

Exam technique

How the exams work, every command word, and tips for each stage of the exam

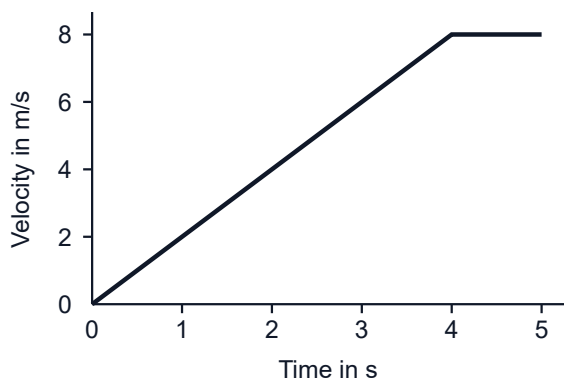
How the exams work

Two written exams at the end of the course, each 1 hour 45 minutes, 100 marks and half of the GCSE, with no coursework. This guide is for Foundation tier (grades 5 to 1). Both papers mix multiple-choice, structured, short-answer, calculation and longer open-response questions. At least 15% of the marks test the 10 required practicals and at least 30% use maths skills. You are given the Physics Equations Sheet. Paper 2 can also draw on the energy ideas from Energy and Electricity (4.1 and 4.2). Topics marked HT only (momentum, the motor effect, transformers and similar) are not on your papers.

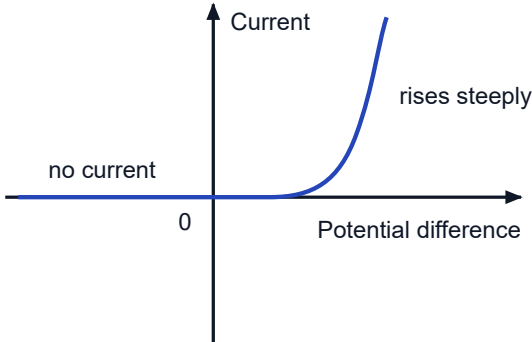
Paper	Time	Marks	Calculator	What's on it
Paper 1 (8463/1F)	1 h 45 min	100	Allowed (scientific calculator)	Topics 4.1 to 4.4: Energy; Electricity; Particle model of matter; Atomic structure.
Paper 2 (8463/2F)	1 h 45 min	100	Allowed (scientific calculator)	Topics 4.5 to 4.8: Forces; Waves; Magnetism and electromagnetism; Space physics.

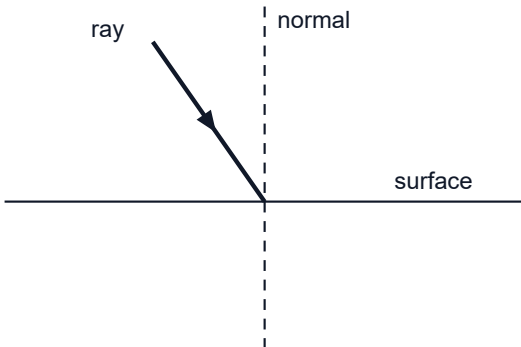
Command words

Word	What it means	How to answer	Example
Calculate	Work out a numerical answer from values given in the question.	Write the equation, substitute values in SI units, rearrange if needed, and give the answer with its unit and the significant figures asked for. Show your working: it earns marks even if the final answer is wrong.	Calculate the kinetic energy of a 1200 kg car travelling at 15 m/s. [2 marks] $E_k = 0.5 \times 1200 \times 15^2 (1) = 135\,000 \text{ J } (1)$
Determine	Use the data or information given, often a graph or table, to get an answer. You may need to take readings or find a gradient.	Show the values you read off and what you did with them. Draw on the graph (reading lines or a gradient triangle) so your method is visible.	The velocity–time graph shows a cyclist speeding up steadily from rest.

Word	What it means	How to answer	Example
			 Determine the acceleration. [2 marks] $a = \text{change in velocity} \div \text{time} = 8.0 \div 4.0 \text{ (1)} = 2.0 \text{ m/s}^2 \text{ (1)}$
Estimate	Find an approximate value, using sensible values of your own or rounded figures, or by counting squares on a graph.	State the values you assume and keep them realistic, show the calculation, and round the answer sensibly.	Estimate the kinetic energy of an adult walking. [3 marks] Mass about 70 kg and walking speed about 1.5 m/s (1); $E_k = 0.5 \times 70 \times 1.5^2 \text{ (1)} \approx 80 \text{ J (1)}$
Show that	Give the working that leads to a result already stated in the question.	Write every step, starting from the equation. Give your answer to one more significant figure than the value stated so the examiner can see you didn't just copy it. If you can't get there, use the stated value in later parts.	A lamp has a potential difference of 6.0 V across it and a current of 0.52 A through it. Show that its resistance is about 12 Ω. [2 marks] $R = V \div I = 6.0 \div 0.52 \text{ (1)} = 11.5 \Omega$, which is about 12 Ω (1)
Describe	Say accurately what happens, what something is like, or what a pattern shows. Reasons are not needed.	Give the features or steps in a logical order, one point per mark. For a pattern in data, give the trend and quote values with units.	Describe the motion of the particles in a gas. [2 marks] They move randomly in all directions at a range of speeds (1), colliding with each other and with the walls of the container (1).
Explain	Give the reasons why something happens or is true, showing how one idea leads to the next.	Link each point to its cause or effect with 'because', 'so' or 'therefore'. Each mark usually needs a	Explain why the resistance of a filament lamp increases as the current through it increases. [2 marks] A larger current makes the filament hotter (1), so the ions in the metal vibrate more and the electrons

Word	What it means	How to answer	Example									
		separate step in the chain.	collide with them more often, which increases the resistance (1).									
Compare	Give the similarities and/or differences between two things, writing about both of them.	Make every point a direct comparison with words such as 'more', 'less', 'higher' or 'both'. Two separate descriptions with no comparison usually lose marks.	Compare alpha and gamma radiation. [2 marks] Alpha is much more strongly ionising than gamma (1). Gamma is much more penetrating: alpha is stopped by a sheet of paper, but gamma is only reduced by thick lead or concrete (1).									
Evaluate	Use the information given and your own knowledge to weigh up the points for and against, then reach a judgement.	Give points on both sides, refer to any data given, and end with a conclusion you justify. A justified conclusion is usually needed for full marks.	Evaluate the use of wind turbines to generate electricity for a small town. [4 marks] Wind is renewable and the turbines release no carbon dioxide while generating (1). But the output depends on the weather, so the supply is unreliable (1), and many turbines are needed, which some people find noisy or unsightly (1). Conclusion: useful as part of the supply, but the town also needs a reliable back-up source (1).									
Justify	Support an answer or conclusion with evidence from the information given.	State your answer, then quote the specific figures or facts from the table, graph or text that back it up.	A student wrapped two identical beakers of hot water, one in material A and one in material B, and recorded the temperatures. <table><tr><th>Material</th><th>Temperature at start in °C</th><th>Temperature after 10 minutes in °C</th></tr><tr><td>A</td><td>80</td><td>65</td></tr><tr><td>B</td><td>80</td><td>72</td></tr></table> Which is the better thermal insulator? Justify your answer. [2 marks] B (1): its water cooled by 8 °C in 10 minutes, compared with 15 °C for the water in A (1).	Material	Temperature at start in °C	Temperature after 10 minutes in °C	A	80	65	B	80	72
Material	Temperature at start in °C	Temperature after 10 minutes in °C										
A	80	65										
B	80	72										
Suggest	Apply your physics to a situation you may not have met before. More than one answer may be accepted.	Give a sensible answer based on physics you know and, if there are 2 or more marks, the reason for it.	A student's value for the specific heat capacity of an aluminium block is higher than the true value. Suggest why. [2 marks] Some energy from the heater was transferred to the surroundings instead of the block (1), so the energy measured was more than the energy that heated the block, which makes the calculated value too large (1).									
Predict	Give a likely outcome based on a pattern, a relationship or a physics idea.	State the outcome clearly, with a value if you can, and give a short reason if there are marks for one.	A force of 2.0 N stretches a spring by 3.0 cm. Predict the extension for a force of 6.0 N, assuming the limit of proportionality is not passed. [2 marks] 9.0 cm (1), because extension is directly proportional to force, so three times the force gives three times the extension (1).									

Word	What it means	How to answer	Example
Give, Name or Write down	A short answer only: a word, phrase, value or equation. No explanation is needed.	Answer briefly and precisely. If the question asks for two, give exactly two.	Name the particle emitted from the nucleus in beta decay. [1 mark] A high-speed electron (1) Write down the equation that links weight, mass and gravitational field strength. [1 mark] $\text{weight} = \text{mass} \times \text{gravitational field strength}$ (1)
Choose or Identify	Select an answer from options given, or pick out a particular feature, value or item from the information.	Give one clear answer. If the words come from a box, use them exactly as written.	A student investigates how the length of a wire affects its resistance. Identify the independent variable. [1 mark] The length of the wire (1)
Define	State the precise meaning of a term.	Learn the key definitions word for word, including any conditions, such as 'per kilogram' or 'with no change in temperature'.	Define specific latent heat. [1 mark] The energy needed to change the state of 1 kg of a substance with no change in temperature (1)
Complete or Label	Complete: fill in the gaps in a table, sentence, diagram, graph or equation. Label: add the correct names to parts of a diagram.	Fill in every gap and write answers where the space is provided. When labelling, make each label line touch the exact part you mean. In nuclear equations, check the numbers balance.	Complete the nuclear equation for the alpha decay of uranium-238: ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{Th} + \text{---}$ [1 mark] ${}^4_2\text{He}$ (1), because $238 = 234 + 4$ and $92 = 90 + 2$
Draw or Sketch	Draw: produce or add to a diagram accurately. Sketch: draw roughly, showing the correct shape and key features of a graph or diagram without plotting points.	For a drawing, use a ruler and the standard symbols. For a sketch, label the axes and show the shape clearly: where the line starts, whether it is straight or curved, and where it levels off.	Sketch the current–potential difference graph for a diode. [2 marks] For negative potential differences the line stays on the axis, showing no current (1). Above a small positive potential difference the current rises steeply (1). 
Plot	Mark data points accurately on a	Plot each point within half a small square as	A student's results are shown below.

Word	What it means	How to answer	Example												
	graph grid.	a small cross, then draw a line of best fit if you are asked to.	<table><tr><td>Force in N</td><td>0</td><td>1.0</td><td>2.0</td><td>3.0</td><td>4.0</td></tr><tr><td>Extension in cm</td><td>0</td><td>2.1</td><td>4.0</td><td>6.1</td><td>8.0</td></tr></table> Plot the results on a graph grid and draw a line of best fit. [3 marks] All points plotted correctly (2), or (1) if one point is wrong; a single straight line of best fit (1).	Force in N	0	1.0	2.0	3.0	4.0	Extension in cm	0	2.1	4.0	6.1	8.0
Force in N	0	1.0	2.0	3.0	4.0										
Extension in cm	0	2.1	4.0	6.1	8.0										
Measure	Find a value directly, usually from a diagram, with a ruler or protractor.	Measure to the nearest millimetre or degree, give the unit, and apply any scale stated on the diagram.	Measure the angle of incidence of the ray.  [1 mark] Place the centre of the protractor where the ray meets the surface and measure from the normal, not from the surface: 35° (1)												
Plan or Design	Plan: write a method. Design: set out how something will be done, such as an investigation or a piece of apparatus.	Give the equipment, the variables, numbered steps saying what you measure and how, repeats, a safety point, and how you will use the results.	Plan an investigation into how the mass of a trolley affects its acceleration when the pulling force stays the same. [6 marks] A top-level answer: pull the trolley with a string over a pulley attached to the same hanging mass, so the force stays constant; measure the acceleration with light gates; add masses to the trolley in equal steps, e.g. 0.20 kg; repeat each run three times and find the mean; plot acceleration against mass.												
Use	Your answer must be based on the information given in the question; without it you can't get the marks. Sometimes you also need your own knowledge.	Quote the figures or facts provided and show how you used them. Add physics you know only if the question also asks for it.	The count rate of a radioactive sample is 800 counts/min at the start, 400 counts/min after 5 minutes and 200 counts/min after 10 minutes. Use the data to predict the count rate after 15 minutes. [2 marks] The count rate halves every 5 minutes (1), so after 15 minutes it is 100 counts/min (1).												

Exam tips

Preparing in the weeks before

- List every subtopic for each paper (Paper 1: Energy, Electricity, Particle model, Atomic structure; Paper 2: Forces, Waves, Magnetism and electromagnetism, Space physics) and rate each one red, amber or green. Revise red first, re-rate every week, and keep revisiting green topics so they stay secure.
- Don't leave Energy and Electricity behind after Paper 1: Paper 2 questions can use energy transfers, efficiency and conservation of energy too.
- Learn every equation in words and symbols with the unit of each quantity, and practise rearranging each one for every quantity in it. Do this over weeks, not the night before.
- Know all 10 required practicals: the aim, the equipment, a numbered method, the independent, dependent and control variables, how you process the results, one hazard with its precaution, and the shape of graph you expect.
- Answer questions rather than reread notes. Flashcards, writing out everything you know about a topic on a blank page, and timed questions build memory far better than highlighting.
- Mark every practice answer against a mark scheme and write down exactly which marking point you missed: the unit, a key word, a step of working or the comparison.
- Mix topics within a session (for example 20 minutes of circuit calculations then 20 minutes of waves) so you practise choosing the right physics, as you must in the exam.
- Keep a mistakes list, one line per slip (for example: forgot to square the speed in $\frac{1}{2}mv^2$), and read it before every practice paper.
- In the final weeks, sit at least one full timed Paper 1 and one full timed Paper 2 in exam conditions, with only a calculator, a ruler, a protractor and the equation sheet.

The night before and the morning of the exam

- Check which paper it is and which topics it covers, so you revise the right half of the course.
- Keep the night before light: your equation list with units, your mistakes list, the key definitions and the five required practicals for that paper. Don't start new topics.
- Pack black pens (and spares), a sharp pencil, an eraser, a 30 cm ruler, a protractor and the scientific calculator you have practised with all year, with a working battery.
- Sleep properly. Tiredness causes misreading and arithmetic slips, which cost more marks than a late night of cramming could gain.
- Eat breakfast, arrive early and warm up with five minutes of flashcards on equations, units and definitions rather than trying to relearn a topic.
- Check your calculator is in its normal display mode (not set to a fixed number of decimal places) and clear its memory if your school asks you to.

The first five minutes

- Fill in the front cover, then read the instructions: answer every question in the spaces provided, in black ink, with pencil only for graphs and diagrams. There is no choice of questions.
- Flick through the whole paper to see how many questions there are and where the longer 6-mark questions sit, so nothing surprises you later.
- Put the Physics Equations Sheet beside the paper and glance down it so you know where each equation is.
- Write your checkpoint times at the top of the first page: about 50 marks done by 48 minutes, and start checking at about 95 minutes.
- Start with question 1. The early questions tend to be more straightforward and help you settle. If something looks hard, read it once fully, write what you know and move on.

Timing

- Each paper gives you 105 minutes for 100 marks: just over a minute per mark. The marks for each part are shown in square brackets, so use them as your clock: a 3-mark part is worth about 3 minutes.
- Work at just under a minute a mark to finish at about 95 minutes and leave 10 minutes to check. Checkpoints: about 25 marks by 24 minutes, 50 by 48 minutes and 75 by 71 minutes.
- Recall and multiple-choice marks should take seconds, which banks time for calculations and 6-mark answers.
- Give a 6-mark question 6 to 8 minutes, including a minute to plan.
- If a part has taken twice its marks in minutes and you're not close, write down what you have (the equation, a substitution, one fact), star it and move on.
- Parts of a question often build on each other, but later parts are usually still possible even if you missed an earlier one. Always try them: a wrong earlier answer used correctly can still earn the later marks.
- Never leave a blank. A multiple-choice guess, a correct equation or a single relevant fact can score.

Reading the question

- Underline the command word and the quantity asked for, e.g. 'Calculate the **resistance** of the lamp'.
- Circle each number with its unit and spot units that need converting before you use them: g, kJ, cm, cm², minutes, hours, mA, kΩ.
- Look for instructions that carry or cost marks: 'Give your answer to 2 significant figures', 'Give the unit', 'Use data from Figure 3', 'in terms of particles', 'Tick two boxes', and any word in bold such as **not**.
- Read the stem and any table or figure before the question. Information given at the start (the mass of the trolley, the specific heat capacity of water) is often needed several parts later.
- Use the marks as a guide to length: 1 mark is one point, a 2-mark 'explain' is a point plus its reason, a 3-mark answer needs three distinct points or a chain of three steps. The lines given are a guide too.
- Answer in the context given. If the question is about an electric kettle, write about the kettle; a general textbook paragraph that ignores the context rarely gets full marks.
- When you finish, reread the question and check you answered it in the form asked: a value with a unit, a comparison, a reason, a named variable.

Multiple-choice questions

- Most say 'Tick one box'; some say 'Tick two boxes'. Ticking more boxes than asked scores zero for that question.
- Read all the options before ticking. Rule out the ones you know are wrong: an option with the wrong unit or the wrong kind of quantity can often be crossed out straight away.
- For a calculation, work it out on the paper first, then find your answer among the options. Wrong options are often the result of a common slip (not squaring, not converting g to kg), so check your working before ticking.
- Watch for 'Which is **not**...' and 'Which two...' questions; the key word is easy to miss when you are rushing.
- If you change your mind, cross out the first tick completely and tick the new box, so only one answer is visible.
- Never leave one blank. If you're down to two options, pick one: a guess can score, a blank cannot.

Short written answers

- 'Give', 'name' and 'write down' need a word, phrase, value or equation, not sentences. Answer and move on.
- 'Describe' asks what happens or what a pattern is; 'explain' asks why. An 'explain' answer with no 'because' or 'so' usually has no reason in it.
- For a 2-mark explanation, give a statement and link it to its effect, e.g. 'as the temperature increases the resistance of the thermistor decreases, so the current increases'.
- When describing a pattern in data, give the direction and quote values with units, e.g. 'as the length of wire increased from 20 cm to 80 cm the resistance increased from $1.2\ \Omega$ to $4.8\ \Omega$ '.
- Use exact physics terms: current **through** a component, potential difference **across** it; energy **transferred** to a named store; energy **dissipated**, not 'lost'; particles move faster, they don't get bigger.
- For 'compare', make each point a comparison using words such as 'more', 'less' or 'both', e.g. 'alpha is more ionising than gamma', not two separate descriptions.
- If you are asked for two things, give two. Adding a wrong extra answer can cancel a right one.

Equations: recall, choose and rearrange

- The specification lists equations you must recall and apply, such as $W = mg$, $F = ma$, $s = vt$, $E_k = \frac{1}{2}mv^2$, $E_p = mgh$, $P = E/t$, $Q = It$, $V = IR$, $P = VI$, $P = I^2R$, $E = QV$, $\rho = m/V$ and $v = f\lambda$, and others that are printed on the Physics Equations Sheet, such as $\Delta E = mc\Delta\theta$, $E = mL$, $E_e = \frac{1}{2}ke^2$, $v^2 - u^2 = 2as$, $F = BIL$ and $V_p/V_s = n_p/n_s$.
- Check with your teacher which equations are on the sheet in your exam, but learn them all anyway: recalling an equation instantly is quicker and safer than hunting for it.
- Learn each equation with its units, e.g. power (W) = energy transferred (J) $\div$ time (s). Knowing the units lets you check which equation fits the data you're given.
- Practise rearranging until it's automatic, including equations with squares ($E_k = \frac{1}{2}mv^2$ for v) and more than one step ($v^2 - u^2 = 2as$ for a or s). Either rearrange first or substitute first, but write every step.
- When no single equation gets you there, find the quantity that links two equations, e.g. a heater's energy from $E = Pt$, then the temperature rise from $\Delta E = mc\Delta\theta$.
- 'Write down the equation that links...' is a recall mark: write it in words or standard symbols. A correct rearrangement is normally accepted; an equation with numbers in it instead of quantities is not.

Calculations and method marks

- Set out every calculation the same way: equation, substitution with units converted, rearrangement, answer with unit.
- A correct final answer usually earns full marks, but a wrong answer with no working earns nothing. With working shown, the correct equation, substitution and rearrangement can earn marks even if the arithmetic slips.
- Errors carry forward: if you use your own wrong answer from an earlier part correctly in a later part, you can usually still get the later marks.
- 'Show that' questions give the answer, so the marks are for the working: show every step and give your answer to one more significant figure than the value shown (e.g. 4.17 when asked to show it is about 4.2). If you can't get there, use the given value in the next part.
- Write any values you read from a graph or table into your working, so the examiner can follow your method.
- Keep full calculator values through a multi-step calculation and round only the final answer.
- Sense-check the size of every answer: a walking speed of 300 m/s, a kettle power of 2 W or an efficiency greater than 1 means something has gone wrong, usually a unit conversion.

Units, significant figures, standard form and your calculator

- Convert to SI units before substituting: g to kg ($\div 1000$), cm to m ($\div 100$), cm^2 to m^2 ($\div 10\,000$), cm^3 to m^3 ($\div 1\,000\,000$), kJ to J ($\times 1000$), minutes to s ($\times 60$), hours to s ($\times 3600$), mA to A ($\div 1000$), k Ω to Ω ($\times 1000$).
- Know the prefixes: tera 10^{12} , giga 10^9 , mega 10^6 , kilo 10^3 , centi 10^{-2} , milli 10^{-3} , micro 10^{-6} , nano 10^{-9} .
- Know the unit of every quantity: J, W, N, Pa, C, A, V, Ω , Hz, m/s, m/s^2 , kg/m^3 , N/m, J/kg, $^\circ\text{C}$, J/kg, kg m/s, N m, T and Bq. When the question says 'Give the unit', there is a mark for it.
- Give the significant figures asked for. If none are specified, match the data in the question, usually 2 or 3 significant figures, and don't round to 1 significant figure without a reason.
- For standard form use the $\times 10^x$ key (it may be labelled EXP). Typing ' $\times 10 \wedge$ ' can go wrong when you divide by the number, e.g. $6.0 \div 3.0 \times 10^8$.
- Use brackets: square only the speed in $\frac{1}{2}mv^2$, put the whole fraction under the square root when you find v , and bracket the bottom of any fraction you type in one go.
- Use the Ans key to carry unrounded values between steps. If you do write an intermediate value down, keep at least 4 significant figures.
- Practise with the same calculator all year so you know where the keys are, and check it gives a sensible answer to a sum you can do in your head.

Graphs, tables and data

- Plotting: choose a scale that uses at least half the grid in each direction, in steps of 1, 2, 5 or 10 per square (never 3), and plot each point as a small neat cross within half a small square.
- Label both axes with the quantity and unit, e.g. 'Extension in cm', with the independent variable on the x-axis.
- Draw a single line of best fit, straight or a smooth curve, with points spread evenly either side. Circle and ignore anomalies, and never join dot to dot.
- A straight line through the origin shows the variables are directly proportional; a straight line that doesn't pass through the origin is linear but not proportional.
- Gradient: draw a large triangle on the line and work out change in $y \div$ change in x , with a unit. On a distance–time graph the gradient is speed; on a velocity–time graph it is acceleration.
- For a curved distance–time graph, draw a tangent at the time asked for and find its gradient to get the speed at that instant. The area under a velocity–time graph is the distance travelled: split it into triangles and rectangles, or count squares for a curve. **Grade 7+ only**
- When reading off a value, draw ruled lines from the axis to the graph and across, and check what one small square is worth on each axis first.
- Tables: head each column with the quantity and unit, leave anomalies out of a mean, and give the mean to the same resolution as the readings.
- When interpreting data, describe the pattern (including where it changes), quote values with units and use the form 'as x increases, y ...'.

Drawing diagrams

- Use a sharp pencil and a ruler for every straight line. A clear diagram can earn marks; an ambiguous sketch can't.
- Circuit diagrams: use the standard symbols exactly (cell, battery, switch, lamp, fuse, resistor, variable resistor, diode, LED, LDR, thermistor, ammeter, voltmeter), leave no gaps in the wires, and put the ammeter in series and the voltmeter in parallel with the component.
- Ray diagrams: draw rays as ruled lines with arrows showing the direction of travel, draw the normal as a dashed line at 90° to the surface, and measure every angle from the normal.
- Lens diagrams: draw the principal axis and mark the principal focus on each side. For a convex lens, a ray parallel to the axis passes through the principal focus and a ray through the centre of the lens carries straight on. For a concave lens, the parallel ray spreads out as if it came from the principal focus on the object's side. Say whether the image is real or virtual, upright or inverted, magnified or diminished.
- Magnetic field lines go from north to south, never cross, carry arrows and are closer together where the field is stronger. Know the patterns around a bar magnet, a straight wire carrying a current and a solenoid.
- Force diagrams: draw each force as an arrow from the object with its length in proportion to the size of the force, and label each one (weight, normal contact force, friction, air resistance, thrust).
- Vector diagrams: draw forces to scale, tip to tail, to find a resultant force, or to resolve one force into two components at right angles. State your scale and measure lengths and angles carefully. **Grade 7+ only**
- Waves: mark the wavelength from one peak to the next and the amplitude from the undisturbed position to a peak, not from peak to trough.
- Nuclear equations: mass numbers and atomic numbers must balance on both sides. An alpha particle is written ${}^4_2\text{He}$ and a beta particle ${}^0_{-1}\text{e}$

Six-mark extended answers

- These are marked in levels, not by counting points. The examiner reads the whole answer, places it in Level 1 (1 to 2 marks), Level 2 (3 to 4) or Level 3 (5 to 6), then decides the mark within the level. Level 3 needs a detailed answer with a clear, logical order that covers everything the question asks.
- Spend a minute planning. Underline every task in the question (e.g. 'describe a method' AND 'explain how the results would be used'), then jot your key points in order in the margin.
- For 'describe a method' or 'plan', write numbered steps: the equipment, what you change and how, what you measure and with which instrument, what you keep the same, repeats, and how you use the results (mean, graph, equation). Someone else should be able to follow it.
- For 'explain', build chains of reasoning with 'so' and 'because', e.g. 'the gas particles gain kinetic energy, so they move faster, so they hit the walls more often and with more force, so the pressure increases'.
- For 'compare' or 'evaluate', cover both sides and finish with a conclusion that is justified by the information given.
- Use the context and data in the question. A generic answer that could have been written without reading the question rarely reaches Level 3.
- If the question has bullet points listing what to include, cover every one.
- Write in clear sentences or numbered steps. There are no marks for an introduction or for copying out the question.

Required practicals and working scientifically

- At least 15% of the marks come from the 10 required practicals (five on each paper) and the skills behind them. You can be asked to write a method, name variables, give a hazard, process results, plot or interpret a graph, or evaluate an unfamiliar method.
- Paper 1 practicals: specific heat capacity, thermal insulation, resistance, I–V characteristics and density. Paper 2 practicals: force and extension, acceleration, waves, light, and infrared radiation and absorption.
- Variables: independent (what you change), dependent (what you measure) and control (what you keep the same). Be specific: 'the length of the wire', not 'the wire'.
- Know the terms exactly: **accurate** (close to the true value); **precise** (repeat readings close together); **repeatable** (the same person with the same method and equipment gets similar results); **reproducible** (a different person, method or piece of equipment gets similar results); **resolution** (the smallest change an instrument can show); **valid** (the method actually answers the question).
- Random errors make readings scatter unpredictably: repeat and take a mean to reduce their effect. Systematic errors shift every reading the same way, such as a zero error on a balance: repeating doesn't help, so check or recalibrate the instrument.
- Estimate uncertainty as half the range of the repeat readings: readings of 2.3 s, 2.5 s and 2.4 s give a mean of $2.4 \text{ s} \pm 0.1 \text{ s}$.
- Improvements must be specific and justified: 'use light gates instead of a stopwatch, which removes the effect of human reaction time', not 'use better equipment'.
- Hazards: name the hazard, the risk and the precaution, e.g. 'the resistance wire gets hot and could burn you, so switch off between readings' or 'the masses could fall on your feet, so keep feet clear and put a cushion underneath'.
- Learn the typical graph for each practical, e.g. extension against force is a straight line through the origin up to the limit of proportionality; a filament lamp's current–potential difference graph curves because its resistance increases as it heats up.

Checking, getting stuck, extra space and crossing out

- When stuck, write what you know: the quantities given with units, the equation that uses them, a labelled sketch. That often earns the first mark and shows you the next step.
- Let the data point to the physics: a mass and a speed suggest kinetic energy; a power and a time suggest energy transferred.
- Star anything you skip and come back at the end; a second look with fresh eyes often works.
- Check calculations first: re-enter them into the calculator, then check unit conversions, the unit on the answer and the significant figures.
- Then check every part has an answer (including every multiple-choice question) and that each answer does what its command word asks.
- If you run out of space, use the extra pages at the back of the booklet, write the question number clearly there, and write 'continued on extra page' next to the original answer.
- Only cross out work once you have written something better, with a single neat line. Crossed-out work that hasn't been replaced may still be marked, but two different answers left side by side can cost you the mark.

Learning from your mocks

- After each mock, sort every lost mark by cause: didn't know the physics, misread the question, slipped in a calculation or unit, wrote a weak 6-mark answer, or ran out of time. Each cause needs a different fix.
- For knowledge gaps, relearn the subtopic from notes, then do a short set of questions on it within a week.
- For misreading and slips, add each one to your mistakes list and read it before the next paper.
- For timing, write checkpoint times on the first page next time and practise sections against a timer.
- For 6-mark answers, compare yours line by line with the mark scheme's indicative content and rewrite it as a Level 3 answer.
- Redo every question you dropped marks on about a week later without looking at the answer. Count it as fixed only when you get full marks.
- Track your score for each topic across mocks, not just your total, so you can see which topics are improving and which need more time.

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