PHYSICS DATA SHEET

Constants

Acceleration due to gravity near Earth ..... $|\vec{a}_g| = 9.81\ \text{m/s}^2$

Gravitational constant ..... $G = 6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$

Radius of the Earth ..... $r_E = 6.37\times10^{6}\ \text{m}$

Mass of the Earth..... $M_E = 5.97\times10^{24}\ \text{kg}$

Elementary Charge ..... $e = 1.60\times10^{-19}\ \text{C}$

Coulomb's Law Constant.. $k = 8.99\times10^{9}\ \text{N}\cdot\text{m}^2/\text{C}^2$

Electron Volt ..... $1\text{eV} = 1.60\times10^{-19}\ \text{J}$

Index of Refraction of Air . $n = 1.00$

Speed of Light in Vacuum $c = 3.00\times10^{8}\ \text{m/s}$

Planck's Constant ..... $h = 6.63\times10^{-34}\ \text{J}\cdot\text{s}$ or $h = 4.14\times10^{-15}\ \text{eV}\cdot\text{s}$

Atomic Mass Unit ..... $u = 1.66\times10^{-27}\ \text{kg}$

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	$+2e$	6.65×10^{-27} kg
Electron	$-1e$	9.11×10^{-31} kg
Proton	$+1e$	1.67×10^{-27} kg
Neutron	0	1.67×10^{-27} kg

First-Generation Fermions

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

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

EQUATIONS

Kinematics

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

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

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

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

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

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

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

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

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

$$f_o = \left(\frac{v}{v \mp v_s}\right)f_s \qquad \lambda = \frac{dx}{nl}$$

Electricity and Magnetism

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

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

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

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

$$V = B\,v\,l\sin\theta$$

$$V = IR$$

Atomic Physics

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

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

Quantum Mechanics and Nuclear Physics

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

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

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

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 = πr^2

Circumference

Circle = $2\pi r$

Graphing Calculator Window Format

$$x:\left[x_{min}, x_{max}, x_{scl}\right]$$

$$y:\left[y_{min}, y_{max}, y_{scl}\right]$$

Periodic Table of the Elements

1 H **1.01** hydrogen																	2 He **4.00** helium
3 Li **6.94** lithium	4 Be **9.01** beryllium											5 B **10.81** boron	6 C **12.01** carbon	7 N **14.01** nitrogen	8 O **16.00** oxygen	9 F **19.00** fluorine	10 Ne **20.18** neon
11 Na **22.99** sodium	12 Mg **24.31** magnesium											13 Al **26.98** aluminium	14 Si **28.09** silicon	15 P **30.97** phosphorous	16 S **32.07** sulfur	17 Cl **35.45** chlorine	18 Ar **39.95** argon
19 K **39.10** potassium	20 Ca **40.08** calcium	21 Sc **44.96** scandium	22 Ti **47.87** titanium	23 V **50.94** vanadium	24 Cr **52.00** chromium	25 Mn **54.94** manganese	26 Fe **55.85** iron	27 Co **58.93** cobalt	28 Ni **58.69** nickel	29 Cu **63.55** copper	30 Zn **65.39** zinc	31 Ga **69.72** gallium	32 Ge **72.64** germanium	33 As **74.92** arsenic	34 Se **78.96** selenium	35 Br **79.90** bromine	36 Kr **83.80** krypton
37 Rb **85.47** rubidium	38 Sr **87.62** strontium	39 Y **88.91** yttrium	40 Zr **91.22** zirconium	41 Nb **92.91** niobium	42 Mo **95.94** molybdenum	43 Tc **(98)** technetium	44 Ru **101.07** ruthenium	45 Rh **102.91** rhodium	46 Pd **106.42** palladium	47 Ag **107.87** silver	48 Cd **112.41** cadmium	49 In **114.82** indium	50 Sn **118.71** tin	51 Sb **121.75** antimony	52 Te **127.60** tellurium	53 I **126.90** iodine	54 Xe **131.29** xenon
55 Cs **132.91** cesium	56 Ba **137.33** barium	57-71	72 Hf **178.49** hafnium	73 Ta **180.95** tantalum	74 W **183.84** tungsten	75 Re **186.21** rhenium	76 Os **190.23** osmium	77 Ir **192.22** iridium	78 Pt **195.08** platinum	79 Au **196.97** gold	80 Hg **200.59** mercury	81 Tl **204.38** thallium	82 Pb **207.21** lead	83 Bi **208.98** bismuth	84 Po **(209)** polonium	85 At **(210)** astatine	86 Rn **(222)** radon
87 Fr **(223)** francium	88 Ra **(226)** radium	89-103	104 Rf **(261)** rutherfordium	105 Db **(262)** dubnium	106 Sg **(266)** seaborgium	107 Bh **(264)** bohrium	108 Hs **(277)** hassium	109 Mt **(268)** meitnerium	110 Ds **(271)** darmstadtium	111 Rg **(272)** roentgenium	112Uub **(285)** ununbium	113 Uut **(284)** ununtrium	114Uuq **(289)** ununquadium	115Uup **(288)** ununpentium	116Uuh **(292)** ununhexium	117Uus **(?)** ununseptium	118Uuo **(294)** ununoctium

57 La **138.91** lanthanum	58 Ce **140.12** cerium	59 Pr **140.91** praseodymium	60 Nd **144.24** neodymium	61 Pm **(145)** promethium	62 Sm **150.36** samarium	63 Eu **151.96** europium	64 Gd **157.25** gadolinium	65 Tb **158.93** terbium	66 Dy **162.50** dysprosium	67 Ho **164.93** holmium	68 Er **167.26** erbium	69 Tm **168.93** thulium	70 Yb **173.04** ytterbium	71 Lu **174.97** lutetium
89 Ac **(227)** actinium	90 Th **232.04** thorium	91 Pa **231.04** protactinium	92 U **238.03** uranium	93 Np **(237)** neptunium	94 Pu **(244)** plutonium	95 Am **(243)** americium	96 Cm **(247)** curium	97 Bk **(247)** berkelium	98 Cf **(251)** californium	99 Es **(252)** einsteinium	100Fm **(257)** fermium	101Md **(258)** mendelevium	102 No **(259)** nobelium	103 Lr **(262)** lawrencium