

## Potentially Useful Equations and Constants

### Physical Constants

Speed of light	$c$	$3 \times 10^8$ m/s
Electron Charge	$-e$	$1.602 \times 10^{-19}$ C
Proton Charge	$+e$	$1.602 \times 10^{-19}$ C
Permeability of Free Space	$\mu_0$	$4\pi \times 10^{-7}$ T.m/A
Electron Mass	$m_e$	$9.11 \times 10^{-31}$ kg
Proton Mass	$m_p$	$1.67 \times 10^{-27}$ kg

### RC circuits

#### Charging a capacitor

$$q(t) = C\varepsilon(1 - e^{-t/\tau})$$

#### Time constant

$$\tau = RC$$

#### Combining capacitors

$$\frac{1}{C_{series}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$$

$$C_{parallel} = C_1 + C_2 + C_3 + \dots$$

#### Magnetic Force on a moving charge

$$F = |q|vB \sin \theta$$

#### Magnetic Force on a current-carrying wire

$$F = ILB \sin \theta$$

#### Magnetic Field of a long, straight wire

$$B = \frac{\mu_0 I}{2\pi r}$$

#### Forces between current-carrying wires

$$F = \frac{\mu_0 I_1 I_2}{2\pi d} L$$

Magnetic Field of a solenoid

$$B = \mu_0 \left( \frac{N}{L} \right) I = \mu_0 n I$$

Magnetic Flux

$$\Phi = B A \cos \theta$$

Faraday's Law

Magnitude of the induced *emf*

$$|\mathcal{E}| = N \left| \frac{\Delta \Phi}{\Delta t} \right|$$

Inductance of a solenoid

$$L = \mu_0 n^2 A l = \mu_0 \left( \frac{N^2}{l} \right) A$$

Transformers

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

Electromagnetic Waves

Direction of propagation

$$\vec{E} \times \vec{B}$$

Frequency-wavelength relationship

$$c = f \lambda$$