GCE Physics (Advanced Subsidiary and Advanced)

Data and Formulae Sheet

Values of constants

speed of light in a vacuum	$c = 3.00 \times 10^{8}\,\text{m s}^{-1}$
permeability of a vacuum	$\mu_0 = 4\pi \times 10^{-7}\,\text{H m}^{-1}$
permittivity of a vacuum	$\varepsilon_0 = 8.85 \times 10^{-12}\,\text{F m}^{-1}$ $\left(\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\,\text{F}^{-1}\,\text{m}\right)$
elementary charge	$e = 1.60 \times 10^{-19}\,\text{C}$
the Planck constant	$h = 6.63 \times 10^{-34}\,\text{J s}$
unified atomic mass unit	$1\,\text{u} = 1.66 \times 10^{-27}\,\text{kg}$
mass of electron	$m_e = 9.11 \times 10^{-31}\,\text{kg}$
mass of proton	$m_p = 1.67 \times 10^{-27}\,\text{kg}$
molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
the Avogadro constant	$N_A = 6.02 \times 10^{23}\,\text{mol}^{-1}$
the Boltzmann constant	$k = 1.38 \times 10^{-23}\,\text{J K}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$
acceleration of free fall on the Earth's surface	$g = 9.81\,\text{m s}^{-2}$
electron volt	$1\,\text{eV} = 1.60 \times 10^{-19}\,\text{J}$

USEFUL FORMULAE

The following equations may be useful in answering some of the questions in the examination:

Mechanics

Momentum-impulse relation	$mv - mu = Ft$ for a constant force
Power	$P = Fv$
Conservation of energy	$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = Fs$ for a constant force

Simple harmonic motion

Displacement	$x = x_0 \cos \omega t$ or $x = x_0 \sin \omega t$
Velocity	$v = \pm\omega\sqrt{x_0{}^2 - x^2}$
Simple pendulum	$T = 2\pi\sqrt{l/g}$
Loaded helical spring	$T = 2\pi\sqrt{m/k}$

Medical physics

Sound intensity level/dB	$= 10 \lg_{10}(I/I_0)$
Sound intensity difference/dB	$= 10 \lg_{10}(I_2/I_1)$
Resolving power	$\sin\theta = \lambda/D$

Waves

Two-slit interference	$\lambda = ay/d$
Diffraction grating	$d \sin\theta = n\lambda$

Light

Lens formula	$1/u + 1/v = 1/f$

Stress and Strain

Hooke's law	$F = kx$
Strain energy	$E = <F> x$ $(= \frac{1}{2}Fx = \frac{1}{2}kx^2$ if Hooke's law is obeyed)

Electricity

Potential divider	$V_{out} = R_1 V_{in}/(R_1 + R_2)$

Thermal physics

Average kinetic energy of a molecule	$\frac{1}{2}m<c^2> = \frac{3}{2}kT$
Kinetic theory	$pV = \frac{1}{3}Nm<c^2>$

Capacitors

Capacitors in series	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
Capacitors in parallel	$C = C_1 + C_2 + C_3$
Time constant	$\tau = RC$

Electromagnetism

Magnetic flux density due to current in

(i) long straight solenoid	$B = \frac{\mu_0 NI}{l}$
(ii) long straight conductor	$B = \frac{\mu_0 I}{2\pi a}$

Alternating currents

A.c. generator	$E = E_0 \sin \omega t$ $= BAN\omega \sin \omega t$

Particles and photons

Radioactive decay	$A = \lambda N$ $A = A_0 e^{-\lambda t}$
Half life	$t_{\frac{1}{2}} = 0.693/\lambda$
Photoelectric effect	$\frac{1}{2}mv^2_{max} = hf - hf_0$
de Broglie equation	$\lambda = h/p$

Particle Physics

Nuclear radius	$r = r_0 A^{\frac{1}{3}}$