\[B = \mu_0 I / 2\pi r \quad \mu_0 = 4\pi \times 10^{-7} \text{ T-m/A} \quad \varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}^2 \text{-m}^2\]

\[\text{Emf} = v B L \text{ (motional emf)} \quad \text{Emf} = N B\omega \sin \omega t \text{ (rotational emf)}\]

Ohm’s Law: \[I = \text{Emf}/R \quad \text{rms} = \text{amplitude}/\sqrt{2} \quad c = 3 \times 10^8 \text{ m/sec}\]

\[\Phi = BA \cos \theta \quad \text{Faraday: Emf} = -N (\Delta \Phi/\Delta t) \quad \text{Transformer} \quad V_S/V_P = N_S/N_P = I_P/I_S\]

In EM wave: \[E = c B \quad u = \varepsilon_0 E_{\text{rms}}^2 \quad \text{Intensity: } I = u c = \text{Power/area} \quad v = f \lambda\]

\[I = I_0/2 \text{ (unpolarized)} \quad I = I_0 \cos^2 \theta \quad \text{Doppler: } f_o = f_s (1 + v_{rel}/c)\]

\[n = c/v \quad \lambda_{\text{medium}} = \lambda_{\text{vacuum}}/n \quad \text{reflection: } \theta_i = \theta_r \quad \text{refraction: } n_i \sin \theta_i = n_t \sin \theta_t\]

Total internal reflection: \[\sin \theta_c = n_i/n_t \quad (n_i > n_t)\]

Images: \[1/f = 1/p + 1/q \quad m = -q/p \quad (q>0, \text{ real, inverted}; q<0, \text{ virtual, erect for a single mirror or lens})\]

\[f>0 \text{ (concave mirror, converging or convex lens)} \quad f \text{ (concave mirror)} = \frac{1}{2} R \quad f<0 \text{ (convex mirror, diverging or concave lens)} \quad f \text{ (convex mirror)} = -\frac{1}{2} R\]

Multiple lenses: \[p_2 = s - q_1 \quad m = m_1 m_2 \quad \text{Near point N=25 cm}\]

Power of lens: \[P = 1/f \text{ (diopters if f in meters)} \quad \text{Angular magnification } M = \theta'/\theta\]

Magnifying glass: \[M = N/f \quad \text{Compound micro: } M = -L N/f_o f_c \quad \text{Telescope: } M = -f_o/f_c\]

In phase: \[A = A_1 + A_2 \quad \text{Out of phase: } A = A_1 - A_2 \quad \text{Intensity prop. to } A^2\]

Double slit: \[d \sin \theta = m\lambda \text{ (maxima, } m = \text{integer); } \quad d \sin \theta = (m+1/2)\lambda \text{ (minima)}\]

Thin films: If \(n_{\text{film}}\) is middle index (i.e. between the other two), then \(2t = m\lambda\) is constructive and \(2t = (m + 1/2)\lambda\) is destructive. If \(n_{\text{film}}\) is not the middle index, then \(2t = m\lambda\) is destructive and \(2t = (m + 1/2)\lambda\) is constructive.

\[n(\text{air}) = 1 \quad n(\text{water}) = 1.33 \quad n(\text{glass}) = 1.50\]