STUDY FORMULA BOOKLET

Cambridge AS and A Level Physics 9702 data and formulae

Cambridge 9702 prints 14 constants and only a short list of formulae, so most equations (F = ma, V = IR, E = hf and more) must be learned.

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

Based on the official **Cambridge International AS & A Level Physics 9702 syllabus for 2025, 2026 and 2027, Additional information: Data and formulae (pages 58 to 62)**, with what to learn and exam tips added by CuratedPrep.

Data

Printed on page 2 of Papers 1, 2 and 4.

Data

Quantity	Symbol	Value	Units
acceleration of free fall	g	9.81	m s^{-2}
speed of light in free space	c	3.00×10^{8}	m s^{-1}
elementary charge	e	1.60×10^{-19}	C
unified atomic mass unit	1 u	1.66×10^{-27}	kg
rest mass of proton	m_{p}	1.67×10^{-27}	kg
rest mass of electron	m_{e}	9.11×10^{-31}	kg
Avogadro constant	N_{A}	6.02×10^{23}	mol^{-1}
molar gas constant	R	8.31	J K^{-1} mol^{-1}
Boltzmann constant	k	1.38×10^{-23}	J K^{-1}
gravitational constant	G	6.67×10^{-11}	N m^2 kg^{-2}
permittivity of free space	ε_0	8.85×10^{-12}	F m^{-1}
permittivity of free space, second form	$\frac{1}{4\pi\varepsilon_0}$	8.99×10^{9}	m F^{-1}
Planck constant	h	6.63×10^{-34}	J s
Stefan-Boltzmann constant	σ	5.67×10^{-8}	W m^{-2} K^{-4}

Formulae (Papers 1, 2 and 4)

Printed on page 2 of Papers 1, 2 and 4.

Uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$	IN THE BOOKLET
Uniformly accelerated motion	$v^2 = u^2 + 2as$	IN THE BOOKLET
Hydrostatic pressure	$\Delta p = \rho g \Delta h$	IN THE BOOKLET
Upthrust	$F = \rho g V$	IN THE BOOKLET
Doppler effect for sound waves f_s is the source frequency, v is the speed of sound and v_s the speed of the source.	$f_{\mathrm{o}} = \frac{f_{\mathrm{s}} v}{v \pm v_{\mathrm{s}}}$	IN THE BOOKLET

Electric current n is the number density of charge carriers, q the charge on each.	$I = Anvq$	IN THE BOOKLET
Resistors in series	$R = R_1 + R_2 + \ldots$	IN THE BOOKLET
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	IN THE BOOKLET
Equation of motion Not printed. Only two of the four equations of motion are given.	$v = u + at$	LEARN IT
Equation of motion Not printed.	$s = \frac{(u+v)t}{2}$	LEARN IT

Formulae (Paper 4)

Printed on page 3 of Paper 4.

Gravitational potential	$\phi = -\frac{GM}{r}$	IN THE BOOKLET
Gravitational potential energy	$E_\mathrm{P} = -\frac{GMm}{r}$	IN THE BOOKLET
Pressure of an ideal gas The angle brackets mean the mean square speed.	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$	IN THE BOOKLET
Simple harmonic motion	$a = -\omega^2 x$	IN THE BOOKLET
Velocity of a particle in s.h.m.	$v = v_0 \cos \omega t$	IN THE BOOKLET
Velocity of a particle in s.h.m.	$v = \pm\omega\sqrt{x_0^2 - x^2}$	IN THE BOOKLET
Electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$	IN THE BOOKLET
Electrical potential energy	$E_\mathrm{P} = \frac{Qq}{4\pi\varepsilon_0 r}$	IN THE BOOKLET
Capacitors in series	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$	IN THE BOOKLET
Capacitors in parallel	$C = C_1 + C_2 + \ldots$	IN THE BOOKLET
Discharge of a capacitor x can be charge, current or potential difference.	$x = x_0\, e^{-t/RC}$	IN THE BOOKLET
Hall voltage	$V_\mathrm{H} = \frac{BI}{ntq}$	IN THE BOOKLET
Alternating current or voltage	$x = x_0 \sin \omega t$	IN THE BOOKLET
Radioactive decay	$x = x_0\, e^{-\lambda t}$	IN THE BOOKLET
Decay constant	$\lambda = \frac{0.693}{t_{1/2}}$	IN THE BOOKLET
Intensity reflection coefficient	$\frac{I_\mathrm{R}}{I_0} = \frac{(Z_1 - Z_2)^2}{(Z_1 + Z_2)^2}$	IN THE BOOKLET
Stefan-Boltzmann law	$L = 4\pi\sigma r^2 T^4$	IN THE BOOKLET
Doppler redshift	$\frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$	IN THE BOOKLET

Circuit symbols

The booklet shows 27 drawn symbols that may be used in examination papers. Here each is named and described in words.

Component	Drawn as
cell	One long and one short parallel line.
battery of cells	Several cells in series: alternating long and short lines (also drawn with a dashed break in the middle).
power supply	Two open circles (terminals) on the wire.
a.c. power supply	Two open circles with a sine wave symbol between them.
junction of conductors	A solid dot where wires join.
lamp	A circle with a cross inside.
fixed resistor	A plain rectangle.
variable resistor	A rectangle with a diagonal arrow through it.
thermistor	A rectangle with a diagonal line through it that has a bend at the end.
light-dependent resistor	A rectangle with two arrows pointing at it.
heater	A rectangle divided into sections by vertical lines.
switch	A gap in the wire with a slanted line across it.
earth	A vertical line ending in three short horizontal lines of decreasing length.
electric bell	A dome shape on two legs.
buzzer	A half-round shape with a flat top on two legs.
microphone	A small circle with a short bar on its left and two leads.
loudspeaker	A small rectangle with a cone opening to the right.
motor	A circle containing M.
generator	A square containing G.
ammeter	A circle containing A.
voltmeter	A circle containing V.
galvanometer	A circle containing an upward arrow.
potentiometer	A rectangle with an arrow pointing down onto it.
oscilloscope	A circle containing a zigzag trace.
diode	A triangle pointing at a bar.
capacitor	Two parallel plates (lines) with a lead to each.
light-emitting diode	A diode symbol with two arrows pointing away from it.

Not printed: mechanics, materials and waves (AS)

These must be recalled. The booklet prints only the equations above.

Velocity and acceleration	$v = \frac{\Delta s}{\Delta t}, \quad a = \frac{\Delta v}{\Delta t}$	LEARN IT
Newton's second law	$F = ma$	LEARN IT
Weight	$W = mg$	LEARN IT
Momentum	$p = mv$	LEARN IT
Force as rate of change of momentum	$F = \frac{\Delta p}{\Delta t}$	LEARN IT
Density	$\rho = \frac{m}{V}$	LEARN IT

Pressure	$p = \frac{F}{A}$	LEARN IT
Moment of a force	$\text{moment} = F \times \text{perpendicular distance}$	LEARN IT
Work done	$W = Fs\cos\theta$	LEARN IT
Power	$P = \frac{W}{t} = Fv$	LEARN IT
Efficiency	$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$	LEARN IT
Kinetic energy	$E_\text{K} = \frac{1}{2}mv^2$	LEARN IT
Gravitational potential energy change	$\Delta E_\text{P} = mg\Delta h$	LEARN IT
Hooke's law	$F = kx$	LEARN IT
Elastic potential energy	$E = \frac{1}{2}Fx = \frac{1}{2}kx^2$	LEARN IT
Stress, strain and Young modulus	$\sigma = \frac{F}{A},\ \varepsilon = \frac{x}{L},\ E = \frac{\sigma}{\varepsilon}$	LEARN IT
Wave speed	$v = f\lambda$	LEARN IT
Intensity of a wave A in the proportionality is the amplitude.	$I = \frac{P}{A},\ I \propto A^2$	LEARN IT
Malus's law	$I = I_0\cos^2\theta$	LEARN IT
Double-slit interference	$\lambda = \frac{ax}{D}$	LEARN IT
Diffraction grating	$d\sin\theta = n\lambda$	LEARN IT

Not printed: electricity (AS)

Charge	$Q = It$	LEARN IT
Potential difference	$V = \frac{W}{Q}$	LEARN IT
Resistance (Ohm's law form)	$V = IR$	LEARN IT
Resistivity	$R = \frac{\rho L}{A}$	LEARN IT
Power	$P = VI = I^2R = \frac{V^2}{R}$	LEARN IT
Emf and internal resistance E = I(R + r).	$E = V + Ir$	LEARN IT
Potential divider	$V_\text{out} = \frac{R_2}{R_1 + R_2}V_\text{in}$	LEARN IT

Not printed: circular motion, gravitation and thermal physics (A Level)

Angular speed Angles in radians.	$\omega = \frac{2\pi}{T},\ v = r\omega$	LEARN IT
Centripetal acceleration	$a = r\omega^2 = \frac{v^2}{r}$	LEARN IT
Centripetal force	$F = mr\omega^2 = \frac{mv^2}{r}$	LEARN IT

Newton's law of gravitation	$F = \frac{Gm_1m_2}{r^2}$	LEARN IT
Gravitational field strength of a point mass	$g = \frac{GM}{r^2}$	LEARN IT
Orbits Equate the gravitational force to the centripetal force.	$T^2 \propto r^3$	LEARN IT
Specific heat capacity	$Q = mc\Delta\theta$	LEARN IT
Specific latent heat	$Q = mL$	LEARN IT
Equation of state	$pV = nRT = NkT$	LEARN IT
Boltzmann constant	$k = \frac{R}{N_\mathrm{A}}$	LEARN IT
Mean translational kinetic energy of a molecule	$\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$	LEARN IT
Work done by a gas At constant pressure.	$W = p\Delta V$	LEARN IT
First law of thermodynamics q is heat supplied to the system and W is work done on it.	$\Delta U = q + W$	LEARN IT

Not printed: fields, capacitors and magnetism (A Level)

Force on a charge in an electric field	$F = qE$	LEARN IT
Uniform field	$E = \frac{\Delta V}{\Delta d}$	LEARN IT
Coulomb's law	$F = \frac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$	LEARN IT
Field strength of a point charge	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$	LEARN IT
Capacitance	$C = \frac{Q}{V}$	LEARN IT
Energy stored in a capacitor	$W = \frac{1}{2}QV = \frac{1}{2}CV^2$	LEARN IT
Time constant	$\tau = RC$	LEARN IT
Force on a current	$F = BIL\sin\theta$	LEARN IT
Force on a moving charge	$F = BQv\sin\theta$	LEARN IT
Magnetic flux	$\Phi = BA$	LEARN IT
Faraday's law The minus sign is Lenz's law: the induced emf opposes the change.	$\varepsilon = -\frac{\Delta(N\Phi)}{\Delta t}$	LEARN IT
Root mean square values For a sinusoidal supply. Mean power is half the maximum power.	$I_\mathrm{rms} = \frac{I_0}{\sqrt{2}},\ V_\mathrm{rms} = \frac{V_0}{\sqrt{2}}$	LEARN IT

Not printed: quantum, nuclear, medical and astronomical physics (A Level)

Photon energy	$E = hf$	LEARN IT

Photoelectric effect	$hf = \Phi + \frac{1}{2}mv_{\max}^2$	LEARN IT
de Broglie wavelength	$\lambda = \dfrac{h}{p}$	LEARN IT
Energy levels	$hf = E_1 - E_2$	LEARN IT
Photon momentum	$p = \dfrac{E}{c}$	LEARN IT
Mass-energy equivalence Mass defect gives the binding energy.	$E = mc^2, \quad \Delta E = c^2 \Delta m$	LEARN IT
Activity	$A = \lambda N$	LEARN IT
Acoustic impedance	$Z = \rho c$	LEARN IT
Attenuation of X-rays or ultrasound	$I = I_0\, e^{-\mu x}$	LEARN IT
Radiant flux intensity L is luminosity: the printed Stefan-Boltzmann law uses the same symbol.	$F = \dfrac{L}{4\pi d^2}$	LEARN IT
Wien's displacement law	$\lambda_{\max} \propto \dfrac{1}{T}$	LEARN IT
Hubble's law	$v \approx H_0 d$	LEARN IT

Learn these: not in the booklet

SI base quantities and units

mass (kg), length (m), time (s), current (A), temperature (K), amount of substance (mol).

Prefixes

$\mathrm{p} = 10^{-12},\ \mathrm{n} = 10^{-9},\ \mu = 10^{-6},\ \mathrm{m} = 10^{-3},\ \mathrm{c} = 10^{-2},\ \mathrm{d} = 10^{-1},\ \mathrm{k} = 10^{3},\ \mathrm{M} = 10^{6},\ \mathrm{G} = 10^{9},\ \mathrm{T} = 10^{12}$

Temperature conversion

$T/\mathrm{K} = \theta/^{\circ}\mathrm{C} + 273.15$

Visible light

Wavelengths in free space from 400 nm to 700 nm.

Conservation of momentum

The total momentum of a system is conserved in an interaction. In an elastic collision total kinetic energy is also conserved and the relative speed of approach equals the relative speed of separation.

Equilibrium

No resultant force and no resultant torque.

Kirchhoff's laws

First law: the sum of currents into a junction equals the sum out (conservation of charge). Second law: round a loop the sum of emfs equals the sum of potential differences (conservation of energy).

Straight-line graphs

$y = mx + c$

Rearrange any relationship into this form and read the gradient and intercept.

Percentage uncertainty

$\dfrac{\Delta x}{x} \times 100\%$

For products and quotients add percentage uncertainties; for a power n multiply the percentage uncertainty by n.

Faraday and Lenz

The induced emf is proportional to the rate of change of flux linkage, and acts in the direction that opposes the change.

Quarks

Recall the charge of each flavour of quark and that an antiquark has the opposite charge. Protons and neutrons are not fundamental: a proton is uud and a neutron is udd.

Using the booklet in the exam

- Check page 2 of the paper first: it prints the data and the short formula list, so you do not need to memorise constants such as h, e and R.
- The list is short. Equations such as F = ma, V = IR, E = hf and pV = nRT are not printed, so write them from memory.
- Paper 4 also prints formulae for gravitational and electric potential, capacitor discharge, the Hall voltage and decay, so use them instead of deriving.
- Most printed constants have 3 significant figures. Carry extra figures in your working and round the final answer at the end.

- Learn the circuit symbols: the table lists every symbol that may be used in examination papers, so you should recognise and draw each one.

Based on: Cambridge International, Cambridge International AS & A Level Physics 9702 syllabus 2025 to 2027 (Data and formulae). 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.