Pearson

Pearson Edexcel Level 3
Advanced Level
GCE in Physics (9PH0)

List of data, formulae and relationships

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List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$	
Coulomb law constant	$k = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9} \text{ N m}^2 \text{ C}^{-2}$	
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8} \text{ m s}^{-1}$	
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{2} \text{ K}^{-4}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$	

Mechanics

<u>Kinematic equations of motion</u>

$$s = \frac{(u+v)t}{2}$$

$$v = u + at$$

$$s = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

<u>Forces</u>

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

moment of force = Fx

<u>Momentum</u>

$$p = mv$$

<u>Work, energy and power</u>

$$\Delta W = F\Delta s$$

$$E_k = \tfrac{1}{2}mv^2$$

$$\Delta E_{grav} = mg\Delta h$$

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Electric circuits

<u>Potential difference</u>

$$V = \frac{W}{Q}$$

<u>Resistance</u>

$$R = \frac{V}{I}$$

<u>Electrical power, energy and efficiency</u>

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$W = VIt$$

<u>Resistivity</u>

$$R = \frac{\rho l}{A}$$

<u>Current</u>

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nqvA$$

Materials

<u>Density</u>

$$\rho = \frac{m}{V}$$

<u>Stokes' law</u>

$$F = 6\pi\eta rv$$

<u>Hooke's law</u>

$$F = k\Delta x$$

<u>Pressure</u>

$$p = \frac{F}{A}$$

<u>Young modulus</u>

$$\text{Stress } \sigma = \frac{F}{A}$$

$$\text{Strain } \varepsilon = \frac{\Delta x}{x}$$

$$E = \frac{\sigma}{\varepsilon}$$

<u>Elastic strain energy</u>

$$\Delta E_{el} = \tfrac{1}{2}F\Delta x$$

Waves and Particle Nature of Light

<u>Wave speed</u>

$$v = f\lambda$$

<u>Speed of a transverse wave on a string</u>

$$v = \sqrt{\frac{T}{\mu}}$$

<u>Intensity of radiation</u>

$$I = \frac{P}{A}$$

<u>Power of a lens</u>

$$P = \frac{1}{f}$$

$$P = P_1 + P_2 + P_3 + \ldots$$

<u>Thin lens equation</u>

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

<u>Magnification for a lens</u>

$$m = \frac{\text{image height}}{\text{object height}} = \frac{v}{u}$$

<u>Diffraction grating</u>

$$n\lambda = d \sin\theta$$

Refractive index

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$n = \frac{c}{v}$$

Critical angle

$$\sin C = \frac{1}{n}$$

Photon model

$$E = hf$$

Einstein's photoelectric equation

$$hf = \phi + \tfrac{1}{2}mv^2_{\max}$$

de Broglie wavelength

$$\lambda = \frac{h}{p}$$

Further mechanics

Impulse

$$F\Delta t = \Delta p$$

Kinetic energy of a non-relativistic particle

$$E_k = \frac{p^2}{2m}$$

Motion in a circle

$$v = \omega r$$

$$T = \frac{2\pi}{\omega}$$

$$F = ma = \frac{mv^2}{r}$$

$$a = \frac{v^2}{r}$$

$$a = r\omega^2$$

Centripetal force

$$F = \frac{mv^2}{r}$$

$$F = mr\omega^2$$

Fields

Coulomb's law

$$F = k\,\frac{Q_1 Q_2}{r^2}$$

$$\text{where } k = \frac{1}{4\pi\varepsilon_0}$$

Electric field

$$E = \frac{F}{Q}$$

$$E = k\,\frac{Q}{r^2}$$

$$E = \frac{V}{d}$$

Electric potential

$$V = k\,\frac{Q}{r}$$

Capacitance

$$C = \frac{Q}{V}$$

Energy stored in a capacitor

$$W = \tfrac{1}{2}QV$$

Capacitor discharge

$$Q = Q_0 e^{-t/RC}$$

Resistor - capacitor discharge

$$I = I_0 e^{-t/RC}$$

$$V = V_0 e^{-t/RC}$$

In a magnetic field

$$F = BIl \sin \theta$$

$$F = Bqv \sin \theta$$

Faraday's and Lenz's laws

$$\varepsilon = \frac{-d(N\phi)}{dt}$$

Root-mean-square values

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

Nuclear and particle physics

In a magnetic field

$$r = \frac{p}{BQ}$$

Radioactive decay

$$A = \lambda N$$

$$\frac{\mathrm{d}N}{\mathrm{d}t} = -\lambda N$$

$$\lambda = \frac{\ln 2}{t_{½}}$$

$$N = N_0 \, \mathrm{e}^{-\lambda t}$$

$$A = A_0 \, \mathrm{e}^{-\lambda t}$$

Thermodynamics

Heating

$$\Delta E = mc\Delta\theta$$

$$\Delta E = L\Delta m$$

Molecular kinetic theory

$$\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$$

$$pV = \frac{1}{3}Nm\langle c^2\rangle$$

Ideal gas equation

$$pV = NkT$$

Stefan-Boltzmann law

$$L = \sigma T^4 A$$

$$L = 4\pi r^2 \sigma T^4$$

Wien's law

$$\lambda_{\max} T = 2.898 \text{ x } 10^{-3} \text{ m K}$$

Space

Radiant energy flux

$$I = \frac{L}{4\pi d^2}$$

Redshift of electromagnetic radiation

$$z = \frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$$

Cosmological expansion

$$v = H_0 d$$

Nuclear radiation

Mass-energy

$$\Delta E = c^2 \Delta m$$

Gravitational fields

Gravitational force

$$F = \frac{Gm_1 m_2}{r^2}$$

Gravitational field

$$g = \frac{Gm}{r^2}$$

Gravitational potential

$$V_{\mathrm{grav}} = \frac{-GM}{r}$$

Oscillations

Simple harmonic motion

$$F = -kx$$

$$a = -\omega^2 x$$

$$x = A \cos \omega t$$

$$v = -A\omega \sin \omega t$$

$$a = -A\omega^2 \cos \omega t$$

$$T = \frac{1}{f} = \frac{2\pi}{\omega}$$

$$\omega = 2\pi f$$

Simple harmonic oscillator

$$T = 2\pi \sqrt{\frac{m}{k}}$$

$$T = 2\pi \sqrt{\frac{l}{g}}$$

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