

Mr. Schneider presents...

Electromagnetic Formulae

Concepts	Formula	Units
Force $\propto \frac{(\text{charge}_1)(\text{charge}_2)}{\text{distance}^2}$	$F = k \frac{q_1 q_2}{r^2}$	newton = $\left(\frac{\text{newton} \cdot \text{meter}^2}{\text{coulomb}^2} \right) \frac{(\text{coulomb})(\text{coulomb})}{\text{meter}^2}$
Electric field strength = $\frac{\text{force}}{\text{charge}}$	$\vec{E} = \frac{\vec{F}}{q}$	$\left(\frac{\text{newton}}{\text{coulomb}} \right) = \frac{\text{newton}}{\text{coulomb}}$
Voltage = $\frac{\text{energy}}{\text{charge}}$	$V = \frac{W}{q}$	volt = $\frac{\text{joule}}{\text{coulomb}}$
Current = $\frac{\text{charge flowing by}}{\text{time change}}$	$i = \frac{q}{\Delta t}$	ampere = $\frac{\text{coulomb}}{\text{second}}$
Voltage = (current)(resistance)	$V = iR$	volt = (ampere)(ohm)
Power = (current)(voltage)	$P = iV = i^2 R = \frac{V^2}{R}$	watt = (ampere)(volt)
Power = $\frac{\text{energy}}{\text{time change}}$	$P = \frac{W}{\Delta t}$	watt = $\frac{\text{joule}}{\text{second}}$
The magnetic field at the center of a coil of wire is proportional to the number of turns, the current, and the inverse of the coil radius.	$B = 2\pi K' \frac{Ni}{r}$	tesla = $\left(\frac{\text{tesla} \cdot \text{meter}}{\text{ampere}} \right) \frac{(\text{ampere})}{(\text{meter})}$
Forces are produced when a length of wire carries current across magnetic field lines.	$\vec{F} = li \times \vec{B}$	newton = (meter)(ampere)(tesla)
Forces are produced when charges move across magnetic field lines.	$\vec{F} = q\vec{v} \times \vec{B}$	newton = (coulomb) $\left(\frac{\text{meter}}{\text{second}} \right)$ (tesla)
The voltage induced to oppose a change in magnetic flux through a coil of wire is proportional to the number of turns and the rate of magnetic flux change.	$V = -N \frac{\Delta\Phi_B}{\Delta t}$	volt = $\left[\frac{\text{volt} \cdot \text{second}}{\text{second}} \right] = \frac{(\text{weber})}{(\text{second})}$

Note: The units for the last four formulas in the table above are given for consistency. You don't need to know anything about teslas or webers, nor will you have to work any problems using these four formulas. You just need to understand what happens to the result as you vary one of the other variables.

And for those of you who are algebraically challenged...

Basic Formula	Alternate Forms
$\vec{E} = \frac{\vec{F}}{q}$	$q = \frac{\vec{F}}{\vec{E}}$ or $\vec{F} = q\vec{E}$
$V = \frac{W}{q}$	$q = \frac{W}{V}$ or $W = qV$
$i = \frac{q}{\Delta t}$	$\Delta t = \frac{q}{i}$ or $q = i\Delta t$
$V = iR$	$i = \frac{V}{R}$ or $R = \frac{V}{i}$
$P = iV$	$i = \frac{P}{V}$ or $V = \frac{P}{i}$
$P = \frac{W}{\Delta t}$	$\Delta t = \frac{W}{P}$ or $W = P\Delta t$