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

Emf = v B L (motional emf) Emf = NBAω sin ωt (rotational emf)

Ohm's Law: I = Emf/R rms = amplitude/sqrt(2) $c = 3 \times 10^8$ m/sec

$\Phi = BA \cos\theta$ Faraday: $Emf = -N(\Delta\Phi/\Delta t)$ Transformer $V_S/V_P = N_S/N_P = I_P/I_S$

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

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

$n = c/v$ $\lambda_{medium} = \lambda_{vacuum} / n$ reflection: $\theta_I = \theta_r$ refraction: $n_i \sin\theta_I = n_t \sin\theta_t$

Total internal reflection: $\sin\theta_c = n_t/n_i$ $(n_i > n_t)$

Images: $1/f = 1/p + 1/q$ $m = -q/p$ (q>0, real, inverted; q<0, virtual, erect for a single mirror or lens)

f>0 (concave mirror, converging or convex lens) f (concave mirror) = ½ R
f<0 (convex mirror, diverging or concave lens) f (convex mirror) = -½ R

Multiple lenses: $p_2 = s - q_1$ $m = m_1 m_2$ Near point N=25 cm

Power of lens: P = 1/f (diopters if f in meters) Angular magnification $M = \theta'/\theta$

Magnifying glass: M = N/f Compound micro: $M = -LN/f_o f_e$ Telescope: $M = -f_o/f_e$

In phase: $A = A_1 + A_2$ Out of phase: $A = A_1 - A_2$ Intensity prop. to A^2

Double slit: $d \sin\theta = m\lambda$ (maxima, m =integer); $d \sin\theta = (m + 1/2)\lambda$ (minima)

Thin films: If n_{film} is middle index (i.e. between the other two), then $2t = m\lambda$ is constructive and $2t = (m + ½)\lambda$ is destructive. If n_{film} is not the middle index, then $2t = m\lambda$ is destructive and $2t = (m + ½)\lambda$ is constructive.

n(air) = 1 n(water) = 1.33 n(glass)=1.50