IGCSE Physics 0625 — Paper 2 (Extended) MCQ Survival Guide

Where Cambridge Extended candidates drop marks, and the technique to win them back.

Built from every Paper 2 examiner report 2021–2025 (Extended variants 0625/21, /22, /23). Brought to you by CIE Insider.

How to use this guide

This is a map of the **specific traps** Cambridge examiners flag in Extended MCQ every year. Paper 2 sits above Paper 1 — the calculations are heavier, the wrong answers are more sophisticated, and the marks lost are the marks that separate A* from A.

You've already learned the physics. This guide focuses on the **places examiners say candidates lose easy marks**: vector signs they ignore, formulas they invert, units they don't convert, conservation laws they half-apply.

Read it twice in your last fortnight. Look at the last-week checklist on exam morning.

The paper at a glance

- **40 multiple-choice questions, 45 minutes** — just over **a minute per question**.
- Four options (A, B, C, D). One correct. **No negative marking** — never leave a blank.
- Three variants (21, 22, 23) sit in each main series. Examiners flag identical misconceptions across variants every single year.
- Topic spread: Motion & Forces (heavier on momentum/impulse than Core), Pressure & Thermal Physics (Boyle's law, kinetic model), Waves & Optics (Snell's law, refractive index), Electricity & Magnetism (Lenz's law, transformers, $R \propto L/A$), Atomic & Space.

Extended questions reward **precision**: sign conventions, vector direction, exact formulas. The most-flagged sentence in 5 years of reports is some version of: "candidates did not consider direction" or "candidates did not convert the units".

The Top 10 Mistakes That Cost Extended Candidates Marks

Ranked by frequency across 15 series of examiner reports. These are the kills that show up paper after paper.

1. Momentum is a **vector** — sign matters on rebounds

> `Flagged every series since Jun 2021.`

When a ball bounces back, the change in momentum is the **difference between two vectors in opposite directions**. If initial velocity is +30 m/s and rebound is –20 m/s:

- Change in momentum = m × (–20 – 30) = m × (–50)
- Magnitude of change = **50** m/s × m, **not** 10.

The fix: Always set a positive direction first. Treat anything in the opposite direction as **negative**. Then subtract.

This appears in Jun 2021, Mar 2021, Jun 2022, Nov 2023, Jun 2024, Mar 2025, Jun 2025 — and it is still being flagged.

2. Snell's law — take the **sines** of the angles

> `Flagged every June series and most others.`

`n = sin i / sin r` — not `i/r`, not `r/i`, not the angles measured from the surface.

Watch the geometry too: angles are measured **from the normal** (the dashed perpendicular line). If a diagram gives you the angle from the surface, **subtract from 90°** before using it.

Also link the two formulas: `n = sin i / sin r` AND `n = 1 / sin c` (where c is the critical angle).

3. Background count rate — three-step rule

> `Flagged in Nov 2021 (3 variants), Jun 2023, Nov 2023, Jun 2024, Jun 2025 (3 variants). The most-flagged single error in Paper 2.`

When a count rate question gives you a non-zero background, you must:

1. **Subtract** the background from the initial reading.
2. **Halve** the result for each half-life that has elapsed.
3. **Add** the background back at the end (if asked for total measured rate).

The common error patterns:

- Forget to subtract → wrong starting value.
- Subtract but forget to add back → answer too low by exactly the background amount.

- Take the mean count over a 10-minute interval but forget to divide by 10 to get count **rate** (per minute) before doing anything else.

4. Wire resistance scales with **diameter squared**

> Flagged Mar 2024, Jun 2024, Nov 2024, Mar 2025, Jun 2025, Nov 2025.

$R \propto L / A$, and $A \propto d^2$. So:

- Double the diameter → area × 4 → resistance × ¼
- Quarter the diameter → area × 1/16 → resistance × 16

The trap: A common wrong move is treating the diameter relationship as **linear** (doubling d halves R). Always go via area.

5. Boyle's law: $pV = constant$ — **inversely** proportional

> Flagged Jun 2024 (P21 + P22), Mar 2025, Nov 2025.

$pV = constant$ means: double the volume → pressure halves. **Inversely** proportional, **not** directly proportional. Candidates who pick "directly proportional" lose this mark in droves.

Also: **at constant temperature**, the **kinetic energy** of gas particles is **unchanged** even when volume changes. Particle speed doesn't change either. Only the average spacing changes.

6. Transformer iron core carries **magnetic flux**, not current

> Flagged Jun 2023 (P21 + P22), Jun 2025.

The iron core is a high-permeability path for the **changing magnetic field** between primary and secondary coils. It does **not** carry electric current between coils.

Adjacent traps:

- **Transformer needs a.c. on the primary.** DC produces no changing flux → no induction → no output. To convert a.c. to d.c. you need a **diode** (rectifier), not a transformer.
- **Thicker copper wire = more efficient transformer** (lower resistance → less heat loss). Thin wire is **wrong**.
- **Power equation:** $I_pV_p = I_sV_s$ (ideal). Less well-known than the turns-ratio $N_p/N_s = V_p/V_s$. Know both.

7. Lenz's law — induced EMF **opposes** the change

> Flagged Jun 2022, Mar 2023, Nov 2023 (all variants).

When a magnet approaches a coil, the induced current flows in whichever direction creates a magnetic pole that **repels** the approaching magnet. When the magnet moves away, the induced current reverses to create a pole that **attracts** the receding magnet — opposing the change.

Adjacent rules:

- **Fleming's right-hand rule** for generators / induced current.
- **Fleming's left-hand rule** for motors / force on a current-carrying wire.
- Maximum induced EMF in an a.c. generator = when the **flux is changing fastest** (coil parallel to field). Zero EMF when flux is at its maximum (coil perpendicular to field).

8. Beta emission is a **nuclear** process — neutron → proton + electron

> `Flagged Mar 2025, Nov 2025.`

The beta particle is **not** an electron from an outer shell. Inside the nucleus, a neutron decays into a proton + an electron. The electron is ejected from the **nucleus** at high speed.

After β^- decay: nucleon number unchanged, proton number **+1**, neutron number **–1**. After α decay: nucleon number **–4**, proton number **–2**, neutron number **–2** (not –4!).

The neutron-vs-nucleon confusion is the second most-flagged radioactivity error.

9. Newton's 2nd law on a spring: weight matters too

> `Flagged Jun 2025 P22.`

When a mass is suspended from a spring, the resultant upward force is `T − W` (tension minus weight). Many candidates use the tension alone and miss the weight. The signature error: forgetting that gravity is still acting even when the spring is in tension.

10. Unit prefixes in `E = VIt`, `P = IV`, `Q = It` — **mA** → **A** and **min** → **s** every time

> `Flagged Nov 2024, Mar 2025, Jun 2025, Nov 2025.`

If a question gives current in milliamps, you must convert to amps before the formula. If time is in minutes, convert to seconds. If power is in kilowatts, convert to watts. **Both** conversions are often needed in the same question (e.g. `E = VIt` with mA AND minutes).

The signature wrong answer: off by a factor of 1000 or 60 — the classic "I did the physics, I just forgot the unit" error.

Topic-by-topic pitfalls (Extended-specific)

Motion, Forces and Momentum

- **Free fall: constant acceleration g.** Same as Core — flagged in Extended every series too.
- **Terminal velocity:** drag = weight → zero resultant force → zero acceleration → constant velocity. Not zero velocity.

- **Circular motion** (mentioned at Extended level): velocity direction is constantly changing → object is accelerating → there must be a resultant **centripetal** force pointing toward the centre.
- **Conservation of momentum:** total momentum before = total momentum after. **Always** in collisions and explosions. Even in inelastic collisions.
- **Conservation of kinetic energy:** in **elastic** collisions only. Inelastic = KE is converted to heat / sound / deformation. In an **explosion**, total KE **increases** (from chemical energy released).
- **Impulse = change in momentum = F × t.** Impulse is not change in momentum divided by time — that would be force.
- **Pendulum at the lowest point of its swing:** at the bottom, the bob is momentarily neither rising nor falling. Its vertical velocity is zero at the top (extremes), maximum at the bottom.

Pressure and Density

- `p = ρgh` for pressure in a liquid. The pressure depends on **depth and density only** — not on the volume or surface area of the liquid.
- `p = F/A` for solids on surfaces — not F × A, not F ÷ volume. Pressure has units of Pa (= N/m²).
- **Atmospheric pressure at altitude** = atmospheric pressure at base **minus** the change. Don't stop at Δp.
- **Floating:** an object floats if its density is **less** than the liquid's density. Compare densities, not masses.

Thermal Physics and Kinetic Model

- **No temperature change during melting / boiling / condensing.** Energy goes into bond-breaking.
- **At constant volume:** heating → particle speed and KE rise; pressure rises; particle **separation unchanged**.
- **At constant pressure** (movable piston): heating → temperature rises, volume rises, pressure unchanged.
- **At constant temperature** (isothermal): pressure × volume = constant. Particle speed and KE **don't** change.
- **Specific heat capacity** = energy per **kg** per °C. **Thermal capacity** = energy for the **whole object** per °C. Different quantities.
- **Specific heat capacity has nothing to do with thermal conductivity.** Conductivity is about how fast energy flows through; SHC is about how much energy is stored per kg per °C.
- **Evaporation cools** the remaining liquid. Most energetic molecules escape → average KE of remainder drops.

- **Brownian motion:** random zigzag because of **bombardment by small fast invisible molecules**. Not a density effect.

Waves, Sound and Optics

- **Refraction:** speed and wavelength change. **Frequency does not**.
- **Snell's law:** `n = sin i / sin r`. Equivalently, `n = 1 / sin c` (critical angle).
- **TIR conditions:** light travelling from **denser to less dense** medium (glass → air, not air → water), at angle > critical angle. Above critical → no refracted ray.
- **Optical fibres:** lower speed of light in glass → higher refractive index → smaller critical angle → easier to achieve TIR.
- **Converging lens (magnifying glass):** for a real enlarged image, the object must be between **f and 2f**. Object **at** f produces parallel rays (no image). Object inside f gives a virtual enlarged image.
- **Short-sightedness corrected with a diverging lens.** Long-sightedness corrected with a converging lens.
- **Diffraction:** wavelength comparable to gap size → maximum diffraction. Longer wavelength → more diffraction. Amplitude has no effect.
- **Ultrasound is a longitudinal wave** (higher frequency than audible sound, but still mechanical / longitudinal).
- **Digital signal** = two discrete states (0 and 1). **Analogue signal** = continuously variable.
- **EM waves in vacuum: all travel at the same speed c.** In a medium, different EM waves can travel at different speeds.

Electricity, Circuits and Electromagnetism

- **Resistance = V/I.** Not the gradient of an I-V graph for non-ohmic conductors.
- **Filament lamp:** R increases as temperature rises → I-V graph curves over.
- **Diode:** current flows one way only. In a circuit, identify which direction the current would flow; if it opposes the arrow, no current.
- **LDR:** brighter light → lower resistance.
- **Thermistor:** higher temperature → lower resistance. So in a potential divider, hotter thermistor → smaller share of the supply voltage → less PD across the thermistor → more PD across the fixed resistor.
- **Wire resistance:** `R ∝ L/A`. Double L → double R. Double diameter → R ÷ 4.
- **Logic gates:** NAND + NOT inverters can be combined to make OR (and similar combos). Trace the inputs through one gate at a time.
- **a.c. generator:** maximum EMF when flux is changing fastest (coil parallel to field, sweeping through it). Zero EMF when coil is perpendicular to field (flux at max, momentarily stationary).

- **Fleming's left-hand rule (motor effect):** thumb = force, first finger = field, second finger = current. Force on a current-carrying conductor in a magnetic field.
- **Fleming's right-hand rule (generator):** same fingers, used for induced current in a moving conductor.
- **Force on negative charge** (e.g. electron) in an electric field: opposite to the field direction.
- **Electric field direction** = direction of force on a **positive** test charge.

Atomic, Nuclear and Space

- **Alpha decay:** A↓4, Z↓2. Helium nucleus emitted. Highly ionising, stopped by paper.
- **Beta$^-$ decay:** A unchanged, Z↑1. Neutron → proton + electron. Stopped by aluminium.
- **Gamma decay:** A, Z unchanged. Stopped only by thick lead/concrete. Least ionising.
- **Rutherford alpha scattering** tells us: nucleus is **small, dense, positive**. It does **NOT** tell us about neutrons (the neutron wasn't even discovered yet).
- **Nuclear fission**: heavy nucleus splits, triggered by a **neutron**. Used in nuclear power stations.
- **Nuclear fusion**: light nuclei (hydrogen) combine into helium. Powers the **Sun and stars**.
- **Mass deficit:** in both fission and fusion, total mass of products is **less** than the original — the missing mass is released as energy ($E = mc^2$ — though you won't need the equation at 0625).
- **Half-life uses:** medical tracers want short half-lives; sterilisation (gamma) wants hours; archaeological dating uses long half-lives.
- **Radioactive thickness gauge:** choose a source whose radiation is **partially absorbed** by the material. Alpha is stopped by paper, so it's wrong for paper measurement — use **beta**.
- **Hubble's Law:** $v = H_0 d$. Recession velocity is **directly** proportional to distance. H_0 has units of **s^{-1}** (m/s ÷ m).
- **Star lifecycle endpoint depends on mass:**
  - Low/medium-mass: red giant → white dwarf.
  - High-mass: red supergiant → **supernova** → neutron star or black hole.
- **Comet orbits** are highly elliptical; the Sun is at **one focus** of the ellipse, not the centre.
- **Orbital speed** `v = 2πr / T` (circumference ÷ period). Use 2πr, not r.
- **Light-year** ≈ 9.5×10^{15} **metres**. Convert correctly when given a distance in light-years.

Universal MCQ technique (Extended edition)

The Core technique applies — plus a layer of extra precision for Extended.

1. Cover the options. Always.

Calculate cleanly before peeking. Trial-and-error from options is the #1 examiner gripe at every level.

2. Set a positive direction before any vector calculation.

Momentum, velocity, acceleration, impulse, force balance — write a small arrow on the question paper showing which way is positive. Then sign every quantity.

3. Write the formula symbolically, then substitute.

`n = sin i / sin r` (with the inversion clearly shown) prevents the very common Snell's-law flip.

4. Eliminate the impossible.

- Negative resistance? Impossible.
- Parallel resistors greater than either input? Impossible.
- Refracted-angle answer when angle > critical? Impossible (TIR only).

5. Magnitude check.

- Speed of sound in air ≈ 340 m/s. Speed of light = 3×10^8 m/s. Speed of EM waves in any vacuum context = 3×10^8 m/s.
- Density of water = 1000 kg/m³. Density of air ≈ 1.2 kg/m³.
- `g` = 9.8 m/s² (often rounded to 10).
- Adult mass ≈ 60–80 kg.

6. Underline command words.

NOT, EXCEPT, ONLY, BEST. Every question. The negation traps catch even strong candidates when they're rushed.

7. Multi-step problems: do the steps in order.

Examiners flag candidates who **start the calculation** but stop one step short. Background subtraction → halve → add back. Pressure question → calculate Δp → subtract from atmospheric → get final.

8. Don't leave blanks.

No negative marking. If you've eliminated two, guess between the other two.

The trap-spotter — distractor patterns (Extended)

PATTERN	HOW IT LOOKS	HOW TO BEAT IT
Sign ignored	Two velocities given, options add them; you should subtract (or vice versa)	Set + direction, sign each quantity, then combine
Formula inverted	Option uses `r/i` instead of `i/r` for refractive index, or `t/n` for period instead of `nT/t`	Always write the formula in symbols before substituting
Unit prefix off	mA treated as A; kV treated as V; cm^3 treated as m^3	Convert everything to SI **before** substituting
Half / double missed	Echo / round-trip / two half-lives missed	Read the situation: is the time given one-way or there-and-back?
Forgot to add background back	All three steps done except step 3	Always check: is the question asking for source rate or total rate?
Right physics, missed a force	Resultant force calculation with three forces (weight, tension, upthrust) — only used two	List ALL forces before combining
Confused linear vs square law	Doubling diameter halves R (wrong — quarters it)	Always go via area: $A \propto d^2$, so $R \propto 1/d^2$
Confused rule	Used left-hand rule for generator instead of right-hand	Motor = left; generator = right
Real vs virtual image	Diverging lens or plane mirror question says "real"	Plane mirror = virtual. Diverging lens = virtual. Converging lens beyond f = real.
Mass instead of weight	Work done question uses mass × distance instead of weight × distance	If lifting against gravity: use weight (mg). Horizontal work: use applied force.

Last-week checklist

Tick each one when you can do it cold without notes.

Vectors and signs

- [ ] Always set positive direction first
- [ ] Rebound velocity is negative (or positive if outgoing was negative)
- [ ] Change in momentum = mv_after – mv_before (signed)
- [ ] Impulse = Ft = Δ(mv)

Pressure and density

- [ ] `p = F/A` , `p = ρgh` , atmospheric pressure – Δp at height
- [ ] Float comparison uses densities
- [ ] Volume conservation in connected containers (when gas expands)

Thermal

- [ ] Boyle's law: pV constant → inversely proportional
- [ ] KE of gas particles depends ONLY on temperature
- [ ] Solid → liquid: small change in spacing. Liquid → gas: large.
- [ ] Specific heat capacity per kg per °C
- [ ] Thermal capacity for the whole object
- [ ] Evaporation cools the remaining liquid

Waves and optics

- [ ] Snell's law: `n = sin i / sin r` , also `n = 1/sin c`
- [ ] Angle of incidence measured from the **normal**
- [ ] TIR: dense → less dense, above critical angle
- [ ] Frequency unchanged in refraction
- [ ] Diffraction: longer λ → more diffraction; amplitude irrelevant
- [ ] Ultrasound is longitudinal

Electricity

- [ ] `R = V/I` (not gradient for non-ohmic)
- [ ] `R ∝ L/A` (NOT L/d directly)
- [ ] Thermistor: T↑ → R↓
- [ ] Diode allows one-way current
- [ ] Logic gates: trace each gate; NAND + inverters → OR

Electromagnetism

- [ ] EMF induced by **changing** magnetic field
- [ ] Faster motion → larger induced EMF
- [ ] Transformer iron core = changing flux, not current
- [ ] Transformer needs a.c.
- [ ] Diode (not transformer) converts a.c. to d.c.
- [ ] Lenz's law: induced effect opposes the change
- [ ] Left-hand rule = motor; right-hand rule = generator

- [ ] a.c. generator max EMF at coil parallel to field (max d(flux)/dt)

Radioactivity and Nuclear

- [ ] α: A–4, Z–2; β^-: A unchanged, Z+1; γ: A, Z unchanged
- [ ] Beta = electron from nucleus (n → p + e), not outer shell
- [ ] Background count: subtract before halving, add back at end
- [ ] Mean count over 10 min ÷ 10 = count rate per minute
- [ ] Rutherford scattering: nucleus is small / dense / positive (no info on neutrons)
- [ ] Fusion = Sun; fission = power station

Space

- [ ] Hubble's law: $v = H_0 d$, directly proportional
- [ ] Orbital speed = $2\pi r / T$
- [ ] Comet orbit: ellipse, Sun at focus
- [ ] 1 light-year ≈ 9.5×10^{15} m
- [ ] Star lifecycle: protostar → main sequence → (giant/supergiant) → (dwarf/supernova → NS/BH)

Exam day habits

- [ ] Cover options, solve first
- [ ] Underline NOT / EXCEPT / ONLY
- [ ] Convert all units to SI before substituting
- [ ] Sign every vector quantity
- [ ] Multi-step problems — finish every step
- [ ] Never leave a blank

Worked example

Question: A wire of length L and diameter d has resistance R. A second wire of the same material has length 4L and diameter 2d. What is its resistance?

A. R/4 B. R C. 2R D. 4R

Solving cleanly (cover the options first):

Step 1 — relationship: `R = ρL / A`, and `A = π(d/2)² = πd²/4`. So `R ∝ L / d²`.

Step 2 — apply the changes:

– Length: × 4 → resistance × 4

- Diameter: × 2 → area × 4 → resistance × ¼

Step 3 — combine: 4 × ¼ = **1**. So the new resistance = R.

Step 4 — match: **B. R**.

Why each wrong option exists:

- **A (R/4)** — only applied the diameter effect (and treated diameter linearly as well, getting halving instead of quartering). Two errors.
- **C (2R)** — treated diameter linearly (× 2 → R ÷ 2), then combined with length × 4 → 4 × ½ = 2. Forgot the squaring.
- **D (4R)** — applied length scaling only. Forgot the diameter contribution entirely.

The trap: **$R \propto L/d^2$**, not $R \propto L/d$. This is flagged across Mar 2024, Nov 2024, Mar 2025, Jun 2025, Nov 2025 — every single year. A 4× change in length perfectly cancels a 2× change in diameter, which only happens because of the **square** in the area formula.

A final word

Extended Paper 2 is where the small mistakes compound. A missed sign on momentum, a slip on `sin/cos`, a forgotten background-add-back — each costs one mark, but they add up to grade boundaries.

The candidates who get A* are not the ones who know more physics than everyone else. They are the ones who **set positive directions, write formulas before substituting, convert all units to SI, and finish every step**.

Slow down. Read every NOT. Sign every vector. You've already done the hard work to get here.

— CIE INSIDER