

General College Physics II (PHY 104)
Equation Sheet

$$F = k \frac{|qQ|}{r^2}$$

$$\vec{F} = q\vec{E}$$

$$E = k \frac{|Q|}{r^2}$$

$$E = \frac{|\sigma|}{2\epsilon_0} = 2\pi k |\sigma|$$

$$\text{PE} = k \frac{qQ}{r}$$

$$\text{PE} = qV$$

$$V = k \frac{Q}{r}$$

$$V = -2\pi k \sigma |x|$$

$$\Delta V = Ed$$

$$Q = C\Delta V$$

$$C = \epsilon_0 \frac{A}{d}$$

$$\text{PE} = \frac{1}{2}Q\Delta V = \frac{1}{2}C(\Delta V)^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$V = IR$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$R = \frac{\rho L}{A}$$

$$I_{\text{rms}} = \frac{I_0}{\sqrt{2}}$$

$$V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$$

$$R_{\text{eq}} = R_1 + R_2$$

$$R_{\text{eq}} = \frac{R_1 R_2}{R_1 + R_2}$$

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

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

$$F = |q| v B \sin \theta$$

$$\Phi_B = BA \cos \theta$$

$$\Phi_B = BA \cos \omega t$$

$$B = \mu_0 NI / l$$

$$F = IlB \sin \theta$$

$$\mathcal{E} = -N \frac{\Delta \Phi_B}{\Delta t}$$

$$\mathcal{E} = NB\omega A \sin \omega t$$

$$\begin{array}{ll}
 n = \frac{c}{v} & f = \frac{r}{2} \\
 \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} & m = \frac{h_i}{h_o} = -\frac{d_i}{d_o} \\
 n_1 \sin \theta_1 = n_2 \sin \theta_2 & \sin \theta_C = \frac{n_2}{n_1}
 \end{array}$$

Conventions:

- The focal length f is positive for concave mirrors and converging lenses, and negative for convex mirrors and diverging lenses.
- For a single-lens or single-mirror system, we choose $d_o > 0$.
- A real image has $d_i > 0$, while a virtual image has $d_i < 0$.
- An upright image has $h_i > 0$, while an inverted image has $h_i < 0$.

$$\begin{array}{ll}
 \lambda_n = \frac{\lambda}{n} & \sin \theta = \frac{\lambda}{D} \\
 \#\lambda_s = \frac{d \sin \theta}{\lambda} & \#\lambda_s = \frac{2tn}{\lambda_0} + \left\{ \begin{array}{c} 1/2 \\ 0 \end{array} \right\} + \left\{ \begin{array}{c} 1/2 \\ 0 \end{array} \right\}
 \end{array}$$

$$E = hf \qquad p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$$

$$E_n = -(13.6 \text{ eV}) \frac{Z^2}{n^2}$$

$$N = N_0 e^{-\lambda t}$$

$$T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

Electron mass		$9.11 \times 10^{-31} \text{ kg}$
Proton mass		$1.6726 \times 10^{-27} \text{ kg}$
Neutron mass		$1.6749 \times 10^{-27} \text{ kg}$
Atomic mass unit (1 u)	$1.6605 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$	
Proton charge		$1.602 \times 10^{-19} \text{ C}$
Electrical constant		$k = 8.988 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$
Permittivity of free space		$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$
Permeability of free space		$\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m}/\text{A}$
Gravitational constant		$G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$
Planck's constant		$h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$
Speed of light in vacuum		$c = 3.00 \times 10^8 \text{ m/s}$

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

Material	Resistivity, ρ
Silver	$1.59 \times 10^{-8} \Omega\cdot\text{m}$
Copper	$1.68 \times 10^{-8} \Omega\cdot\text{m}$
Gold	$2.44 \times 10^{-8} \Omega\cdot\text{m}$
Tungsten	$5.6 \times 10^{-8} \Omega\cdot\text{m}$

Medium	Index of refraction, n
Vacuum	1.0000
Air (at STP)	1.0003
Water	1.33
Lucite	1.51
Crown glass	1.52

From Giancoli 7th, Appendix B

Atomic Number	Z	Element	Symbol	Mass		Half-life (if radioactive)
				Number A	Atomic Mass [†]	
0		(Neutron)	n	1	1.008665	10.183 min
1		Hydrogen	H	1	1.007825	
				1	1.007276	
				2	2.014102	
		Deuterium	${}^2_1\text{H}$	2	2.014102	
				3	3.016049	12.32 yr
2		Helium	He	3	3.016029	
				4	4.002603	
6		Carbon	C	11	11.011434	20.334 min
				12	12.000000	
				13	13.003355	
				14	14.003242	5730 yr
82		Lead	Pb	206	205.974466	
				207	206.975897	
				208	207.976652	
				210	209.984189	22.20 yr
				211	210.988737	36.1 min
				212	211.991898	10.64 h
				214	213.999806	26.8 min
84		Polonium	Po	210	209.982874	138.376 days
				214	213.995202	164.3 μs
85		Astatine	At	218	218.008695	1.5 s

[†]Masses given are those for the neutral atom, including the Z electrons (except for the proton).