IB DP PHYSICS · EXAM SPECIAL · SL & HL · FOUR CRITERIA, 24 MARKS · FROM THE 2025 SUBJECT REPORTS · ~7 MIN READ

IB Physics IA Guide: Scientific Investigation (New Syllabus)

A practical guide to the new-syllabus IB Physics internal assessment: what each of the four criteria rewards, how to write a focused research question, the uncertainty analysis moderators expect and how to write a conclusion and evaluation that score.

How the IA is marked · Research design · Data analysis · Conclusion · Evaluation · Research question ideas · Uncertainties & graphs · Common mistakes

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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

- **The scientific investigation is 20% of your grade** at SL and HL, marked out of **24** across four equally weighted criteria. The limit is **3000 words**.
- **In May 2025 a 7 needed 20/24** in every time zone (see the Physics grade boundaries).
- **Conclusion and Evaluation are half the marks,** and moderators said Evaluation was again the hardest criterion.

BY THE END YOU CAN

- Understand what each of the four criteria rewards.
- Write a focused research question and a method that answers it.
- Process data with uncertainties, max/min gradients and residuals.
- Write a conclusion and evaluation that compare, explain and improve.

1 How the IA is marked

Criterion	What it rewards	Marks
Research design	A focused research question, its context, and a method that can answer it (variables, range, repeats, safety)	6
Data analysis	Clear, correct processing of the data, with uncertainties, presented in tables and graphs	6
Conclusion	A conclusion that answers the research question, **justified** by the analysis and **compared** with accepted physics	6
Evaluation	Specific weaknesses and limitations of **your** method, their effect on the results, and realistic improvements	6

- **There is no separate "personal engagement" criterion** in the new syllabus, and no marks for a section with that title.
- **Collaboration is allowed** for data collection (up to three students), but each report must be written individually.

2 Research design

- **A focused research question names both variables and the system:** "How does the length of a simple pendulum (0.20–1.00 m) affect its period, and what value of g does this give?"
- **Don't derive equations from the data booklet.** A reference to the equation is enough; the derivation wastes words.
- **A hypothesis isn't needed** when you're testing a well-known law. State the expected relationship instead.
- **Variables table:** independent (range and number of values), dependent (how it is measured), controlled (**how** each is kept constant and why it matters).
- **Range and repeats:** at least 5 values of the independent variable over a wide range, with repeats at each value.

COMMON MISTAKE

"How does temperature affect resistance?" is too vague: which conductor, which range, measured how?

3 Data analysis

- **Raw data tables:** units in the headings, uncertainties stated, consistent decimal places.
- **Sensible uncertainties:** usually 1 significant figure, with values rounded to match (see Paper 1B data skills).
- **When repeat readings don't vary,** the uncertainty is the instrument's least count, not zero.
- **Propagate uncertainties** into the processed quantities and show one worked example.
- **Graphs:** error bars on every point, a line of best fit, and **max and min lines through all the error bars**. The gradient uncertainty is (max − min)/2.
- **Linear vs proportional:** a straight line that misses the origin is linear, not proportional. Comment on the intercept.
- **Residuals** (data − fit) help justify a linear model: random scatter about zero supports it; a pattern suggests another relationship.
- **Outliers:** you may exclude a point only with a stated reason (for example a known timing slip), not because it doesn't fit.

4 Conclusion

- **Answer the research question directly,** with the final value and its uncertainty: "g = 9.6 ± 0.2 m s^{-2}".
- **Compare with accepted physics.** Does the accepted value lie inside your uncertainty range? If not, by how many uncertainties is it outside? Cite a reliable source; local values of g vary slightly with location.
- **Talk about physics, not just statistics.** "R^2 = 0.998" doesn't answer the question. Explain what the gradient or intercept means physically.
- **Don't repeat the method** in the conclusion.

WORKED EXAMPLE

A student finds g = 9.62 ± 0.15 m s^{-2} from a pendulum. The accepted local value is 9.79 m s^{-2}. What can they conclude?

1. Range: 9.47 to 9.77 m s^{-2}
2. 9.79 lies **just outside** the range, so the result is slightly low
3. **A consistent low value suggests a systematic error, for example measuring L to the top of the bob instead of its centre, which makes L too small.**

5 Evaluation

- **The hardest criterion.** Moderators said students list textbook errors ("human error", "random error") without linking them to their own data.
- **Name the specific weakness, its effect and the evidence:** "Reaction time at the start and stop of each timing (about 0.2 s) was large compared with a single period of 1.2 s, which is why the uncertainty in T was 15%."
- **Use your graph as evidence:** a non-zero intercept points to a systematic error; a large scatter to random error; a curved trend to a limited model (for example large amplitude for a pendulum).
- **Realistic improvements that fix the weakness you named:** time 20 oscillations instead of 1; use a light gate; a fiducial marker at the centre of the swing; a wider range of lengths.

COMMON MISTAKE

Generic improvements such as "use a video camera", "repeat more times" or "use better equipment". Say what to use, and which error it reduces.

- **Strengths are not required.** Spend the words on limitations and improvements.

6 Research question ideas

Research question	Physics	Analysis
How does the drop height of a ball affect its bounce height?	Energy losses, coefficient of restitution	Ratio, linear fit
How does the length of a wire affect its resistance (and find ρ)?	Resistivity	Gradient = ρ/A
How does the angle of incidence affect the angle of refraction in a glass block?	Snell's law	sin r against sin i
How does a magnet's drop height through a coil affect the peak emf?	Faraday's law	Data logger, emf against speed
How does the mass on a spring affect the period of oscillation?	SHM	T^2 against m
How does the temperature of water affect how fast it cools?	Newton's law of cooling	ln(ΔT) against t
How does the distance from a light source affect the intensity?	Inverse-square law	I against $1/d^2$, log–log

7 Final checklist

- Research question: specific system, both variables, range.
- Controlled variables: how each is controlled.
- Uncertainties: shown, propagated, sensibly rounded.
- Graph: error bars, best fit, max and min lines; residuals if helpful.
- Conclusion: final value ± uncertainty, compared with an accepted value and its source.
- Evaluation: specific weaknesses, linked to the data, with matching improvements.
- Word count under 3000; any AI use cited under IB guidelines.

LINKING QUESTION

The experiments above use physics from C.1 Simple harmonic motion, B.5 Current and circuits and D.4 Induction. Practise the graph skills in Paper 1B data skills.

Test yourself — cover the answers first

QUICK CHECK

1. How many marks is the Physics IA out of?
2. Which two criteria make up half the marks?
3. Is a hypothesis required when testing a known law?
4. What is the uncertainty in a gradient?
5. Is "use a video camera" a good improvement?

Show answers

1. 24
2. Conclusion and Evaluation
3. no
4. (max gradient − min gradient)/2
5. only if you say which error it reduces and how

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