IB DP PHYSICS · EXAM SPECIAL · SL & HL · CALCULATIONS, "EXPLAIN" ANSWERS AND MULTI-CONCEPT QUESTIONS · ~8 MIN READ

IB Physics Paper 2: How to Write Full-Mark Answers

How to write IB Physics Paper 2 answers that earn every mark: setting out calculations, "show that" questions, model answers for the "explain" questions examiners see go wrong, and how to tackle the long multi-concept questions.

Command terms · Calculation layout · Show that · Free-body diagrams · Explain answers · Model answers by topic · Multi-concept questions · Presentation

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No tag = **SL and HL** · HL ONLY HL students only · DATA BOOKLET given in the exam · M1 A1 how marks are awarded · highlight = comes up again and again · HANDY worth memorising · Test yourself at the end

IN 30 SECONDS

- **Paper 2 is 44% of your grade:** 90 marks at HL and 50 at SL, all structured questions.
- **The new syllabus ends Paper 2 with long multi-concept questions** that mix several topics. In May 2025 these had the most blank answers.
- **Examiners mark what is written.** A wrong final answer with no working scores zero; a wrong answer with clear working can still earn most of the marks.

BY THE END YOU CAN

- Match the length of each answer to the command term and the marks.
- Set out calculations so every method mark is visible.
- Write "explain" answers with precise physics, not a rewording of the question.
- Tackle multi-concept questions part by part.

1 Command terms decide the answer

Command term	What examiners want	Typical marks
State	A name, value or short fact; no explanation	1
Outline	A brief account: one or two linked points	2
Describe	A detailed account of what happens (no reasons needed)	2–3
Explain	**Reasons or causes**: "because...", "so..."	2–4
Calculate / Determine	A numerical answer with working	2–4
Estimate	An approximate value, with the working shown	2–3
Show that	Every step to a given answer, finishing with **more** s.f. than given	2–3
Deduce / Suggest	A conclusion from given information; a plausible idea	2–3
Sketch	The shape and key features, labelled axes, no exact scale	2–3

EXAM TIP

Count the marks. A 3-mark "explain" needs three separate, correct physics points.

2 Calculation layout

- **Line 1:** the equation, in symbols (from the data booklet or derived).
- **Line 2:** the equation with the numbers substituted, in SI units. This line earns the method mark; copying the equation alone doesn't.
- **Line 3:** the answer, with units and sensible significant figures (usually 2–3 s.f.).

WORKED EXAMPLE

A 0.20 kg ball moves in a vertical circle of radius 0.50 m. At the top its speed is 4.0 m s^{-1}. Find the normal force from the track at the top.

1. At the top both forces point **down** towards the centre: $N + mg = mv^2/r$
2. $N + 0.20 \times 9.81 = 0.20 \times 4.0^2 \div 0.50 = 6.4$
3. **$N = 6.4 - 1.96 = 4.4$ N**

COMMON MISTAKE

Writing $N - mg = mv^2/r$ at the top, or leaving out mg. **Draw a free-body diagram first**: the reports say this single step prevents most circular-motion errors.

- **Decimals, not fractions or surds:** write 0.67, not 2/3.
- **Kelvin** in every gas and thermal-radiation calculation: 27 °C = 300 K.
- **Joules or electronvolts?** Don't mix them. With photons, hc = 1240 eV nm saves time.

WORKED EXAMPLE

Light of wavelength 250 nm falls on a metal with work function 2.3 eV. Find the maximum KE of the photoelectrons.

1. $E = hc/\lambda = 1240 \div 250 = 4.96$ eV
2. **$KE_{max} = E - \Phi = 4.96 - 2.3 = 2.7$ eV ($\approx 4.3 \times 10^{-19}$ J)**

- **Horizontal and vertical separately** in projectile questions. Never put both into one suvat equation.
- **Constant acceleration only.** If the force or acceleration changes (a spring, a varying field), suvat is invalid: use energy, work or the area under a graph.
- **Collisions:** momentum is conserved in **every** collision; kinetic energy only in elastic ones. If in doubt, use momentum.

3 "Show that" questions

- **Work forwards** from the data in the question; don't start from the given answer.
- **Finish with one more significant figure** than the given value, then the statement.

WORKED EXAMPLE

Show that a ball dropped from 7.5 m hits the ground at about 12 m s^{-1} (ignore air resistance).

1. $mgh = \frac{1}{2}mv^2$, so $v = \sqrt{(2gh)}$
2. $v = \sqrt{(2 \times 9.81 \times 7.5)} = \sqrt{147.2}$
3. **$v = 12.1\ m\ s^{-1} \approx 12\ m\ s^{-1}$**

COMMON MISTAKE

Inventing a number to make it work (a different g, an emissivity of 0.8, an extra factor of 10). Examiners spot it and award nothing for that step. If you can't get the given value, use it in the next part anyway.

4 "Explain" answers

- **Add physics the question didn't give you.** Restating the stem ("the gases re-radiate energy back to the surface") scores nothing.
- **Use the precise term:** "constant phase difference", not "in sync"; "rate of change of flux linkage", not "the magnet moves".
- **Link cause and effect** with "so", "therefore", "which means".

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Model answers

Question	Points that score
Explain the greenhouse effect	The surface emits **infrared**; greenhouse gas molecules **absorb** IR (their natural frequency matches); they **re-emit it in all directions**, so some returns to the surface, which warms further
Explain why the wave model fails for the photoelectric effect	There is a **threshold frequency**, whatever the intensity; emission is **instantaneous**; max KE depends on **frequency**, not intensity. Each photon gives its energy hf to **one** electron
Explain why a constant current in a coil induces no emf in a nearby coil	A constant current gives a **constant B**, so the **flux linkage doesn't change**; emf needs a **rate of change** of flux (Faraday)
Explain how a star stays stable	The **inward gravitational force** is balanced by the **outward pressure** of the hot gas and radiation from **fusion** in the core
Outline the conditions for fusion in a star's core	**Very high temperature** (so nuclei move fast enough to overcome the electrostatic repulsion) and **high density/pressure** (so collisions are frequent)
Explain how we know a star contains helium	Its spectrum shows **absorption lines** at wavelengths that match helium's emission lines
Explain thermal conduction in a metal	**Lattice vibrations** pass energy between neighbouring ions, and **free electrons** carry energy quickly through the metal
Explain the role of the iron core in a transformer	It **concentrates the magnetic flux** and **links** it from the primary to the secondary coil; it doesn't carry the current
State the conditions for observable two-source interference	**Coherent** sources: same frequency and **constant phase difference**; similar amplitudes

COMMON MISTAKE

Interference "destroys" energy at the dark fringes. Energy is **redistributed**: bright fringes get more.

5 Multi-concept questions

- **They link two or more topics** (for example a satellite's orbit and its solar-panel power, or a nuclear reaction and its thermal output).
- **Each part can usually be started on its own.** Given values ("show that…") let you continue; error carried forward (ECF) means a wrong earlier answer used correctly still scores.
- **Make a quick list** of the quantities you know and the one you need, then find the link in the data booklet.
- **Budget the time.** Leave about **25–30 minutes** at HL (15–20 at SL) for these questions, so they're not left blank.

6 Presentation

- **Write inside the answer boxes.** Writing outside them might not be scanned for marking.
- **Clear digits:** examiners flag 4 vs 9, 1 vs 7, and powers of ten ($\times 10^{-3}$ written as $\times 10^{3}$).
- **Cross out with one line.** If you give two answers, only the first may be marked.

LINKING QUESTION

Revise the topics behind these answers: A.2 Forces and momentum, B.2 Greenhouse effect, D.4 Induction, E.2 Quantum physics and E.5 Fusion and stars. See also Paper 1B data skills.

Test yourself — cover the answers first

QUICK CHECK

1. What is the equation at the top of a vertical loop?
2. Is kinetic energy conserved in an inelastic collision?
3. How many s.f. should you give in "show that v ≈ 12"?
4. Photon energy for λ = 620 nm in eV?
5. Why does a constant current not induce an emf?
6. What makes two sources coherent?

Show answers

1. $N + mg = mv^2/r$
2. no; only momentum is conserved
3. 3, e.g. 12.1
4. 2.0 eV (1240 ÷ 620)
5. the flux doesn't change
6. a constant phase difference

Stuck on a question?

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