



Physics A

Data and Formulae Booklet

DATA

FUNDAMENTAL CONSTANTS AND VALUES

<i>Quantity</i>	<i>Symbol</i>	<i>Value</i>	<i>Units</i>
speed of light in vacuo	c	3.00×10^8	m s^{-1}
permeability of free space	μ_0	$4\pi \times 10^{-7}$	H m^{-1}
permittivity of free space	ϵ_0	8.85×10^{-12}	F m^{-1}
magnitude of the charge of electron	e	1.60×10^{-19}	C
the Planck constant	h	6.63×10^{-34}	J s
gravitational constant	G	6.67×10^{-11}	$\text{N m}^2 \text{kg}^{-2}$
the Avogadro constant	N_A	6.02×10^{23}	mol^{-1}
molar gas constant	R	8.31	$\text{J K}^{-1} \text{mol}^{-1}$
the Boltzmann constant	k	1.38×10^{-23}	J K^{-1}
the Stefan constant	σ	5.67×10^{-8}	$\text{W m}^{-2} \text{K}^{-4}$
the Wien constant	α	2.90×10^{-3}	m K
electron rest mass (equivalent to 5.5×10^{-4} u)	m_e	9.11×10^{-31}	kg
electron charge/mass ratio	e/m_e	1.76×10^{11}	C kg^{-1}
proton rest mass (equivalent to 1.00728 u)	m_p	$1.67(3) \times 10^{-27}$	kg
proton charge/mass ratio	e/m_p	9.58×10^7	C kg^{-1}
neutron rest mass (equivalent to 1.00867 u)	m_n	$1.67(5) \times 10^{-27}$	kg
gravitational field strength	g	9.81	N kg^{-1}
acceleration due to gravity	g	9.81	m s^{-2}
atomic mass unit (1u is equivalent to 931.5 MeV)	u	1.661×10^{-27}	kg

GEOMETRICAL EQUATIONS

<i>arc length</i>	$= r\theta$
<i>circumference of circle</i>	$= 2\pi r$
<i>area of circle</i>	$= \pi r^2$
<i>surface area of cylinder</i>	$= 2\pi rh$
<i>volume of cylinder</i>	$= \pi r^2 h$
<i>area of sphere</i>	$= 4\pi r^2$
<i>volume of sphere</i>	$= \frac{4}{3} \pi r^3$

ASTRONOMICAL DATA

<i>Body</i>	<i>Mass/kg</i>	<i>Mean radius/m</i>
Sun	1.99×10^{30}	6.96×10^8
Earth	5.98×10^{24}	6.37×10^6

AS FORMULAE

PARTICLE PHYSICS

Rest energy values

class	name	symbol	rest energy /MeV
photon	photon	γ	0
lepton	neutrino	ν_e	0
		ν_μ	0
	electron	$e^\pm$	0.510999
	muon	$\mu^\pm$	105.659
mesons	π meson	$\pi^\pm$	139.576
		π^0	134.972
	K meson	$K^\pm$	493.821
		K^0	497.762
baryons	proton	p	938.257
	neutron	n	939.551

Properties of quarks

antiquarks have opposite signs

type	charge	baryon number	strangeness
u	$+\frac{2}{3}e$	$+\frac{1}{3}$	0
d	$-\frac{1}{3}e$	$+\frac{1}{3}$	0
s	$-\frac{1}{3}e$	$+\frac{1}{3}$	-1

Properties of leptons

	lepton number
particles: $e^-, \nu_e; \mu^-, \nu_\mu$	+1
antiparticles: $e^+, \bar{\nu}_e; \mu^+, \bar{\nu}_\mu$	-1

Photons and energy levels

photon energy	$E = hf = hc/\lambda$
photoelectricity	$hf = \phi + E_{K(\max)}$
energy levels	$hf = E_1 - E_2$
de Broglie wavelength	$\lambda = \frac{h}{p} = \frac{h}{mv}$

ELECTRICITY

$$\text{current and pd} \quad I = \frac{\Delta Q}{\Delta t} \quad V = \frac{W}{Q} \quad R = \frac{V}{I}$$

$$\text{emf} \quad \varepsilon = \frac{E}{Q} \quad \varepsilon = I(R + r)$$

$$\text{resistors in series} \quad R = R_1 + R_2 + R_3 + \dots$$

$$\text{resistors in parallel} \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$\text{resistivity} \quad \rho = \frac{RA}{L}$$

$$\text{power} \quad P = VI = I^2 R = \frac{V^2}{R}$$

$$\text{alternating current} \quad I_{\text{rms}} = \frac{I_0}{\sqrt{2}} \quad V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$$

MECHANICS

$$\text{moments} \quad \text{moment} = Fd$$

$$\text{velocity and acceleration} \quad v = \frac{\Delta s}{\Delta t} \quad a = \frac{\Delta v}{\Delta t}$$

$$\text{equations of motion} \quad v = u + at \quad s = \frac{(u+v)}{2}t$$

$$v^2 = u^2 + 2as \quad s = ut + \frac{at^2}{2}$$

$$\text{force} \quad F = ma$$

$$\text{work, energy and power} \quad W = Fs \cos \theta \quad E_K = \frac{1}{2}mv^2 \quad \Delta E_p = mg\Delta h$$

$$P = \frac{\Delta W}{\Delta t}, P = Fv$$

$$\text{efficiency} = \frac{\text{useful output power}}{\text{input power}}$$

MATERIALS

$$\text{density} \quad \rho = \frac{m}{V} \quad \text{Hooke's law} \quad F = k \Delta L$$

$$\text{Young modulus} = \frac{\text{tensile stress}}{\text{tensile strain}} \quad \text{tensile stress} = \frac{F}{A}$$

$$\text{tensile strain} = \frac{\Delta L}{L}$$

$$\text{energy stored} \quad E = \frac{1}{2}F\Delta L$$

WAVES

$$\text{wave speed} \quad c = f\lambda \quad \text{period} \quad T = \frac{1}{f}$$

$$\text{fringe spacing} \quad w = \frac{\lambda D}{s} \quad \text{diffraction grating} \quad d \sin \theta = n\lambda$$

$$\text{refractive index of a substance } s, \quad n = \frac{c}{c_s}$$

for two different substances of refractive indices n_1 and n_2 ,

$$\text{law of refraction} \quad n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\text{critical angle} \quad \sin \theta_c = \frac{n_2}{n_1} \text{ for } n_1 > n_2$$