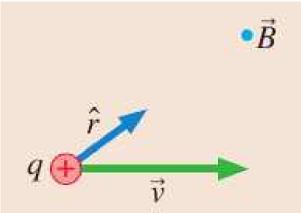
The Biot-Savart law:
A point charge: $\vec{B} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2}$



A short current element: $\vec{B} = \frac{\mu_0}{4\pi}\frac{I\vec{\Delta s}\times\hat{r}}{r^2}$
Amperes law: $\oint \vec{B}\cdot d\vec{s} = \mu_0 I_{through}$, where $I_{through}$ is the current through the area bounded by the integration path.
Magnetic Forces:
The magnetic force on a moving charge is $\vec{F} = q\vec{v}\times\vec{B}$, the force is perpendicular to $\vec{v}$ and $\vec{B}$
The magnetic force on a current-carrying wire is $\vec{F} = I\vec{l}\times\vec{B}$
The magnetic torque on a magnetic dipole is $\vec{\tau} = \vec{\mu}\times\vec{B}$
Magnetic field:
of the infinite **wire** is $B = \frac{\mu_0}{2\pi}\frac{I}{d}$
of the **current loop** is $B = \frac{\mu_0}{2}\frac{IR^2}{(z^2+R^2)^{3/2}}$
of the **coil** at the center is $B = \frac{\mu_0}{2}\frac{NI}{R}$
of the **solenoid** is $B = \frac{\mu_0 NI}{l}$

Circular motion at the cyclotron frequency $f_{cyc} = \frac{qB}{2\pi m}$

Faradays Law:
The induced emf is $\mathcal{E} = \left|\frac{d\Phi}{dt}\right|$
Multiply by N for an N-turn coil.
The size of the induced current is $I = \frac{\mathcal{E}}{R}$

Lenzs Law:
There is an induced current in a closed conducting loop if and only if the magnetic flux through the loop is changing.
The direction of the induced current is such that the induced magnetic field opposes the change in the flux.
Magnetic flux: $\Phi_m = \vec{A}\cdot\vec{B} = AB\cos\theta$
Inductors:
Solenoid inductance $L_{solenoid} = \frac{\mu_0 N^2 A}{l}$
Potential difference $\Delta V_L = -L\frac{dI}{dt}$
Energy stored $U_L = \frac{1}{2}LI^2$
Magnetic energy density $u_B = \frac{1}{2\mu_0}B^2$
LC circuit:
Oscillates at $\omega = \sqrt{\frac{1}{LC}}$; **RC circuit**:
Exponential change with $\tau = \frac{L}{R}$

Maxwells Equations:
$\oint \vec{E}\cdot d\vec{A} = \frac{Q_{in}}{\epsilon_0}$
$\oint \vec{B}\cdot d\vec{A} = 0$
$\oint \vec{E}\cdot d\vec{s} = -\frac{d\Phi_m}{dt}$
$\oint \vec{B}\cdot d\vec{s} = \mu_0 I_{through} + \epsilon_0\mu_0\frac{d\Phi_e}{dt}$
Lorentz Force: $\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$
$c = \frac{1}{\sqrt{\epsilon_0\mu_0}}$
The electric and magnetic field strengths in electromagnetic wave are related by $E = cB$.
The Poynting vector $\vec{S} = \frac{\vec{E}\times\vec{B}}{\mu_o}$
The wave intensity $I = \frac{P}{A} = \frac{c\epsilon_0}{2}E_0^2$

The Maluss law: $I = I_0\cos^2\theta$
Series RLC circuits:
$I = \frac{\mathcal{E}_0}{Z}$ where Z is the impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$ and $V_R = IR$, $V_L = IX_L$, $V_C = IX_C$
The resonance frequency is $\omega = \frac{1}{\sqrt{LC}}$