OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

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.

Clean copies of this booklet must be available in the examination room, and must be given up to the invigilator at the end of the examination.

Copies of this sheet may be used for teaching.

Data

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

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

Conversion factors

unified atomic mass unit	1 u = 1.661 x 10^{-27} kg
electronvolt	1 eV = 1.60 x 10^{-19} J
	1 day = 8.64 x 10^{4} s
	1 year ≈ 3.16 x 10^{7} s
	1 light year ≈ 9.5 x 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($\frac{A}{B}$) = lg(A) – lg(B)
ln(x^n) = n ln(x)
ln(e^{kx}) = kx

Formulae and relationships

Unit G481 - Mechanics	Unit G482 - Electrons, Waves and Photons
$F_x = F\cos\theta$ $F_y = F\sin\theta$	$\Delta Q = I\Delta t$
$a = \frac{\Delta v}{\Delta t}$	$I = Anev$
$v = u + at$	$W = VQ$
$s = \frac{1}{2}(u+v)t$	$V = IR$
$s = ut + \frac{1}{2}at^2$	$R = \frac{\rho L}{A}$
$v^2 = u^2 + 2as$	$P = VI \qquad P = I^2R \qquad P = \frac{V^2}{R}$
$F = ma$	$W = VIt$
$W = mg$	e.m.f = $V + Ir$
moment $= Fx$	$V_{out} = \frac{R_2}{R_1 + R_2} \times V_{in}$
torque $= Fd$	$v = f\lambda$
$\rho = \frac{m}{V}$	$\lambda = \frac{ax}{D}$
$P = \frac{F}{A}$	$d\sin\theta = n\lambda$
$W = Fx\cos\theta$	$E = hf \qquad E = \frac{hc}{\lambda}$
$E_k = \frac{1}{2}mv^2$	$hf = \phi + \mathrm{KE}_{max}$
$E_p = mgh$	$\lambda = \frac{h}{mv}$
efficiency $= \frac{\text{useful energy output}}{\text{totalenergy input}} \times 100\%$	
$F = kx$	
$E = \frac{1}{2}Fx \qquad E = \frac{1}{2}kx^2$	
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
$F = \frac{\Delta p}{\Delta t}$	$E = \frac{F}{Q}$
$v = \frac{2\pi r}{T}$	$F = \frac{Qq}{4\pi\varepsilon_0 r^2}$
$a = \frac{v^2}{r}$	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$
$F = \frac{mv^2}{r}$	$E = \frac{V}{d}$
$F = -\frac{GMm}{r^2}$	$F = BIL\sin\theta$
$g = \frac{F}{m}$	$F = BQv$
$g = -\frac{GM}{r^2}$	$\phi = BA\cos\theta$
$T^2 = (\frac{4\pi^2}{GM})r^3$	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
$v_{max} = (2\pi f)A$	$x = x_0 e^{-\frac{t}{CR}}$
$E = mc\Delta\theta$	$C = C_1 + C_2 + C_3$
$pV = NkT$	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
$pV = nRT$	$A = -\lambda N$
$E = \frac{3}{2}kT$	$A = A_0 e^{-\lambda t}$
	$N = N_0 e^{-\lambda t}$
	$\lambda t_{1/2} = 0.693$

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

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