

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

OXFORD AQA INTERNATIONAL AS AS Physics

Data and formulae booklet

Insert

DATA - FUNDAMENTAL CONSTANTS AND VALUES

Quantity	Symbol	Value	Units
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	$\frac{e}{m_e}$	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	$\frac{e}{m_p}$	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

ASTRONOMICAL DATA

Body	Mass/kg	Mean radius/m
Sun	1.99×10^{30}	6.96×10^8
Earth	5.97×10^{24}	6.37×10^6

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>curved surface area of cylinder</i>	$= 2\pi r h$
<i>area of sphere</i>	$= 4\pi r^2$
<i>volume of sphere</i>	$= \frac{4}{3} \pi r^3$

Unit 1

Mechanics and materials

<i>moments</i>	moment = Fd
<i>velocity and acceleration</i>	$v = \frac{\Delta s}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$
<i>equations of motion</i>	$v = u + at$ $v^2 = u^2 + 2as$ $s = \left(\frac{u+v}{2}\right)t$ $s = ut + \frac{at^2}{2}$
<i>force</i>	$F = ma$ $F = \frac{\Delta(mv)}{\Delta t}$
<i>impulse</i>	$F \Delta t = \Delta(mv)$
<i>work, energy and power</i>	$W = F s \cos \theta$ $E_k = \frac{1}{2} m v^2$ $\Delta E_p = mg\Delta h$ $P = \frac{\Delta W}{\Delta t}, P = Fv$ $\text{efficiency} = \frac{\text{useful output power}}{\text{input power}}$
<i>density</i>	$\rho = \frac{m}{V}$
<i>Hooke's law</i>	$F = k \Delta L$
<i>Young modulus</i>	$\text{Young modulus} = \frac{\text{tensile stress}}{\text{tensile strain}}$
<i>tensile stress</i>	$= \frac{F}{A}$
<i>tensile strain</i>	$= \frac{\Delta L}{L}$
<i>energy stored</i>	$E = \frac{1}{2} F \Delta L$

Particles, radiation and radioactivity

inverse square law for γ radiation $I = \frac{I_0}{r^2}$

Unit 2

Electricity

<i>current and pd</i>	$I = \frac{\Delta Q}{\Delta t}$ $V = \frac{W}{Q}$ $R = \frac{V}{I}$
<i>resistivity</i>	$\rho = \frac{RA}{L}$
<i>resistors in series</i>	$R_T = R_1 + R_2 + R_3 + \dots$
<i>resistors in parallel</i>	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
<i>energy transferred</i>	$E = IVt$
<i>power</i>	$P = VI = I^2R = \frac{V^2}{R}$
<i>emf</i>	$\varepsilon = \frac{E}{Q}$ $\varepsilon = I(R + r)$

Oscillations and waves

<i>for a mass-spring system</i>	$T = 2\pi \sqrt{\frac{m}{k}}$
<i>for a simple pendulum</i>	$T = 2\pi \sqrt{\frac{l}{g}}$
<i>wave speed</i>	$c = f\lambda$ <i>period</i> $f = \frac{1}{T}$
<i>first harmonic</i>	$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}}$
<i>fringe spacing</i>	$w = \frac{\lambda D}{s}$ <i>diffraction grating</i> $d \sin \theta = n\lambda$
<i>refractive index of a substance s,</i>	$n = \frac{c}{c_s}$
<i>for two different substances of refractive indices n_1 and n_2,</i>	
<i>law of refraction</i>	$n_1 \sin \theta_1 = n_2 \sin \theta_2$
<i>critical angle</i>	$\sin \theta_c = \frac{n_2}{n_1}$ for $n_1 > n_2$
<i>photon energy</i>	$E = hf = \frac{hc}{\lambda}$
<i>photoelectricity</i>	$hf = \phi + E_{k(\text{max})}$
<i>energy levels</i>	$hf = E_1 - E_2$
<i>de Broglie Wavelength</i>	$\lambda = \frac{h}{p} = \frac{h}{mv}$

