = \rho\, L/A$ $\quad V_{ab} = \mathcal{E} - Ir$

$\Delta W = V_{ab}\Delta Q = V_{ab}\, I\Delta t$ $\quad \Delta W/\Delta t = V_{ab}I$

$P = V_{ab}I$ $\quad P = I^2R$ or $P = V^2_{ab}/R$

Resistors in series $\quad R_{eq} = R_1 + R_2$

Resistors in parallel $\quad 1/R_{eq} = 1/R_1 + 1/R_2$

CHAPTER 20

$$F = |q|v_\perp B = |q|vB\sin\phi$$

$F = mv^2/R$ $\quad$ ***$R = mv/|q|B$*** $\quad$ ***$\omega = v/R = |q|B/m$***

$$F = IlB_\perp = IlB\sin\phi.$$

$$\mu_0 = 4\pi\times10^{-7}\,\mathrm{T\cdot m/A}.$$

$$\tau = IAB\sin\phi, \qquad \mu = IA.$$

$F = \mu_0 L(I_1 I_2)/(2\pi r)$ $\quad$ ***$F/L = \mu_0 (I_1 I_2)/(2\pi r)$***

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

$$B = \frac{\mu_0 I}{2R} \quad \text{(center of circular loop).}$$

$$B = \frac{\mu_0 NI}{2R} \quad \text{(center of } N \text{ circular loops).}$$

$$V_{ab} = vBL.$$

B=μ_0nI with n=N/L

$$\tau = IAB\sin\phi$$

$$\Phi_B = B_\perp A = BA\cos\phi.$$

CHAPTER 21

$$\mathcal{E} = \left|\frac{\Delta\Phi_B}{\Delta t}\right|. \qquad \mathcal{E} = N\left|\frac{\Delta\Phi_B}{\Delta t}\right|$$

$$M = M_{21} = M_{12} = \left|\frac{N_2\Phi_{B2}}{i_1}\right| = \left|\frac{N_1\Phi_{B1}}{i_2}\right|. \qquad \mathcal{E}_2 = M\left|\frac{\Delta i_1}{\Delta t}\right| \qquad \mathcal{E} = L\left|\frac{\Delta i}{\Delta t}\right|.$$

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}. \qquad U = \frac{1}{2}LI^2.$$

$$i = \frac{\mathcal{E}}{R}(1 - e^{-t/\tau}). \qquad \omega = \frac{1}{\sqrt{LC}}.$$

CHAPTER 22

$i = I\cos\omega t$ $\quad v_R = V_R\cos\omega t$

$v_L = V_L\cos(\omega t+\pi/2)$ $\quad v_C = V_C\cos(\omega t-\pi/2)$

$V_C = X_C I$ $\quad V_R = RI$ $\quad V_L = X_L I$

$X_C = 1/(\omega C)$ $\quad X_L = \omega L$ $\quad Z = \sqrt{(R^2 + (X_L - X_C)^2}$

$X = (X_L - X_C)$ $\quad \tan\Phi = (X_L - X_C)/R$ $\quad P = (1/2)(VI\cos\Phi)$

CHAPTER 23

$$c = 3.00 \times 10^8\ \text{m/s}.\ c = f\lambda.\ 2\pi f = \omega.\ k = \frac{2\pi}{\lambda}.$$

E=cB $\quad c = \lambda f$ $\quad v = \lambda f$ $\quad v = \lambda/T$

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

Energy density in electric and magnetic fields

The energy density u (energy per unit volume) in a region of empty space where electric and magnetic fields are present is

$$u = \frac{1}{2}\epsilon_0 E^2 + \frac{1}{2\mu_0}B^2. \qquad (23.6)$$

The two field magnitudes are related by Equation 23.1:

$$B = \frac{E}{c} = \sqrt{\epsilon_0\mu_0}E.$$

Combining this equation with Equation 23.6, we can also express the energy density u as

$$u = \frac{1}{2}\epsilon_0 E^2 + \frac{1}{2\mu_0}(\sqrt{\epsilon_0\mu_0}E)^2 = \epsilon_0 E^2. \qquad (23.7)$$

This result shows that the energy density associated with the $\vec{E}$ field is equal to that of the $\vec{B}$ field.

$S = \varepsilon_0 cE^2$ $S = EB/\mu_o$ $S_{av} = (1/2)\,\varepsilon_0 cE^2{}_{max}$ $S_{av} = (E_{max}B_{max})/(2\mu_0)$ $I = S_{av}$

$n_a \sin\theta_a = n_b \sin\theta_b$ $\theta_a = \theta_r$ $\mathbf{Sin\theta_{crit} = n_b/n_a}$ $\mathbf{n=c/v}$ $\mathbf{\lambda = \lambda_0/n}$

TABLE 23.1 Index of refraction for yellow sodium light ($\lambda_0 = 589$ nm)

Substance	Index of refraction, n	Substance	Index of refraction, n
Solids		Medium flint	1.62
Ice (H_2O)	1.309	Dense flint	1.66
Fluorite (CaF_2)	1.434	Lanthanum flint	1.80
Polystyrene	1.49	*Liquids at 20°C*	
Rock salt (NaCl)	1.544	Methanol (CH_3OH)	1.329
Quartz (SiO_2)	1.544	Water (H_2O)	1.333
Zircon ($ZrO_2 \cdot SiO_2$)	1.923	Ethanol (C_2H_5OH)	1.36
Fabulite ($SrTiO_3$)	2.409	Carbon tetrachloride (CCl_4)	1.460
Diamond (C)	2.417	Turpentine	1.472
Rutile (TiO_2)	2.62	Glycerine	1.473
Glasses (typical values)		Benzene	1.501
Crown	1.52	Carbon disulfide (CS_2)	1.628
Light flint	1.58		

CHAPER 24

$m = y'/y$ $m = -s'/s$ $1/s + 1/s' = 2/R$ $1/s + 1/s' = 1/f$ $f=R/2$

$(n_a/s) + (n_b/s') = (n_b-n_a)/R$ $m = -(n_a s')/(n_b s)$ $(1/f) = (n-1)[(1/R_1) - (1/R_2)]$

CHAPTER 25

f-number = f/D

correcting farsighted: s =25 cm correcting nearsighted: s =∞

M=25cm/f(cm) $M(\text{microscope}) = m_1 M_2 = (25\text{cm})s_1'/f_1 f_2$