IGCSE Physics

Formula Sheet every equation you need, topic by topic

Motion, forces & energy · Thermal · Waves · Electricity · Nuclear · Space · Maths & units

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Cambridge IGCSE 0625 · Core + Extended

Start here

How to read this sheet

- CORE everyone needs it (Core and Extended students).
- EXTENDED Supplement content: Extended students only.
- HANDY a shortcut made by combining syllabus equations.
- Units are in brackets, e.g. (m/s). **Convert to these units first** (cm → m, g → kg, min → s).

Formula triangles

$$V = IR$$



- Cover the quantity you want. What is left tells you what to do.
- Cover **V** → $I \times R$ · cover **I** → $V \div R$ · cover **R** → $V \div I$
- Look for the triangle △ on a card: it works the same way.

The 4-step rule for every calculation

- **1** Write the equation.
- **2** Substitute the numbers (with units, already converted).
- **3** Calculate. Keep the full calculator value until the end.
- **4** Answer with the **unit**, to the same number of significant figures as your least precise data.

Why *Examiners give marks for the equation, the substitution and the answer with its unit.*

1 Motion, forces and energy

MOTION

Speed CORE

$$v = \frac{s}{t}$$



v	speed (m/s)
s	distance travelled (m)
t	time taken (s)

Tip ***Average speed*** *= total distance ÷ total time (include any time spent stopped).*

Acceleration EXTENDED

$$a = \frac{\Delta v}{\Delta t}$$



a	acceleration (m/s²)
Δv	change in velocity (m/s) = final − initial
Δt	time taken (s)

Tip *Deceleration is a negative acceleration.*

Reading motion graphs CORE

- **Distance–time graph:** gradient = speed. Flat line = at rest; steeper = faster.
- **Speed–time graph:** area under the graph = distance travelled.
- **Speed–time graph:** gradient = acceleration EXTENDED

Falling and terminal velocity EXTENDED

- Near Earth, free fall has a nearly constant acceleration of about 9.8 m/s².
- Air resistance grows as the speed grows.
- At **terminal velocity**: air resistance = weight → resultant force = 0 → constant speed.

TRY IT **A runner covers 400 m in 50 s. Find the speed.**

$v = s \div t = 400 \div 50 =$ **8 m/s**

MASS, WEIGHT AND DENSITY

Weight CORE

$$W = mg$$



W	weight (N)
m	mass (kg)
g	gravitational field strength (N/kg); on Earth about 9.8 N/kg (= 9.8 m/s²)

Tip *Mass stays the same everywhere; weight changes with g. Use the value of g given in the question.*

Density

CORE

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



- ρ density (kg/m³ or g/cm³)
- m mass (kg or g)
- V volume (m³ or cm³)

Tip An object floats if its density is less than the liquid's. A less dense liquid floats on a denser one (Extended). 1 g/cm³ = 1000 kg/m³.

FORCES AND TURNING EFFECTS

Force and acceleration

EXTENDED

$$F = ma$$



- F resultant force (N)
- m mass (kg)
- a acceleration (m/s²)

Tip Force and acceleration point the same way. With no resultant force an object stays at rest or keeps moving at constant speed in a straight line.

Springs: Hooke's law

EXTENDED

$$F = kx$$



- F force (N)
- k spring constant (N/m or N/cm); also k = F ÷ x
- x extension = new length − original length (m or cm)

Tip On a load–extension graph the straight part obeys Hooke's law. The point where the line starts to curve is the limit of proportionality.

Moment of a force

CORE

$$\text{moment} = F \times d$$



- F force (N)
- d perpendicular distance from the pivot (m)
- M moment (N m)

Principle of moments

CORE

clockwise moments = anticlockwise moments

$$F_1 \times d_1 = F_2 \times d_2$$

Tip Balanced beam: use the same pivot for every moment. With more than one force on a side, add them up (Extended). In equilibrium there is no resultant force and no resultant moment.

TRY IT

A 20 N weight is 0.30 m from the pivot. What force 0.15 m on the other side balances it?

$F \times 0.15 = 20 \times 0.30 \rightarrow F = 6.0 \div 0.15 =$ **40 N**

Scalar or vector?

EXTENDED

- **Scalars** (size only): distance, speed, time, mass, energy, temperature.
- **Vectors** (size and direction): force, weight, velocity, acceleration, momentum.

Two vectors at right angles

EXTENDED

$$R = \sqrt{(a^2 + b^2)}$$

$$\tan\theta = \frac{b}{a}$$

- R resultant force or velocity
- a, b the two perpendicular vectors
- θ angle between the resultant and a

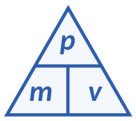
Tip Or draw a scale diagram. Forces on the same line: add if the same direction, subtract if opposite (Core).

MOMENTUM (EXTENDED)

Momentum

EXTENDED

$$p = mv$$



- p momentum (kg m/s)
- m mass (kg)
- v velocity (m/s)

Tip Conservation of momentum: total momentum before a collision = total momentum after (one dimension). Pick one direction as positive.

Impulse and resultant force

EXTENDED

$$\text{impulse} = F\Delta t = \Delta(mv)$$

$$F = \frac{\Delta p}{\Delta t}$$

- F resultant force (N)
- Δt time the force acts (s)
- Δp change in momentum = Δ(mv) (kg m/s)

Tip Impulse is measured in N s. Resultant force = change in momentum per unit time.

ENERGY, WORK AND POWER

Kinetic energy

EXTENDED

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

E_k	kinetic energy (J)
m	mass (kg)
v	speed (m/s)

Gravitational potential energy

EXTENDED

$$\Delta E_p = mg\Delta h$$

ΔE_p	change in gravitational potential energy (J)
m	mass (kg)
g	gravitational field strength (N/kg)
Δh	change in height (m)

TRY IT **A 2.0 kg ball moves at 6.0 m/s. Find its kinetic energy.**

$E_k = \tfrac{1}{2} mv^2 = \tfrac{1}{2} \times 2.0 \times 6.0^2 =$ **36 J**

Conservation of energy

HANDY

$$mg\Delta h = \tfrac{1}{2} mv^2$$

Idea *Energy is never created or destroyed, only transferred between stores (Core). For a falling object with no air resistance, loss in E_p = gain in E_k.*

Work done

CORE

$$W = Fd = \Delta E$$



W	work done (J)
F	force (N)
d	distance moved in the direction of the force (m)
ΔE	energy transferred (J)

Tip *Work done = energy transferred.*

Power

CORE

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

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



P	power (W)
W	work done (J)
ΔE	energy transferred (J)
t	time (s)

Tip *1 W = 1 J/s. Power is the rate of doing work (or transferring energy).*

Efficiency

EXTENDED

$$\text{efficiency (\%)} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

$$\text{efficiency (\%)} = \frac{\text{useful power output}}{\text{total power input}} \times 100\%$$

Tip *Efficiency can never be more than 100%. Energy that is not useful is wasted, usually as thermal energy.*

TRY IT **A motor takes in 80 J and gives out 60 J of useful energy. Find its efficiency.**

efficiency = 60 ÷ 80 × 100% = **75%**

PRESSURE

Pressure

CORE

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



p	pressure (Pa = N/m²)
F	force (N)
A	area (m²)

Tip *The same force on a smaller area gives a bigger pressure (drawing pin, knife).*

Pressure in a liquid

EXTENDED

$$\Delta p = \rho g \Delta h$$

Δp	change in pressure (Pa)
ρ	density of the liquid (kg/m³)
g	gravitational field strength (N/kg)
Δh	change in depth (m)

Tip *Pressure increases with depth and with the density of the liquid (Core: describe this).*

TRY IT **A force of 600 N acts on an area of 0.040 m². Find the pressure.**

$p = F \div A = 600 \div 0.040 =$ **15 000 Pa**

2 Thermal physics

Kelvin and Celsius

CORE

$$T\,(\text{K}) = \theta\,(^\circ\text{C}) + 273$$

T	temperature in kelvin (K)
θ	temperature in degrees Celsius (°C)

Tip *Absolute zero: 0 K = −273 °C, where particles have the least kinetic energy. Example: 25 °C = 298 K.*

Gas pressure and volume (Boyle's law) EXTENDED

$$pV = \text{constant}$$
$$p_1V_1 = p_2V_2$$

- p pressure (Pa)
- V volume (m^3 or cm^3, same unit both sides)

Tip Fixed mass of gas at constant temperature. Squash the gas → smaller V → higher p (more collisions per second). A graph of p against 1/V is a straight line through the origin.

TRY IT **A gas at 100 000 Pa has volume 6.0 dm^3. It is squeezed to 2.0 dm^3 at constant temperature. Find the new pressure.**

$p_2 = p_1V_1 \div V_2 = 100\,000 \times 6.0 \div 2.0 =$ **300 000 Pa**

Specific heat capacity EXTENDED

$$c = \frac{\Delta E}{m\Delta\theta}$$
$$\Delta E = mc\Delta\theta$$

- c specific heat capacity (J/(kg °C))
- ΔE energy transferred (J)
- m mass (kg)
- $\Delta\theta$ temperature change (°C)

Tip The energy needed to raise the temperature of 1 kg of a substance by 1 °C.

TRY IT **Heating 0.50 kg of water by 20 °C. Water has c = 4200 J/(kg °C). Find the energy needed.**

$\Delta E = mc\Delta\theta = 0.50 \times 4200 \times 20 =$ **42 000 J**

Melting, boiling and evaporation CORE

- Water melts at 0 °C and boils at 100 °C (standard atmospheric pressure).
- While a substance melts or boils, energy goes in but the **temperature stays the same**.
- Evaporation: the most energetic particles escape from the surface, so the liquid **cools**.
- Evaporation is faster with a higher temperature, a larger surface area and moving air EXTENDED

Heat transfer at a glance CORE

- **Conduction** (solids): vibrating particles, and free electrons in metals, pass energy on.
- **Convection** (liquids, gases): warmer, less dense fluid rises; cooler, denser fluid sinks.
- **Radiation** (infrared): needs no medium; every object emits it.
- Dull black surfaces are the best emitters and absorbers. Shiny or white surfaces are poor emitters and absorbers but good reflectors.

3 Waves

Wave speed CORE

$$v = f\lambda$$



- v wave speed (m/s)
- f frequency (Hz) = waves per second
- λ wavelength (m)

Tip Wavelength = distance between two matching points (crest to crest). Amplitude = maximum displacement from the rest position.

TRY IT **A sound wave has frequency 50 Hz and wavelength 6.8 m. Find its speed.**

$v = f\lambda = 50 \times 6.8 =$ **340 m/s**

Frequency and period HANDY

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

- f frequency (Hz)
- T period: time for one complete wave or oscillation (s)

Tip Pendulum: period = total time ÷ number of swings. Time many swings to reduce the error.

Reflection CORE

angle of incidence = angle of reflection

$$i = r$$

Tip Both angles are measured from the normal (the line at 90° to the surface). A plane mirror image is virtual, the same size and the same distance behind the mirror.

Refractive index EXTENDED

$$n = \frac{\sin i}{\sin r}$$
$$n = \frac{1}{\sin c}$$

- n refractive index (no unit)
- i angle of incidence in air (°)
- r angle of refraction in the material (°)
- c critical angle (°)

Tip n is also the ratio of the speeds of light in the two regions. Entering a denser material, light slows down and bends towards the normal.

TRY IT **Light hits glass at i = 40° and refracts at r = 25°. Find n, then the critical angle.**

$n = \sin 40° \div \sin 25° =$ **1.5** → $\sin c = 1 \div 1.5 \rightarrow c =$ **42°**

Total internal reflection

CORE

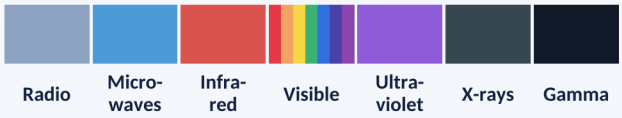
- It happens when light travels from a **denser** material to a **less dense** one (e.g. glass to air),
- **and** the angle of incidence is bigger than the critical angle *c*.
- Everyday use: optical fibres EXTENDED

Electromagnetic spectrum

CORE

- All EM waves are transverse and travel at the same speed in a vacuum: $c = 3.0 \times 10^8$ m/s EXTENDED (learn the value).
- Memory aid: **R**aging **M**artians **I**nvaded **V**enus **U**sing **X**-ray **G**uns.

longer wavelength ← → *higher frequency*



Radio | Micro-waves | Infra-red | Visible | Ultra-violet | X-rays | Gamma

Colours of visible light

CORE

R	O	Y	G	B	I	V
Red	Orange	Yellow	Green	Blue	Indigo	Violet
longest λ · lowest f						*shortest λ · highest f*

Order *Memory aid: Richard Of York Gave Battle In Vain. Light of one frequency only is called monochromatic (Extended).*

Sound

CORE

- A longitudinal wave made of compressions and rarefactions; it needs a medium.
- Human hearing: **20 Hz to 20 000 Hz**. Ultrasound: above 20 kHz.
- Speed in air: about **330–350 m/s**. Fastest in solids, then liquids, then gases EXTENDED
- Louder = bigger amplitude. Higher pitch = higher frequency.

Speed of sound by echo (and sonar)

CORE

$$v = \frac{2d}{t}$$

$$d = \frac{vt}{2}$$

- ***v*** speed of sound (m/s)
- ***d*** distance to the reflecting surface (m)
- ***t*** time for the echo to return (s)

Tip *Sound goes there and back, so the distance travelled is 2d. Sonar depth calculations are Extended.*

TRY IT — **A shout echoes back from a cliff after 0.50 s. Sound travels at 340 m/s. How far away is the cliff?**

$d = vt \div 2 = 340 \times 0.50 \div 2 =$ **85 m**

4 Electricity and magnetism

Charge and current

EXTENDED

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



- ***I*** current (A)
- ***Q*** charge (C)
- ***t*** time (s)

Tip *Conventional current flows from + to −. Free electrons flow from − to +.*

Potential difference and e.m.f.

EXTENDED

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

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



- ***V*** potential difference (V)
- ***E*** e.m.f. (V)
- ***W*** work done or energy transferred (J)
- ***Q*** charge (C)

Tip *1 V = 1 J/C. e.m.f. is the work done by a source per unit charge round a complete circuit. p.d. is the work done per unit charge passing through a component.*

Resistance

CORE

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



- ***R*** resistance (Ω)
- ***V*** p.d. across the component (V)
- ***I*** current through it (A)

Tip *Voltmeter in parallel, ammeter in series. To find R: take V and I readings, then V ÷ I.*

TRY IT — **A lamp has 12 V across it and 0.50 A through it. Find its resistance.**

$R = V \div I = 12 \div 0.50 =$ **24 Ω**

Resistance of a wire

EXTENDED

$$R \propto l$$

$$R \propto \frac{1}{A}$$

- ***l*** length of the wire (m)
- ***A*** cross-sectional area (m^2)

Tip *Double the length → double the resistance. Double the area → half the resistance. (Core: know this in words.)*

Current–voltage graphs

EXTENDED

- **Fixed resistor:** straight line through the origin (constant resistance).
- **Filament lamp:** a curve, because the resistance rises as the filament gets hotter.
- **Diode:** conducts in one direction only.

Resistors in series

CORE

$$R = R_1 + R_2 + \ldots$$

R combined resistance (Ω)
R_1, R_2 individual resistances (Ω)

Tip e.m.f.s of cells in series add up (Core).

Resistors in parallel

EXTENDED

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

handy shortcut for exactly two resistors

$$R = \frac{R_1 \times R_2}{R_1 + R_2}$$

Tip The combined resistance is always less than the smallest branch. Current into a junction = current out of it.

TRY IT

A 6 Ω and a 3 Ω resistor are in parallel. Find the combined resistance.

$1 \div R = 1 \div 6 + 1 \div 3 = 1 \div 2 \rightarrow R =$ **2 Ω**

Series vs parallel at a glance

	Series	Parallel
Current	same everywhere	splits between branches; branch currents add up
p.d.	shared: p.d.s add up to the supply p.d.	same across every branch
Resistance	$R = R_1 + R_2$ (adds up)	less than the smallest branch

Potential divider

EXTENDED

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

V_1, V_2 p.d.s across the two resistors (V)
R_1, R_2 the two resistances (Ω)

Tip The bigger resistor gets the bigger share of the supply p.d. ($V_1 + V_2$ = supply).

TRY IT

A 10 Ω and a 30 Ω resistor are in series across 12 V. Find the p.d. across the 10 Ω resistor.

$V_1 : V_2 = 10 : 30 = 1 : 3 \rightarrow V_1 = ¼ \times 12 =$ **3.0 V**

Electrical power

CORE

$$P = IV$$



P power (W)
I current (A)
V p.d. (V)

Power loss and other forms

EXTENDED

$$P = I^2R$$

also, from $V = IR$ (handy)

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

Why Power lines use a high voltage: for the same power the current is smaller, so the power lost (I^2R) in the cables is much smaller.

Electrical energy

CORE

$$E = IVt$$

E energy transferred (J)
I current (A)
V p.d. (V)
t time (s)

Tip Also $E = P \times t$.

TRY IT

A 12 V heater carries 2.0 A for 30 s. Find the power and the energy transferred.

$P = IV = 2.0 \times 12 =$ **24 W** · $E = IVt = 24 \times 30 =$ **720 J**

Kilowatt-hour and cost

CORE

energy (kWh) = power (kW) × time (h)
cost = energy (kWh) × cost per kWh

Tip 1 kWh = 3 600 000 J (3.6 MJ). Convert watts to kilowatts and minutes to hours first.

TRY IT

A 2.0 kW heater runs for 3.0 h. Electricity costs 20 cents per kWh. Find the cost.

energy = $2.0 \times 3.0 = 6.0$ kWh → cost = $6.0 \times 20 =$ **120 cents**

Choosing a fuse

CORE

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

Tip Work out the normal working current, then choose the fuse rating just above it (from the ratings the question gives).

Transformers

CORE

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

100% efficient (Extended)

$$I_p V_p = I_s V_s$$

V_p, V_s	voltage across the primary, secondary coil (V)
N_p, N_s	turns on the primary, secondary coil
I_p, I_s	current in the primary, secondary coil (A)

Tip *Step-up: $N_s > N_p$ (voltage rises). Step-down: $N_s < N_p$ (voltage falls). Soft iron core.*

TRY IT **Primary: 1000 turns, 230 V. Secondary: 50 turns. Find the secondary voltage.**

$V_s = V_p \times N_s \div N_p = 230 \times 50 \div 1000 =$ **11.5 V**

Magnetism and electromagnetic effects

- Like poles repel, unlike poles attract. Field lines leave a north pole and enter a south pole.
- Moving a conductor across a magnetic field (or a changing field) induces an e.m.f.
- No calculations here apart from the transformer: learn the rules and diagrams.

5 Nuclear physics

Inside the atom: nuclide notation

CORE

$${}^{A}_{Z}X$$

$$N = A - Z$$

A	nucleon number = protons + neutrons
Z	proton number (atomic number)
N	number of neutrons

Tip *Isotopes: same Z, different A (different number of neutrons). Relative charges: proton +1, neutron 0, electron −1.*

TRY IT **Uranium-238 has $Z = 92$ and $A = 238$. How many neutrons?**

$N = A - Z = 238 - 92 =$ **146**

Alpha, beta and gamma compared

CORE

	Alpha α	Beta β	Gamma γ
What is it?	helium nucleus (2 protons + 2 neutrons)	fast-moving electron	electromagnetic wave
Charge	+2	−1	0
Ionising	strongest	medium	weakest
Penetrating	weakest: stopped by paper	medium: stopped by a few mm of aluminium	strongest: only thick lead stops most

Note *In electric and magnetic fields, α and β bend in opposite directions; γ goes straight (Extended). Emission is spontaneous and random.*

Decay equations

EXTENDED

alpha decay

$${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\alpha$$

beta decay (a neutron becomes a proton + electron)

$${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$$

gamma: A and Z do not change

examples

$${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}\alpha$$

$${}^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

Check: *the top numbers balance and the bottom numbers balance.*

Half-life

CORE

$$\text{number of half-lives } n = \frac{\text{total time}}{\text{half-life}}$$

$$\text{amount left} = \text{original} \times (½)^n$$

100%	÷2	50%	÷2	25%	÷2	12.5%
start		*1 half-life*		*2 half-lives*		*3 half-lives*

Def *Half-life: the time taken for half the nuclei of an isotope in a sample to decay. The count rate halves too.*

TRY IT **80 g of an isotope has a half-life of 3 days. How much is left after 9 days?**

$n = 9 \div 3 = 3$ half-lives → $80 \times (½)^3 = 80 \div 8 =$ **10 g**

Corrected count rate

EXTENDED

$$\text{corrected count rate} = \text{measured} - \text{background}$$

Tip *Count rate is in counts/s or counts/min. Background radiation comes from radon gas, rocks and buildings, food and drink, and cosmic rays.*

Radiation safety

EXTENDED

- Reduce the **time** of exposure.
- Increase the **distance** from the source.
- Use **shielding** (e.g. lead) to absorb the radiation.

6 Space physics

Orbital speed

EXTENDED

$$v = \frac{2\pi r}{T}$$

- v — average orbital speed (m/s)
- r — average radius of the orbit (m)
- T — orbital period (s)

Tip *2πr is the circumference of the orbit. Convert the period to seconds first (1 day = 86 400 s; 1 year ≈ 3.15 × 10^7 s).*

TRY IT

Earth orbits the Sun at $r = 1.5 \times 10^{11}$ m once in 3.15×10^7 s. Find its orbital speed.

$v = 2\pi r \div T = 2\pi \times 1.5 \times 10^{11} \div 3.15 \times 10^7 =$ **3.0×10^4 m/s**

Time for light to travel

CORE

$$\text{time} = \frac{\text{distance}}{\text{speed of light}}$$

Fact *Speed of light $c = 3.0 \times 10^8$ m/s (Extended: learn it). Sunlight takes about 8 minutes to reach Earth.*

TRY IT

The Sun is 1.5×10^{11} m from Earth. How long does its light take to arrive?

time = $1.5 \times 10^{11} \div 3.0 \times 10^8 =$ **500 s** (about 8.3 minutes)

Light-years

CORE

- A light-year is the distance light travels in one year in a vacuum.
- 1 light-year = 9.5×10^{15} m EXTENDED
- The Milky Way is about 100 000 light-years across.

Hubble constant

EXTENDED

$$H_0 = \frac{v}{d}$$

estimate for the age of the Universe

$$\frac{1}{H_0}$$

- H_0 — Hubble constant (s^{-1}, "per second")
- v — speed a galaxy moves away from Earth (m/s)
- d — distance of the galaxy from Earth (m)

Tip *Current estimate: $H_0 = 2.2 \times 10^{-18}$ per second, so $1 \div H_0 \approx 4.5 \times 10^{17}$ s, about 14 billion years.*

Redshift and the Big Bang

CORE

- Light from distant galaxies is **redshifted**: its observed wavelength is longer.
- So the galaxies are moving away → the Universe is expanding → this supports the Big Bang theory.
- CMBR: microwave radiation from every direction, left over from soon after the Big Bang EXTENDED

Earth, Moon, Sun and planets

CORE

- Earth spins once in about **24 hours** (day and night).
- Earth orbits the Sun once in about **365 days** (a year; the tilt gives the seasons).
- The Moon orbits Earth in about **one month** (phases).
- Planets in order: Mercury, Venus, Earth, Mars (small, rocky) then Jupiter, Saturn, Uranus, Neptune (large, gaseous).
- The Sun holds most of the Solar System's mass; its gravity keeps the planets in orbit. Gravity gets weaker with distance, and planets farther out orbit more slowly EXTENDED

7 Maths toolkit and units

Areas and volumes

MATHS

circle: $C = 2\pi r$ $A = \pi r^2$

rectangle: $A = l \times w$ triangle: $A = \frac{1}{2} bh$

block: $V = l \times w \times h$ cylinder: $V = \pi r^2 h$

Pythagoras and trigonometry

MATHS

$$c^2 = a^2 + b^2 \quad \text{(right-angled)}$$

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} \quad \cos\theta = \frac{\text{adj}}{\text{hyp}} \quad \tan\theta = \frac{\text{opp}}{\text{adj}}$$

Note *Trigonometry is for Extended candidates. SOH CAH TOA.*

Graphs and averages

MATHS

$$\text{gradient} = \frac{\Delta y}{\Delta x}$$

$$y = mx + c$$

$$\text{mean} = \frac{\text{sum of values}}{\text{number of values}}$$

Tip *Direct proportion: a straight line through the origin. For the gradient triangle, use at least half the length of the best-fit line.*

Prefixes

- **All:** M mega 10^6 · k kilo 10^3 · c centi 10^{-2} · m milli 10^{-3}
- **Extended also:** G giga 10^9 · μ micro 10^{-6} · n nano 10^{-9}

Handy conversions

HANDY

- 1 m^3 = 1 000 000 cm^3 · 1 kg = 1000 g · 1 g/cm^3 = 1000 kg/m^3
- km/h → m/s: divide by 3.6 · m/s → km/h: multiply by 3.6
- 1 h = 3600 s · 1 min = 60 s · 1 kWh = 3.6 MJ · K = °C + 273

Every equation at a glance

CORE — everyone learns these

$v = s \div t$ · average speed = total distance ÷ total time

$W = mg$ · $\rho = m \div V$

moment = $F \times d$ · clockwise = anticlockwise moments

$W = Fd = \Delta E$ · $P = W \div t = \Delta E \div t$

$p = F \div A$ · T (K) = θ (°C) + 273

$v = f\lambda$ · $i = r$ (reflection)

$R = V \div I$ · $R = R_1 + R_2$ (series)

$P = IV$ · $E = IVt$ · kWh = kW × h

$V_p \div V_s = N_p \div N_s$ · $I = P \div V$ (fuse)

$N = A - Z$ · left = original × $(½)^n$

time = distance ÷ speed (light travel)

EXTENDED — also learn these

$a = \Delta v \div \Delta t$ · $F = ma$ · $F = kx$

$p = mv$ · $F\Delta t = \Delta(mv)$ · $F = \Delta p \div \Delta t$

$E_k = ½mv^2$ · $\Delta E_p = mg\Delta h$

efficiency = useful output ÷ total input × 100%

$\Delta p = \rho g \Delta h$ · pV = constant

$c = \Delta E \div (m\Delta\theta)$

$n = \sin i \div \sin r$ · $n = 1 \div \sin c$

$I = Q \div t$ · $V = W \div Q$ · $E = W \div Q$

$R \propto I$ · $R \propto 1 \div A$ · $1 \div R = 1 \div R_1 + 1 \div R_2$

$V_1 \div V_2 = R_1 \div R_2$ · $P = I^2R$

$I_pV_p = I_sV_s$ · $v = 2\pi r \div T$

$H_0 = v \div d$ · age ≈ $1 \div H_0$

$c = 3.0 \times 10^8$ m/s · 1 light-year = 9.5×10^{15} m

Units at a glance

Distance, length (s, d, l, h)	**m, cm, km**	Moment of a force	**N m**	Frequency (f)	**Hz, kHz**
Time (t)	**s, min, h**	Momentum (p) • Ext	**kg m/s**	Wavelength (λ)	**m, cm, nm**
Mass (m)	**kg, g**	Impulse • Ext	**N s**	Current (I)	**A, mA**
Speed (v)	**m/s, km/h**	Spring constant (k)	**N/m, N/cm**	Charge (Q)	**C**
Acceleration (a)	**m/s²**	Work, energy (W, E)	**J, kJ, MJ, kWh**	p.d., e.m.f. (V, E)	**V, mV, kV**
Force, weight (F, W)	**N**	Power (P)	**W, kW, MW**	Resistance (R)	**Ω**
Density (ρ)	**kg/m³, g/cm³**	Temperature (θ, T)	**°C, K**	Half-life	**s, min, h, days, years**
Pressure (p)	**Pa (= N/m²)**	Specific heat capacity (c)	**J/(kg °C)**	Hubble constant (H_0) • Ext	**s^{-1}**

THE EXAM-DAY CHECKLIST

Equation → Substitute → Answer + Unit

Convert units first · show every step · check the answer is sensible · you have got this!

*Based on the Cambridge IGCSE Physics 0625 syllabus (2026–2028). Items marked **Ext** or **EXTENDED** are Supplement content. Always check the latest syllabus and the equations your teacher expects you to know.*