

OXFORD

INTERNATIONAL
AQA EXAMINATIONS

OXFORD AQA INTERNATIONAL A-LEVEL 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> | $W = F s \cos \theta$ $E_k = \frac{1}{2} m v^2$ $\Delta E_p = mg\Delta h$ $P = \frac{\Delta W}{\Delta t}, P = Fv$ <i>efficiency</i> = $\frac{\text{useful output power}}{\text{input power}}$ |
| <i>density</i> | $\rho = \frac{m}{V}$ |
| <i>Hooke's law</i> | $F = k \Delta L$ |
| <i>Young modulus</i> | $= \frac{\text{tensile stress}}{\text{tensile strain}}$ |
| <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> | $\lambda = \frac{h}{p} = \frac{h}{mv}$ |

