PHYSICS DATA SHEET

Constants

Acceleration Due to Gravity Near Earth	$\lvert\vec{a}_g\rvert = 9.81\ \text{m/s}^2$
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

0 Uniform motion ($\vec{F}_{net} = 0$)
1 Accelerated motion ($\vec{F}_{net} \neq 0$)
2 Uniform circular motion ($\vec{F}_{net}$ is radially inward)
3 Work-energy theorem
4 Conservation of momentum
5 Conservation of energy
6 Conservation of mass-energy
7 Conservation of charge
8 Conservation of nucleons
9 Wave-particle duality

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	μ	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}

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 MeV/c^2
Positron	$+1e$	~0.511 MeV/c^2
Electron neutrino, ν	0	< 2.2 eV/c^2
Electron antineutrino, $\overline{\nu}$	0	< 2.2 eV/c^2
Up quark, u	$+\frac{2}{3}e$	~2.4 MeV/c^2
Anti-up antiquark, $\overline{u}$	$-\frac{2}{3}e$	~2.4 MeV/c^2
Down quark, d	$-\frac{1}{3}e$	~4.8 MeV/c^2
Anti-down antiquark, $\overline{d}$	$+\frac{1}{3}e$	~4.8 MeV/c^2

EQUATIONS

Kinematics

$$\vec{v}_{ave} = \frac{\Delta\vec{d}}{\Delta t} \qquad \vec{d} = \vec{v}_f t - \frac{1}{2}\vec{a}t^2$$

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

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

$$\left|\vec{v}_c\right| = \frac{2\pi r}{T} \qquad \left|\vec{a}_c\right| = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

Dynamics

$$\vec{a} = \frac{\vec{F}_{net}}{m} \qquad \left|\vec{F}_g\right| = \frac{Gm_1m_2}{r^2}$$

$$\left|\vec{F}_f\right| = \mu\left|\vec{F}_N\right| \qquad \left|\vec{g}\right| = \frac{Gm}{r^2}$$

$$\vec{F}_s = -k\vec{x} \qquad \vec{g} = \frac{\vec{F}_g}{m}$$

Momentum and Energy

$$\vec{p} = m\vec{v} \qquad E_k = \frac{1}{2}mv^2$$

$$\vec{F}\Delta t = m\Delta\vec{v} \qquad E_p = mgh$$

$$W = \left|\vec{F}\right|\left|\vec{d}\right|\cos\theta \qquad E_p = \frac{1}{2}kx^2$$

$$W = \Delta E$$

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

Waves

$$T = 2\pi\sqrt{\frac{m}{k}} \qquad m = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

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

$$T = \frac{1}{f} \qquad \frac{n_2}{n_1} = \frac{\sin\theta_1}{\sin\theta_2}$$

$$v = f\lambda \qquad \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

$$f = \left(\frac{v}{v \pm v_s}\right) f_s \qquad \lambda = \frac{d\sin\theta}{n}$$

$$\lambda = \frac{xd}{nl}$$

Electricity and Magnetism

$$\left|\vec{F}_e\right| = \frac{kq_1q_2}{r^2} \qquad \Delta V = \frac{\Delta E}{q}$$

$$\left|\vec{E}\right| = \frac{kq}{r^2} \qquad I = \frac{q}{t}$$

$$\vec{E} = \frac{\vec{F}_e}{q} \qquad \left|\vec{F}_m\right| = Il_\perp\left|\vec{B}\right|$$

$$\left|\vec{E}\right| = \frac{\Delta V}{\Delta d} \qquad \left|\vec{F}_m\right| = qv_\perp\left|\vec{B}\right|$$

Atomic Physics

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

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

Quantum Mechanics and Nuclear Physics

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

$$p = \frac{h}{\lambda} \qquad \Delta\lambda = \frac{h}{mc}(1 - \cos\theta)$$

Trigonometry and Geometry

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

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

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$c^2 = a^2 + b^2$$

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

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

Line

$$m = \frac{\Delta y}{\Delta x}$$

$$y = mx + b$$

Area

Rectangle $= lw$

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

Circle $= \pi r^2$

Circumference

Circle $= 2\pi r$