

# Phys 122 Equations and Constants

## 1 Magnetism

$$\vec{F} = q\vec{v} \times \vec{B} \quad (1)$$

$$\vec{F} = I\vec{L} \times \vec{B} \quad (2)$$

$$\oint \vec{B} \cdot d\vec{L} = \mu_0 I_{in} \quad (3)$$

$$BL = \mu_0 I_{in} \quad (4)$$

$$\xi = -\frac{d\Phi_B}{dt} = -\frac{\Delta\Phi_B}{\Delta t} \quad (5)$$

$$(6)$$

## 2 Circuits

### 2.1 General

$$V = IR \quad (7)$$

$$V = \frac{Q}{C} \quad (8)$$

$$V = -L \frac{dI}{dt} \quad (9)$$

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} \quad (10)$$

### 2.2 AC Circuit Theory

$$V_{peak} = I_{peak}|Z| \quad (11)$$

$$V_{RMS} = I_{RMS}|Z| \quad (12)$$

$$\vec{Z}_R = R\hat{i} \quad (13)$$

$$\vec{Z}_L = \omega L\hat{j} \quad (14)$$

$$\vec{Z}_C = -\frac{1}{\omega C}\hat{j} \quad (15)$$

$$|Z| = \sqrt{Z_x^2 + Z_y^2} \quad (16)$$

$$\tan(\phi_Z) = \frac{Z_y}{Z_x} \quad (17)$$

$$\langle P \rangle = V_{RMS} I_{RMS} \cos(\phi_Z) \quad (18)$$

$$\omega_{resonance} = \frac{1}{\sqrt{LC}} \quad (19)$$

## 2.3 Transient

$$\tau_{RC} = RC \quad (20)$$

$$\tau_{RL} = \frac{L}{R} \quad (21)$$

$$X(t) = X_0 e^{-\frac{t}{\tau}} \quad (22)$$

$$X(t) = X_0 \left(1 - e^{-\frac{t}{\tau}}\right) \quad (23)$$

## 3 EM Waves

$$\oint \vec{B} \cdot d\vec{L} = \mu_0 I_{in} + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt} \quad (24)$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = 3.00 \times 10^8 \frac{m}{s} \quad (25)$$

$$c = \lambda f \quad (26)$$

$$u = \frac{U}{V} = \frac{1}{2} \epsilon_0 E^2 + \frac{1}{2} \frac{B^2}{\mu_0} = \epsilon_0 E^2 = \frac{B^2}{\mu_0} \quad (27)$$

$$I = \frac{E_{RMS} B_{RMS}}{\mu_0} = \frac{E_{peak} B_{peak}}{2\mu_0} \quad (28)$$

$$P_{absorb} = \frac{I}{c} \quad (29)$$

$$P_{reflect} = \frac{2I}{c} \quad (30)$$

## 4 Geometrical Optics

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \quad (31)$$

$$m = -\frac{d_i}{d_o} \quad (32)$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad (33)$$

$$\sin \theta_{critical} = \frac{n_2}{n_1} \quad (34)$$

## 5 Wave Optics

$$\sin \theta \approx \tan \theta = \frac{y}{L} \quad (35)$$

### 5.1 Two-Slit

$$(Bright) d \sin \theta = m\lambda \quad (36)$$

$$(Dark) d \sin \theta = \left(m + \frac{1}{2}\right) \lambda \quad (37)$$

$$m = 0, \pm 1, \pm 2, \dots \quad (38)$$

## 5.2 Single Slit

$$(\textit{Dark}) \quad D \sin \theta = m\lambda \quad (39)$$

$$m = \pm 1, \pm 2, \dots \quad (40)$$

## 5.3 Grating

$$(\textit{Bright}) \quad d \sin \theta = m\lambda \quad (41)$$

$$m = 0, \pm 1, \pm 2, \dots \quad (42)$$

## 5.4 Polarization

$$I_{out} = I_{in} \cos^2 \Delta\phi \quad (43)$$

$$I_{out} = \frac{1}{2} I_{unpolarized} \quad (44)$$