

The maths you need for physics: a checklist, and a four-week plan for learning physics

Physics is hard mostly because it uses maths as a language. The maths needed is small; tick what is automatic, and fix the rest before the physics.

Checklist: the maths physics uses every week

Skill	Try this	Answer	Have it?
Rearranging a formula	Make a the subject of $v = u + at$	$a = (v - u) / t$	[]
Rearranging with a square	Make v the subject of $E = \frac{1}{2}mv^2$	$v = \sqrt{(2E / m)}$	[]
Substituting with units	$F = ma$ with $m = 2.5 \text{ kg}$, $a = 4 \text{ m/s}^2$	10 N	[]
Unit conversion	72 km/h in m/s; 350 g in kg	20 m/s; 0.35 kg	[]
Ratios and proportion	If F is proportional to $1/r^2$, what happens to F when r doubles?	F becomes a quarter	[]
Standard form	Write 0.00045 and 3,200,000 in standard form	4.5×10 to the -4 ; 3.2×10 to the 6	[]
Gradient of a graph	A distance-time graph rises 40 m in 8 s; the speed?	5 m/s	[]
Area under a graph	A speed-time graph: 10 m/s steady for 6 s; distance?	60 m	[]
Right-angle trigonometry	A 20 N force at 30° to the horizontal: horizontal part?	$20 \cos 30^\circ = 17.3 \text{ N}$	[]
Pythagoras and vectors	3 N east and 4 N north: size of the resultant?	5 N	[]
Significant figures	9.81×2.3 to 2 s.f.	23	[]
Solving a quadratic (AP, A-level)	$s = ut + \frac{1}{2}at^2$: t when $s = 20$, $u = 0$, $a = 10$	$t = 2 \text{ s}$	[]
Derivatives (AP Physics C, A-level)	If $x = 3t^2$, what is velocity at $t = 2$?	$dx/dt = 6t = 12 \text{ m/s}$	[]

Ten or more ticks: the physics itself is the work. Fewer: two weeks on the unticked rows, separate from the physics, is the fastest grade you will ever gain.

The five habits that fix physics

Habit	What it is	Done this week?
1. Draw first	Every problem: a sketch with the quantities marked before any equation; free-body diagrams for forces, bar charts for energy	[]
2. Units, always	Every number with its unit, carried through the algebra; convert to SI first	[]
3. Algebra before numbers	Solve for the unknown in symbols, substitute at the end	[]
4. One type at a time	Ten problems of one kind until automatic, then the next kind, only then mixed sets	[]
5. Spaced revisiting	Ten minutes a week on last month's topics, two problems each, no notes	[]

Where students fall, in order

Topic	Why	What it looks like
Kinematics	Distance vs displacement, speed vs velocity, gradient vs height of a graph	Plug-in problems right, graph problems wrong
Forces and Newton's laws	The intuition switch; free-body diagrams wrong or missing	'A force pushes the ball up'; mass and weight swapped
Energy	An invisible quantity; choosing the system	Energy 'lost'; work done by the wrong force
Momentum	Vectors: direction and signs	Right size, wrong sign
Circuits	Current is not used up; potential difference is abstract	Series and parallel reasoned wrongly
Waves and optics	Ray diagrams and wavefronts	Memorised rules on the wrong situation

How to learn physics: a four-week plan

Week	Do
1	The checklist above: fix the unticked maths rows, 20 minutes a day, no physics yet. Start habit 2 (units) on everything.
2	Kinematics by picture: ten problems a day of one type (graphs, then constant acceleration), each drawn first. Habit 1 and 3.
3	Forces: free-body diagrams for a box on a slope, a lift accelerating up, a ball at the top of its flight, every day until correct without thinking. This is the wall.
4	Mixed problems under time, closed book; two old-topic problems a day (habit 5); past-paper questions marked to the real scheme.

From sciencewithshobha.com/blog/why-is-physics-so-hard-and-the-five-habits-that-fix-it/