STUDY FORMULA BOOKLET

Edexcel A Level Physics 9PH0 list of data, formulae and relationships

The 9PH0 booklet prints 14 constants and equations for every topic; you need not memorise them, but series and parallel resistance, the e.m.f. equation and fringe spacing are missing.

IN THE BOOKLET printed in the official booklet LEARN IT not printed: students must recall it

Based on the official **Pearson Edexcel Level 3 Advanced GCE in Physics (9PH0): List of data, formulae and relationships, Issue 3, November 2022**, with what to learn and exam tips added by CuratedPrep.

Data and constants

Printed at the start of the booklet, in alphabetical order of name.

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

Mechanics

Displacement from average velocity s displacement, u initial velocity, v final velocity, t time.	$s = \frac{(u+v)t}{2}$	IN THE BOOKLET
Final velocity a is constant acceleration.	$v = u + at$	IN THE BOOKLET
Displacement with acceleration	$s = ut + \frac{1}{2}at^2$	IN THE BOOKLET

Velocity and displacement Use when time is not given or not wanted.	$v^2 = u^2 + 2as$	IN THE BOOKLET
Resultant force Newton's second law, for constant mass.	$\sum F = ma$	IN THE BOOKLET
Gravitational field strength Force per unit mass, in N kg^{-1}.	$g = \frac{F}{m}$	IN THE BOOKLET
Weight W in newtons, m in kg.	$W = mg$	IN THE BOOKLET
Moment of force x is the perpendicular distance from the line of action of F to the pivot.	$\text{moment of force} = Fx$	IN THE BOOKLET
Momentum p in kg m s^{-1}.	$p = mv$	IN THE BOOKLET

Mechanics: work, energy and power

Work done s is measured along the force.	$\Delta W = F\Delta s$	IN THE BOOKLET
Kinetic energy	$E_\text{k} = \frac{1}{2}mv^2$	IN THE BOOKLET
Change in gravitational potential energy Near the Earth's surface only.	$\Delta E_\text{grav} = mg\Delta h$	IN THE BOOKLET
Power from energy transferred	$P = \frac{E}{t}$	IN THE BOOKLET
Power from work done	$P = \frac{W}{t}$	IN THE BOOKLET
Efficiency from energy	$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$	IN THE BOOKLET
Efficiency from power	$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$	IN THE BOOKLET

Electric circuits

Potential difference Energy transferred per unit charge.	$V = \frac{W}{Q}$	IN THE BOOKLET
Resistance	$R = \frac{V}{I}$	IN THE BOOKLET
Electrical power (current and pd)	$P = VI$	IN THE BOOKLET
Electrical power (current and resistance)	$P = I^2R$	IN THE BOOKLET
Electrical power (pd and resistance)	$P = \frac{V^2}{R}$	IN THE BOOKLET
Electrical energy	$W = VIt$	IN THE BOOKLET
Resistivity ρ is resistivity in ohm metres; l length; A cross-sectional area.	$R = \frac{\rho l}{A}$	IN THE BOOKLET
Current Rate of flow of charge.	$I = \frac{\Delta Q}{\Delta t}$	IN THE BOOKLET

Current and charge carriers n carriers per unit volume, q charge on each, v drift velocity.	$I = nqvA$	IN THE BOOKLET

Materials

Density	$\rho = \dfrac{m}{V}$	IN THE BOOKLET
Stokes' law Viscous drag on a small sphere of radius r moving at speed v through a fluid of viscosity eta.	$F = 6\pi\eta r v$	IN THE BOOKLET
Hooke's law k is the stiffness of the object, in N m^{-1}.	$\Delta F = k\Delta x$	IN THE BOOKLET
Stress Force per unit cross-sectional area.	$\sigma = \dfrac{F}{A}$	IN THE BOOKLET
Strain Change in length divided by original length.	$\varepsilon = \dfrac{\Delta x}{x}$	IN THE BOOKLET
Young modulus	$E = \dfrac{\sigma}{\varepsilon}$	IN THE BOOKLET
Elastic strain energy	$\Delta E_{\text{el}} = \dfrac{1}{2}F\Delta x$	IN THE BOOKLET

Waves and particle nature of light

Wave speed	$v = f\lambda$	IN THE BOOKLET
Speed of a transverse wave on a string T tension; μ mass per unit length.	$v = \sqrt{\dfrac{T}{\mu}}$	IN THE BOOKLET
Intensity of radiation	$I = \dfrac{P}{A}$	IN THE BOOKLET
Power of a lens Power in dioptres when f is in metres.	$P = \dfrac{1}{f}$	IN THE BOOKLET
Power of thin lenses in combination	$P = P_1 + P_2 + P_3 + \dots$	IN THE BOOKLET
Thin lens equation Real is positive convention.	$\dfrac{1}{u} + \dfrac{1}{v} = \dfrac{1}{f}$	IN THE BOOKLET
Magnification for a lens	$m = \dfrac{\text{image height}}{\text{object height}} = \dfrac{v}{u}$	IN THE BOOKLET
Diffraction grating d is the grating spacing; n is the order.	$n\lambda = d\sin\theta$	IN THE BOOKLET
Refraction at an interface	$n_1 \sin\theta_1 = n_2 \sin\theta_2$	IN THE BOOKLET
Refractive index	$n = \dfrac{c}{v}$	IN THE BOOKLET
Critical angle	$\sin C = \dfrac{1}{n}$	IN THE BOOKLET
Photon energy	$E = hf$	IN THE BOOKLET
Einstein's photoelectric equation φ is the work function.	$hf = \phi + \dfrac{1}{2}mv_{\max}^2$	IN THE BOOKLET

de Broglie wavelength	$\lambda = \frac{h}{p}$	IN THE BOOKLET

Further mechanics

Impulse	$F\Delta t = \Delta p$	IN THE BOOKLET
Kinetic energy of a non-relativistic particle	$E_\mathrm{k} = \frac{p^2}{2m}$	IN THE BOOKLET
Linear and angular speed	$v = \omega r$	IN THE BOOKLET
Period of circular motion	$T = \frac{2\pi}{\omega}$	IN THE BOOKLET
Centripetal force	$F = ma = \frac{mv^2}{r}$	IN THE BOOKLET
Centripetal acceleration (speed)	$a = \frac{v^2}{r}$	IN THE BOOKLET
Centripetal acceleration (angular speed)	$a = r\omega^2$	IN THE BOOKLET
Centripetal force (angular speed)	$F = mr\omega^2$	IN THE BOOKLET

Fields

Coulomb's law Force between two point charges a distance r apart.	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$	IN THE BOOKLET
Electric field strength (force)	$E = \frac{F}{Q}$	IN THE BOOKLET
Electric field of a point charge k is the Coulomb law constant.	$E = k\frac{Q}{r^2}$	IN THE BOOKLET
Electric field between parallel plates	$E = \frac{V}{d}$	IN THE BOOKLET
Electric potential of a point charge	$V = k\frac{Q}{r}$	IN THE BOOKLET
Capacitance In farads.	$C = \frac{Q}{V}$	IN THE BOOKLET

Fields: energy stored in a capacitor and discharge

The booklet prints these in the right-hand column, under Fields.

Energy stored (charge and pd)	$W = \frac{1}{2}QV$	IN THE BOOKLET
Energy stored (capacitance and pd)	$W = \frac{1}{2}CV^2$	IN THE BOOKLET
Energy stored (charge and capacitance)	$W = \frac{1}{2}\frac{Q^2}{C}$	IN THE BOOKLET
Capacitor discharge: charge	$Q = Q_0 e^{-t/RC}$	IN THE BOOKLET
Capacitor discharge: current	$I = I_0 e^{-t/RC}$	IN THE BOOKLET
Capacitor discharge: pd	$V = V_0 e^{-t/RC}$	IN THE BOOKLET

Capacitor discharge: log of charge	$\ln Q = \ln Q_0 - \frac{t}{RC}$	IN THE BOOKLET
Capacitor discharge: log of current	$\ln I = \ln I_0 - \frac{t}{RC}$	IN THE BOOKLET
Capacitor discharge: log of pd	$\ln V = \ln V_0 - \frac{t}{RC}$	IN THE BOOKLET
Resistor-capacitor discharge: current Printed a second time under its own heading in the booklet.	$I = I_0 e^{-t/RC}$	IN THE BOOKLET
Resistor-capacitor discharge: pd Printed a second time under its own heading in the booklet.	$V = V_0 e^{-t/RC}$	IN THE BOOKLET

Fields: magnetic fields, induction and alternating current

Force on a current-carrying conductor θ is the angle between the field and the conductor.	$F = BIl\sin\theta$	IN THE BOOKLET
Force on a moving charge θ is the angle between the field and the velocity.	$F = Bqv\sin\theta$	IN THE BOOKLET
Faraday's and Lenz's laws N φ is the flux linkage; the minus sign is Lenz's law.	$\varepsilon = -\frac{\mathrm{d}(N\phi)}{\mathrm{d}t}$	IN THE BOOKLET
Root-mean-square pd	$V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$	IN THE BOOKLET
Root-mean-square current	$I_{\text{rms}} = \frac{I_0}{\sqrt{2}}$	IN THE BOOKLET

Nuclear and particle physics

Charged particle in a magnetic field Radius of the circular path; p is momentum.	$r = \frac{p}{BQ}$	IN THE BOOKLET

Thermodynamics

Heating: specific heat capacity	$\Delta E = mc\Delta\theta$	IN THE BOOKLET
Heating: specific latent heat	$\Delta E = L\Delta m$	IN THE BOOKLET
Molecular kinetic theory: mean kinetic energy Mean kinetic energy of one molecule.	$\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$	IN THE BOOKLET
Molecular kinetic theory: pressure	$pV = \frac{1}{3}Nm\langle c^2\rangle$	IN THE BOOKLET
Ideal gas equation N is the number of molecules; T in kelvin.	$pV = NkT$	IN THE BOOKLET
Stefan-Boltzmann law L luminosity; A surface area.	$L = \sigma AT^4$	IN THE BOOKLET
Stefan-Boltzmann law for a sphere	$L = 4\pi r^2\sigma T^4$	IN THE BOOKLET

Wien's law	$\lambda_{\max} T = 2.898 \times 10^{-3}\ \mathrm{m\ K}$	IN THE BOOKLET

Space

Intensity L luminosity; d distance from the source.	$I = \dfrac{L}{4\pi d^2}$	IN THE BOOKLET
Redshift of electromagnetic radiation	$z = \dfrac{\Delta\lambda}{\lambda} \approx \dfrac{\Delta f}{f} \approx \dfrac{v}{c}$	IN THE BOOKLET
Cosmological expansion Hubble's law.	$v = H_0 d$	IN THE BOOKLET

Nuclear radiation

Printed in the right-hand column of the final page, under Radioactive decay.

Mass-energy	$\Delta E = c^2 \Delta m$	IN THE BOOKLET
Activity	$A = \lambda N$	IN THE BOOKLET
Rate of decay	$\dfrac{\mathrm{d}N}{\mathrm{d}t} = -\lambda N$	IN THE BOOKLET
Decay constant and half-life	$\lambda = \dfrac{\ln 2}{t_{1/2}}$	IN THE BOOKLET
Number of undecayed nuclei	$N = N_0 e^{-\lambda t}$	IN THE BOOKLET
Activity over time	$A = A_0 e^{-\lambda t}$	IN THE BOOKLET

Gravitational fields

Gravitational force	$F = \dfrac{G m_1 m_2}{r^2}$	IN THE BOOKLET
Gravitational field strength Field of a point mass m at distance r.	$g = \dfrac{Gm}{r^2}$	IN THE BOOKLET
Gravitational potential	$V_{\text{grav}} = \dfrac{-Gm}{r}$	IN THE BOOKLET

Oscillations

Simple harmonic motion: force	$F = -kx$	IN THE BOOKLET
Simple harmonic motion: acceleration	$a = -\omega^2 x$	IN THE BOOKLET
Simple harmonic motion: displacement	$x = A\cos\omega t$	IN THE BOOKLET
Simple harmonic motion: velocity	$v = -A\omega\sin\omega t$	IN THE BOOKLET
Simple harmonic motion: acceleration against time	$a = -A\omega^2\cos\omega t$	IN THE BOOKLET
Period, frequency and angular frequency	$T = \dfrac{1}{f} = \dfrac{2\pi}{\omega}$	IN THE BOOKLET
Angular frequency	$\omega = 2\pi f$	IN THE BOOKLET
Mass on a spring	$T = 2\pi\sqrt{\dfrac{m}{k}}$	IN THE BOOKLET

Simple pendulum	$T = 2\pi\sqrt{\dfrac{l}{g}}$	IN THE BOOKLET

Learn these: not in the booklet

Resistors in series

$$R = R_1 + R_2 + R_3 + \dots$$

Derive it from conservation of energy (pds add).

Resistors in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

Derive it from conservation of charge (currents add).

Potential divider

$$V_{\text{out}} = \frac{R_2}{R_1 + R_2} V_{\text{in}}$$

R_2 is the resistor across which V_out is taken.

E.m.f. of a cell

$$\varepsilon = I(R + r)$$

R is the external resistance and r the internal resistance.

Terminal pd

$$V = \varepsilon - Ir$$

Terminal pd is less than the e.m.f. when a current flows.

E.m.f. as energy per charge

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

Frequency and period

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

The booklet prints this only inside the oscillations equation.

Phase difference and path difference

$$\Delta\phi = \frac{\text{path difference}}{\lambda} \times 360^\circ$$

Interference condition

$$\text{path difference} =$$
$$n\lambda \text{ (constructive)}, \ \left(n + \tfrac{1}{2}\right)\lambda \text{ (destructive)}$$

Fringe separation in a double-slit experiment

$$w = \frac{\lambda D}{s}$$

w fringe spacing, D slit-to-screen distance, s slit separation.

Stationary wave on a string, fundamental

$$f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$$

Combine v = f λ, λ = 2L and v = sqrt(T/μ).

Work done by a force at an angle

$$\Delta W = F\Delta s \cos\theta$$

The booklet prints only F times s; take the component along the motion.

Resolving a vector

$$F_x = F\cos\theta, \quad F_y = F\sin\theta$$

Upthrust

$$\text{upthrust} = \text{weight of fluid displaced}$$

Conservation of momentum

$$\sum p_{\text{before}} = \sum p_{\text{after}}$$

Applies to any collision with no external force.

Threshold frequency and work function

$$\phi = hf_0$$

At the threshold frequency the photoelectron has no kinetic energy.

Energy levels

$$hf = E_1 - E_2$$

Photon frequency for a transition between two energy levels.

Straight line graphs

$$y = mx + c$$

Use with ln plots: the gradient of ln V against t is -1/RC.

Percentage uncertainty

$$\%\ \text{uncertainty} = \frac{\Delta X}{X} \times 100$$

Add percentage uncertainties when multiplying or dividing; multiply by the power for X^n.

Elastic collision

$$\sum E_{\text{k,before}} = \sum E_{\text{k,after}}$$

Kinetic energy is conserved only in an elastic collision.

Radians

$$\theta = \frac{s}{r}, \quad 2\pi \text{ rad} = 360^\circ$$

Time constant

$$\tau = RC$$

Time for the charge to fall to 1/e of its initial value.

Energy gained by a charge through a pd

$$W = QV$$

For an electron, eV equals the gain in kinetic energy: eV = 1/2 m v^2.

Orbital speed from gravitation

$$v = \sqrt{\frac{GM}{r}}$$

Set GMm/r^2 equal to mv^2/r.

Orbital period (derive it)

$$T^2 = \frac{4\pi^2 r^3}{GM}$$

Celsius to kelvin

$$T/\text{K} = \theta/^\circ\text{C} + 273$$

Boyle's law

$$pV = \text{constant}$$

For a fixed mass of gas at constant temperature.

Pressure law

$$\frac{p}{T} = \text{constant}$$

For a fixed mass of gas at constant volume, with T in kelvin.

MeV to joules

$$1\ \text{MeV} = 10^{6}\ \text{eV} = 1.60 \times 10^{-13}\ \text{J}$$

Quark charges

$$\text{up} = +\tfrac{2}{3}e, \quad \text{down} = -\tfrac{1}{3}e$$

Check charge, baryon number and lepton number in particle equations.

Using the booklet in the exam

- Learn the layout, not the equations. The booklet is grouped by topic, so find the heading first. Thermodynamics, Space, Nuclear radiation, Gravitational fields and Oscillations are all on the last page.
- Check which kinetic energy form you need: $E_k = \frac{1}{2}mv^2$ sits under Mechanics, while $E_k = p^2/2m$ sits under Further mechanics and is for non-relativistic particles.
- The Coulomb law constant $k = 1/(4\pi\varepsilon_0)$ is printed with its value. $E = kQ/r^2$ and $V = kQ/r$ use k, while $F = Q_1Q_2/(4\pi\varepsilon_0 r^2)$ uses ε_0, so use the matching value.
- The exponential discharge equations for current and pd are printed twice, under Capacitor discharge and again under Resistor-capacitor discharge. They are the same relationship, so do not look for a difference.
- Constants are given to three significant figures (for example $g = 9.81$ and $h = 6.63 \times 10^{-34}$). Use the printed values, keep extra figures in working, and round only the final answer.

Based on: Pearson Edexcel A Level Physics (9PH0), List of data, formulae and relationships, Issue 3, November 2022; specification Issue 3, November 2018 (Appendix 8: Formulae sheet). Statistical tables are calculated by CuratedPrep to the same layout. Updated 31 October 2026. Always practise with the version of the official booklet your exam uses. More free sheets and topic worksheets at curatedprep.com.