PHYSICS 4B EQUATION SHEET

$\mathbf{F}_{12} = \frac{kq_1q_2}{r^2}\hat{\mathbf{r}}_{12}$	Coulomb's Law
$\mathbf{E} = \frac{\mathbf{F}}{q}$	Electric Field
$\mathbf{E} = k\frac{q}{r^2}\hat{\mathbf{r}}$	Electric Field due to a point charge
$\mathbf{E} = k\int\frac{dq}{r^2}\hat{\mathbf{r}}$	Electric Field due to a continuous charge
$E = \frac{2k\lambda}{r}$	E-field due to infinite line of charge
$E = \frac{\sigma}{2\varepsilon_o}$	E-field due to an infinite plane of charge
$E = \frac{\sigma}{\varepsilon_o}$	E-field just outside a conductor
$\Phi_E = \int \mathbf{E}\bullet d\mathbf{A}$	Electric Flux
$\Phi_E = \oint \mathbf{E}\bullet d\mathbf{A} = \frac{q_{enc}}{\varepsilon_o}$	Gauss's Law
$p = qd$	Electric Dipole Moment
$\tau = \mathbf{p}\times\mathbf{E}$	Torque on Electric Dipole
$U = -\mathbf{p}\bullet\mathbf{E}$	PE of electric dipole
$\Delta V = \frac{\Delta U}{q} = V_B - V_A = -\int_A^B \mathbf{E}\bullet d\mathbf{s}$	Electric Potential Difference
$U = qV$	Electric Potential Energy
$U = \frac{kq_1q_2}{r}$	Electric Potential Energy
$V = \frac{kq}{r}$	Electric Potential due to a point charge
$V = k\int\frac{dq}{r}$	Electric Potential due to an extended body of charge
$\vec{E} = -\vec{\nabla}V$	Relation between V and E
$C = \frac{Q}{V}$	Capacitance
$C = \frac{\varepsilon_o A}{d}$	Capacitance for Parallel-Plate Capacitor
$C_{eq} = C_1 + C_2$	Capacitors in Parallel
$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$	Capacitors in Series

$\mu = \frac{1}{2}\varepsilon_o E^2$	Energy Density in an E-field
$C = kC_o$	Capacitance with Dielectric
$E = \frac{E_o}{k}$	E-field with Dielectric
$U = \frac{1}{2}CV^2$	Energy in a Capacitor
$I = \frac{dQ}{dt}$	Electric Current
$J = \frac{I}{A}$	Current Density
$\mathbf{J} = \sigma\mathbf{E}$	Ohm's Law
$R = \frac{\rho\ell}{A}$	Resistance
$V = IR$	"Ohm's Law"
$\rho = \frac{1}{\sigma}$	Resistivity
$R_{eq} = R_1 + R_2$	Resistors in Series
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$	Resistors in Parallel
$I(t) = \frac{V}{R}e^{-\frac{t}{\tau}}$	Current Charging Capacitor
$q(t) = CV(1 - e^{-\frac{t}{\tau}})$	Charge Charging Capacitor
$\tau = RC$	Time-Constant
$\mathbf{F} = q\mathbf{v}\times\mathbf{B}$	Magnetic Force on a Moving Charge
$\mathbf{F} = I\mathbf{L}\times\mathbf{B}$	Magnetic Force on a Current-Carrying Conductor
$\mathbf{F} = I\int_a^b d\mathbf{s}\times\mathbf{B}$	Magnetic Force on a Current-Carrying Conductor
$\boldsymbol{\tau} = \mu\times\mathbf{B}$	Torque on Current Loop
$U = -\mu\bullet\mathbf{B}$	Magnetic Potential Energy
$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B}$	Lorentz Force
$\Delta V_H = \frac{IB}{nqt}$	Hall Voltage

$$d\mathbf{B} = \frac{\mu_o}{4\pi}\frac{Id\mathbf{s}\times\hat{\mathbf{r}}}{r^2}$$
$$\mathbf{B} = \frac{\mu_o}{4\pi}\frac{q\mathbf{v}\times\hat{\mathbf{r}}}{r^2}$$
$$\oint \mathbf{B}\bullet d\ell = \mu_o(I + I_d)$$
$$I_d = \varepsilon_o \frac{d\Phi_E}{dt}$$
$$B = \mu_o nI$$
$$\Phi_B = \int \mathbf{B}\bullet d\mathbf{A}$$
$$\varepsilon = -\frac{d\Phi_B}{dt}$$
$$\oint \mathbf{E}\bullet d\mathbf{s} = -\frac{d\Phi_B}{dt}$$
$$\varepsilon_L = -N\frac{d\Phi_B}{dt} - L\frac{dI}{dt}$$
$$L = \frac{N\Phi_B}{I}$$
$$I = \frac{V}{R}(1 - e^{-\frac{t}{\tau}})$$
$$\tau = \frac{L}{R}$$
$$U = \frac{1}{2}LI^2$$
$$\mu_B = \frac{B^2}{2\mu_o}$$
$$M_{12} = \frac{N_2\Phi_{12}}{I_1}$$
$$I_{rms} = \frac{I_p}{\sqrt{2}}$$
$$V_{rms} = \frac{V_p}{\sqrt{2}}$$
$$X_L = \omega L$$
$$X_x = \frac{1}{\omega C}$$
$$V_R = I_p R \sin \omega t$$
$$V_L = I_p X_L \sin\left(\omega t + \frac{\pi}{2}\right)$$
$$V_c = I_p X_c \sin\left(\omega t - \frac{\pi}{2}\right)$$
$$P_{ave} = I_{rms}^2 R$$
$$V = I_p Z$$
$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$
$$\phi = \tan^{-1}\left(\frac{X_L - X_c}{R}\right)$$
$$\omega_o = \frac{1}{\sqrt{LC}}$$