

**Advanced Subsidiary GCE
Advanced GCE**

PHYSICS A

Data, Formulae and Relationships

Specimen



The information in this sheet is for the use of candidates following GCE Physics A H158 and H558.

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Copies of this sheet may be used for teaching.

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This document consists of **7** printed pages and **1** blank page.

Data

Values are given to three significant figures, except where more are useful.

speed of light in a vacuum	c	$3.00 \times 10^8 \text{ m s}^{-1}$
permittivity of free space	ϵ_0	$8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2} (\text{ F m}^{-1})$
elementary charge	e	$1.60 \times 10^{-19} \text{ C}$
Planck constant	h	$6.63 \times 10^{-34} \text{ J s}$
gravitational constant	G	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Avogadro constant	N_A	$6.02 \times 10^{23} \text{ mol}^{-1}$
molar gas constant	R	$8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
Boltzmann constant	k	$1.38 \times 10^{-23} \text{ J K}^{-1}$
electron rest mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
proton rest mass	m_p	$1.673 \times 10^{-27} \text{ kg}$
neutron rest mass	m_n	$1.675 \times 10^{-27} \text{ kg}$
alpha particle rest mass	m_α	$6.646 \times 10^{-27} \text{ kg}$
acceleration of free fall	g	9.81 m s^{-2}

Conversion factors

unified atomic mass unit	1 u = 1.661×10^{-27} kg
electronvolt	1 eV = 1.60×10^{-19} J
	1 day = 8.64×10^4 s
	1 year $\approx 3.16 \times 10^7$ s
	1 light year $\approx 9.5 \times 10^{15}$ m

Mathematical equations

arc length = $r\theta$
circumference of circle = $2\pi r$
area of circle = πr^2
surface area of cylinder = $2\pi rh$
volume of cylinder = $\pi r^2 h$
area of circle = $4\pi r^2$
volume of sphere = $\frac{4}{3}\pi r^3$
Pythagoras' theorem: $a^2 = b^2 + c^2$
For small angle $\theta \Rightarrow \sin\theta \approx \tan\theta \approx \theta$ and $\cos\theta \approx 1$
$\lg(A+B) = \lg(A) + \lg(B)$
$\lg\left(\frac{A}{B}\right) = \lg(A) - \lg(B)$
$\ln(x^n) = n \ln(x)$
$\ln(e^{kx}) = kx$

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Formulae and relationships

Unit G481 - Mechanics	Unit G482 - Electrons, Waves and Photons
$F_x = F \cos \theta$ $F_y = F \sin \theta$	$\Delta Q = I \Delta t$
$a = \frac{\Delta v}{\Delta t}$	$I = Anev$
$v = u + at$	$W = VQ$
$s = \frac{1}{2}(u + v)t$	$V = IR$
$s = ut + \frac{1}{2}at^2$	$R = \frac{\rho L}{A}$
$v^2 = u^2 + 2as$	$P = VI \quad P = I^2R \quad P = \frac{V^2}{R}$
$F = ma$	$W = VIt$
$W = mg$	e.m.f = $V + Ir$
moment = Fx	$V_{\text{out}} = \frac{R_2}{R_1 + R_2} \times V_{\text{in}}$
torque = Fd	$v = f\lambda$
$\rho = \frac{m}{V}$	$\lambda = \frac{ax}{D}$
$P = \frac{F}{A}$	$d \sin \theta = n\lambda$
$W = Fx \cos \theta$	$E = hf \quad E = \frac{hc}{\lambda}$
$E_k = \frac{1}{2}mv^2$	$hf = \phi + KE_{\text{max}}$
$E_p = mgh$	$\lambda = \frac{h}{mv}$
efficiency = $\frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$	
$F = kx$	
$E = \frac{1}{2}Fx \quad E = \frac{1}{2}kx^2$	
stress = $\frac{F}{A}$	
strain = $\frac{x}{L}$	
Young modulus = stress/strain	

Unit G484 – The Newtonian World	Unit G485 - Fields, Particles and Frontiers of Physics
$F = \frac{\Delta p}{\Delta t}$	$E = \frac{F}{Q}$
$v = \frac{2\pi r}{T}$	$F = \frac{Qq}{4\pi\epsilon_0 r^2}$
$a = \frac{v^2}{r}$	$E = \frac{Q}{4\pi\epsilon_0 r^2}$
$F = \frac{mv^2}{r}$	$E = \frac{V}{d}$
$F = -\frac{GMm}{r^2}$	$F = BIL \sin \theta$
$g = \frac{F}{m}$	$F = BQv$
$g = -\frac{GM}{r^2}$	$\phi = BA \cos \theta$
$T^2 = \left(\frac{4\pi^2}{GM}\right)r^3$	induced e.m.f. = - rate of change of magnetic flux linkage
$f = \frac{1}{T}$	$\frac{V_s}{V_p} = \frac{n_s}{n_p}$
$\omega = \frac{2\pi}{T} = 2\pi f$	$Q = VC$
$a = -(2\pi f)^2 x$	$W = \frac{1}{2}QV \quad W = \frac{1}{2}CV^2$
$x = A \cos(2\pi ft)$	time constant = CR
$v_{\max} = (2\pi f)A$	$x = x_0 e^{-\frac{t}{CR}}$
$E = mc\Delta\theta$	$C = C_1 + C_2 + C_3$
$pV = NkT$	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
$pV = nRT$	$A = -\lambda N$
$E = \frac{3}{2}kT$	$A = A_0 e^{-\lambda t}$
	$N = N_0 e^{-\lambda t}$
	$\lambda t_{1/2} = 0.693$

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Unit G484 – The Newtonian World	Unit G485 - Fields, Particles and Frontiers of Physics
	$\Delta E = \Delta mc^2$
	$I = I_0 e^{-\mu x}$
	$Z = \rho c$
	$\frac{I_r}{I_0} = \frac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$
	$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$
	age of Universe $\approx \frac{1}{H_0}$
	$\rho_0 = \frac{3H_0^2}{8\pi G}$

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