



## PHYSICS DATA SHEET

### Constants

Acceleration Due to Gravity Near Earth.....  $|\vec{a}_g| = 9.81 \text{ m/s}^2$   
 Gravitational Constant .....  $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$   
 Radius of Earth .....  $r_e = 6.37 \times 10^6 \text{ m}$   
 Mass of Earth .....  $M_e = 5.97 \times 10^{24} \text{ kg}$   
 Elementary Charge .....  $e = 1.60 \times 10^{-19} \text{ C}$   
 Coulomb's Law Constant ..  $k = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$   
 Electron Volt .....  $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$   
 Index of Refraction of Air.  $n = 1.00$   
 Speed of Light in Vacuum.  $c = 3.00 \times 10^8 \text{ m/s}$   
 Planck's Constant .....  $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$   
 $h = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s}$   
 Atomic Mass Unit .....  $u = 1.66 \times 10^{-27} \text{ kg}$

### Physics Principles

- Uniform motion (balanced forces)
- Uniformly accelerated motion (unbalanced forces)
- Circular motion (unbalanced forces)
- Work-energy theorem
- Conservation of momentum
- Conservation of energy
- Conservation of mass-energy
- Conservation of charge
- Conservation of nucleons
- Wave-particle duality

### Particles

	Charge	Mass
Alpha Particle.....	$+2e$	$6.65 \times 10^{-27} \text{ kg}$
Electron .....	$-1e$	$9.11 \times 10^{-31} \text{ kg}$
Proton .....	$+1e$	$1.67 \times 10^{-27} \text{ kg}$
Neutron.....	0	$1.67 \times 10^{-27} \text{ kg}$

### First-Generation Fermions

	Charge	Mass
Electron .....	$-1e$	$0.511 \text{ MeV}/c^2$
Positron .....	$+1e$	$0.511 \text{ MeV}/c^2$
Electron neutrino, $\nu$ .....	0	$< 50 \text{ eV}/c^2$
Electron antineutrino, $\bar{\nu}$ .....	0	$< 50 \text{ eV}/c^2$
Up quark, $u$ .....	$+\frac{2}{3}e$	$\sim 5 \text{ MeV}/c^{2*}$
Anti-up antiquark, $\bar{u}$ .....	$-\frac{2}{3}e$	$\sim 5 \text{ MeV}/c^{2*}$
Down quark, $d$ .....	$-\frac{1}{3}e$	$\sim 10 \text{ MeV}/c^{2*}$
Anti-down antiquark, $\bar{d}$ .....	$+\frac{1}{3}e$	$\sim 10 \text{ MeV}/c^{2*}$

\*Current models seem to suggest a significantly lower mass of these quarks than those in this table.

### Prefixes Used with SI Units

Prefix	Symbol	Exponential Value
atto .....	a	$10^{-18}$
femto .....	f	$10^{-15}$
pico .....	p	$10^{-12}$
nano.....	n	$10^{-9}$
micro .....	$\mu$	$10^{-6}$
milli.....	m	$10^{-3}$
centi.....	c	$10^{-2}$
deci.....	d	$10^{-1}$
deka .....	da	$10^1$
hecto .....	h	$10^2$
kilo .....	k	$10^3$
mega .....	M	$10^6$
giga.....	G	$10^9$
tera.....	T	$10^{12}$

## EQUATIONS

### Kinematics

$$\bar{v}_{\text{ave}} = \frac{\Delta \bar{d}}{\Delta t} \quad \bar{d} = \bar{v}_f t - \frac{1}{2} \bar{a} t^2$$

$$\bar{a}_{\text{ave}} = \frac{\Delta \bar{v}}{\Delta t} \quad \bar{d} = \left( \frac{\bar{v}_f + \bar{v}_i}{2} \right) t$$

$$\bar{d} = \bar{v}_i t + \frac{1}{2} \bar{a} t^2 \quad v_f^2 = v_i^2 + 2ad$$

$$|\bar{v}_c| = \frac{2\pi r}{T} \quad |\bar{a}_c| = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

### Dynamics

$$\bar{a} = \frac{\bar{F}_{\text{net}}}{m} \quad |\bar{F}_g| = \frac{Gm_1 m_2}{r^2}$$

$$|\bar{F}_f| = \mu |\bar{F}_N| \quad |\bar{g}| = \frac{Gm}{r^2}$$

$$\bar{F}_s = -k\bar{x} \quad \bar{g} = \frac{\bar{F}_g}{m}$$

### Momentum and Energy

$$\bar{p} = m\bar{v} \quad E_k = \frac{1}{2} mv^2$$

$$\bar{F} \Delta t = m\Delta \bar{v} \quad E_p = mgh$$

$$W = |\bar{F}| |\bar{d}| \cos\theta \quad E_p = \frac{1}{2} kx^2$$

$$W = \Delta E$$

$$P = \frac{W}{t}$$

### Waves

$$T = 2\pi \sqrt{\frac{m}{k}} \quad m = \frac{h_1}{h_0} = \frac{-d_1}{d_0}$$

$$T = 2\pi \sqrt{\frac{l}{g}} \quad \frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$$T = \frac{1}{f} \quad \frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

$$v = f\lambda \quad \lambda = \frac{d \sin\theta}{n}$$

$$f = \left( \frac{v}{v \pm v_s} \right) f_s \quad \lambda = \frac{xd}{nl}$$

### Electricity and Magnetism

$$|\bar{F}_e| = \frac{kq_1 q_2}{r^2} \quad \Delta V = \frac{\Delta E}{q}$$

$$|\bar{E}| = \frac{kq}{r^2} \quad I = \frac{q}{t}$$

$$\bar{E} = \frac{\bar{F}_e}{q} \quad |\bar{F}_m| = I l_{\perp} |\bar{B}|$$

$$|\bar{E}| = \frac{\Delta V}{\Delta d} \quad |\bar{F}_m| = qv_{\perp} |\bar{B}|$$

### Atomic Physics

$$W = hf_0 \quad E = hf = \frac{hc}{\lambda}$$

$$E_{k_{\text{max}}} = q_e V_{\text{stop}} \quad N = N_0 \left( \frac{1}{2} \right)^n$$

### Quantum Mechanics and Nuclear Physics

$$\Delta E = \Delta mc^2 \quad E = pc$$

$$p = \frac{h}{\lambda} \quad \Delta \lambda = \frac{h}{m\bar{v}} (1 - \cos\theta)$$

### Trigonometry and Geometry

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \quad \text{Slope} \quad m = \frac{\Delta y}{\Delta x}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

#### Area

$$\text{Rectangle} = lw$$

$$\text{Triangle} = \frac{1}{2} ab$$

$$\text{Circle} = \pi r^2$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

#### Circumference

$$\text{Circle} = 2\pi r$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

### Graphing Calculator Window Format

$$x: [x_{\text{min}}, x_{\text{max}}, x_{\text{sc}}]$$

$$y: [y_{\text{min}}, y_{\text{max}}, y_{\text{sc}}]$$