

AS

Physics data and formulae

For use in exams from the June 2016 Series onwards

DATA - FUNDAMEN	ITAL CON	STANTS AND \	/ALUES
Quantity	Symbol	Value	Units
speed of light in vacuo	С	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	$oldsymbol{arepsilon}_0$	8.85 × 10 ⁻¹²	F m ⁻¹
magnitude of the charge of electron	е	1.60 × 10 ⁻¹⁹	С
the Planck constant	h	6.63 × 10 ⁻³⁴	Js
gravitational constant	G	6.67 × 10 ⁻¹¹	N m ² kg ⁻²
the Avogadro constant	NA	6.02×10^{23}	mol ⁻¹
molar gas constant	R	8.31	J K ⁻¹ mol ⁻¹
the Boltzmann constant	k	1.38 × 10 ⁻²³	J K ⁻¹
the Stefan constant	σ	5.67 × 10 ⁻⁸	W m ⁻² K ⁻⁴
the Wien constant	α	2.90×10^{-3}	m K
electron rest mass (equivalent to 5.5 × 10 ⁻⁴ u)	$m_{ m e}$	9.11 × 10 ⁻³¹	kg

electron charge/mass ratio	$\frac{\mathrm{e}}{m_{\mathrm{e}}}$	1.76 × 10 ¹¹	C kg ⁻¹
proton rest mass (equivalent to 1.00728 u)	m _p	1.67(3) × 10 ⁻²⁷	kg
proton charge/mass ratio	$\frac{e}{m_{p}}$	9.58 × 10 ⁷	C kg ⁻¹
neutron rest mass (equivalent to 1.00867 u)	m _n	1.67(5) × 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

ALGEBRAIC EQUATION

quadratic equation

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

ASTRONOMICAL DATA

Body	Mass/kg	Mean radius/m
Sun	1 99 x 1030	6.96 × 10 ⁸

Earth 5.97×10^{24} 6.37×10^{6}

GEOMETRICAL EQUATIONS

arc length $= r\theta$

circumference of circle = $2\pi r$

area of circle $= \pi r^2$

curved surface area of cylinder = $2\pi rh$

area of sphere = $4\pi r^2$

volume of sphere $= \frac{4}{3}\pi r^3$

Particle Physics

Class	Name	Symbol	Rest energy/MeV
photon	photon	γ	0
lepton	neutrino	v _e	0
		$oldsymbol{v}_{\mu}$	0
	electron	e [±]	0.510999
	muon	μ^{\pm}	105.659
mesons	π meson	π^\pm	139.576
		π0	134.972
	K meson	K [±]	493.821
		K ₀	497.762
baryons	proton	р	938.257
	neutron	n	939.551

Properties of quarks antiquarks have opposite signs

Туре	Charge	Baryon number	Strangeness
u	+ 2/3 e	+ 1/3	0
d	- <mark>1</mark> e	+ 1/3	0
s	- <mark>1</mark> e	+ 1/3	– 1

Properties of Leptons

		Lepton number
Particles:	e ⁻ ,ν _e ; μ ⁻ , ν _μ	+ 1
Antiparticles:	$e^+, \overline{v_e}, \mu^+ \overline{v_\mu}$	– 1

Photons and energy levels

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

Waves

wave speed
$$c = f\lambda$$
 period

$$f = \frac{1}{T}$$

$$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}}$$

$$w = \frac{\lambda D}{s}$$

 $w = \frac{\lambda D}{s}$ diffraction grating

 $d \sin \theta = n\lambda$

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

for two different substances of refractive indices n_1 and n_2 , law of refraction $n_1 \sin \theta_1 = n_2 \sin \theta_2$ critical angle $\sin \theta_{\rm C} = \frac{n_2}{n_1} \text{ for } n_1 > n_2$

Mechanics

moments

moment = Fd

velocity and acceleration

$$v = \frac{\Delta s}{\Delta t}$$

$$a = \frac{\Delta \mathbf{v}}{\Delta t}$$

equations of motion

$$v = u + at$$

$$s = \left(\frac{u+v}{2}\right) t$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{at^2}{2}$$

force

$$F = ma$$

force

$$F = \frac{\triangle (mv)}{\triangle t}$$

impulse

$$F \triangle t = \triangle (mv)$$

work, energy and power

$$W = F s \cos \theta$$

$$E_{\mathbf{k}} = \frac{1}{2} m v^2$$
 $\Delta E_{\mathbf{p}} = mg \Delta h$

$$\Delta E_p = mg \Delta h$$

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

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

Materials

density
$$\rho = \frac{m}{V}$$

Hooke's law $F = k \Delta L$

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

tensile stress =
$$\frac{F}{A}$$

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

energy stored
$$E = \frac{1}{2}F\triangle L$$

Electricity

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

$$I = \frac{\Delta Q}{\Delta t}$$

$$V = \frac{W}{\Omega}$$

$$R = \frac{V}{I}$$

$$\rho = \frac{RA}{I}$$

resistors in series

$$R_{\rm T} = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_{\rm T}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

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

$$\varepsilon = \frac{E}{O}$$

$$\varepsilon = \frac{E}{Q} \qquad \varepsilon = I(R+r)$$

There are no formulae printed on this page

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