Lanterna Education

HOW TO REVISE IB PHYSICS

FROM THE IB GRADUATES AT LANTERNA EDUCATION

CONTENT

EXAMINATION STRUCTURE

> **IMPORTANT:** The new IB physics course will be taught for the first time in August 2023, with the first assessment in May 2025. Do be mindful of the fact that this guide details the current syllabus and will be updated when the new one comes into effect!

HERE ARE SOME QUICK TIDBITS ABOUT EACH OF THE THREE PAPERS:

PAPER 1:

- Multiple choice questions only (30 at SL or 40 at HL)
- No calculators permitted
- 45 Minutes at SL, and 1 hour at HL

Paper 1 challenges students to think quickly on their feet and primarily tests conceptual clarity as opposed to multi-step quantitative reasoning. To succeed in this paper, it is crucial to have a firm grip on fundamental facts and to apply high-level physical understanding to unfamiliar contexts. It is also crucial to recognize and resist the temptation to pick incorrect yet cleverly designed answer choices!

PAPER 2:

- Short answer and extended response questions
- Calculators permitted
- 1.25 hours at SL and 2.25 hours at HL

Paper 2 tests students on their ability to deconstruct, analyse and explain the solution to problems based on an in-depth understanding and an accurate interpretation of command terms. While short answer questions may ask students to state or briefly explain a physical phenomenon, extended response questions may demand students show, calculate or determine solutions with a lucid presentation of logical steps.

PAPER 3:

- Section A contains one data-based question followed by short answer questions based on experiments. Section B has short answer and extended response questions from one option.
- Calculators permitted
- 1 hour at SL and 1.25 hours at HL

Paper 2 tests students on their ability to deconstruct, analyse and explain the solution to problems based on an in-depth understanding and an accurate interpretation of command terms. While short answer questions may ask students to state or briefly explain a physical phenomenon, extended response questions may demand students show, calculate or determine solutions with a lucid presentation of logical steps.

Section A of paper 3, in particular, can often cause problems for students due to a lack of practice. This section is more similar to an experimental Internal Assessment than any of the other written papers, demanding of students a sound strategy for processing data, extracting relationships between variables and evaluating the rigour of a given experiment. Thus, working knowledge of errors and uncertainties can go a long way in improving your performance in this section.

Section B focuses exclusively on your chosen option. Happily enough, the format and wording of these questions are identical to paper 2, so no additional preparation is needed to deal with these questions apart from the actual technical content.

IB PHYSICS QUESTION TYPES

Even though there are a large number of topics that the IB can examine us on, there are a relatively limited number of ways in which they can do this. By recognizing that each type of question can be made more manageable with its own specific approach, you can streamline your thought process and produce insightful answers in the limited time you have.

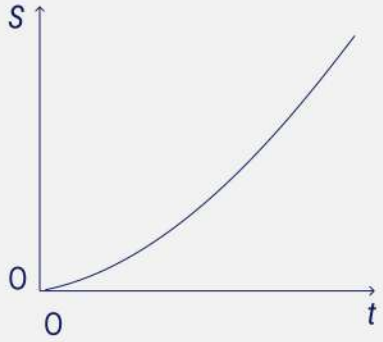
MULTIPLE CHOICE QUESTIONS:

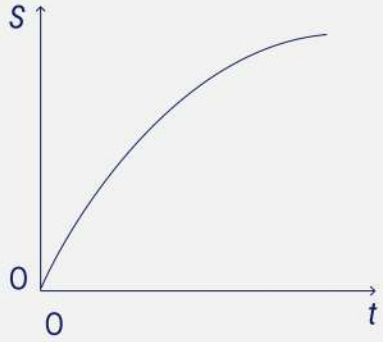
Our suggested strategy for attacking MCQs on the IB physics exam is best illustrated through an example. Although this approach isn't prescriptive, it can be a good starting point if you are looking for some sort of structure of which you can build.

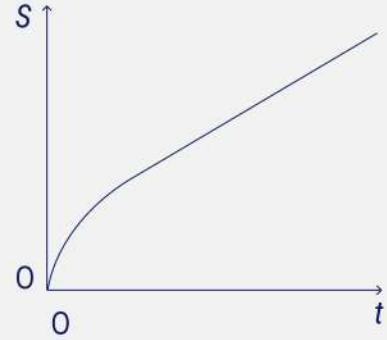
Note that some of these steps may not be applicable for each MCQ, but with practice, you can quickly identify which steps of the process you should take to reach the answer.

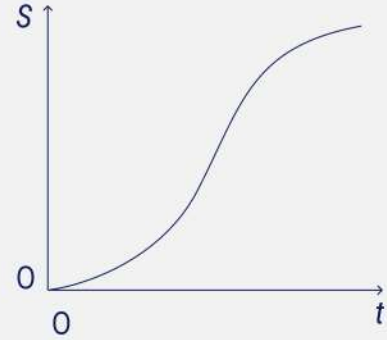
EXAMPLE

A tennis ball is dropped from the top of a tall building. Air resistance is not negligible. Which graph shows the variation with the time t of the displacement s of the ball?

A.


B.


C.


D.


STEP #1

READ THE QUESTION AND UNDERLINE KEYWORDS

And really read it. You should keep an eye out for key details and underline them as you read. Which words describe the conditions, constants, assumptions, and variables?

In this question the term 'dropped' in this question is crucial as it gives us insight into **the initial condition** (zero initial velocity). The fact that air **resistance is not negligible** is also noteworthy and should be highlighted. Finally, we know we need to look for a **time** vs **displacement** graph.

At the end of step 1, your question should look something like this:

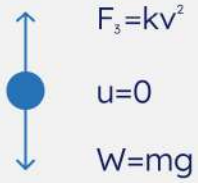
A tennis ball is dropped from the top of a tall building. Air resistance is not negligible. Which graph shows the variation with the time t of the displacement s of the ball?

STEP #2

DRAW A DIAGRAM

Drawing a quick and dirty diagram will suffice- it can be very helpful in visualizing and illuminating your problem.

We could draw something like this:



I know, I know - this isn't a rigorously drawn free body diagram. It is, however, helpful as it contains all the information we need.

STEP #3

QUANTIFY THE PROBLEM

Sometimes, mathematical thinking can help us cut through the noise. This is particularly true of questions designed to trick our intuition into giving the wrong answer. Skip this step if you don't need it, though. Time is of the essence.

Some ways you can quantify the problem are as follows:

- s=ut+0.5at2=0.5gt2 when v is ~ 0
- Air resistance increases proportionally to the velocity squared. Eventually, W=Fa meaning that the net force on the body is zero, leading to no further change in velocity (i.e., we have reached terminal velocity)

STEP #4

PICK YOUR ANSWER

Before dissecting the options, it is good to have a vague idea of what you might need to look for. Having a rough idea will make it easier to resist those plausible-sounding answers that are incorrect.

In our case, we know that we are looking for a graph that ends up being linear, representing the uniform terminal velocity arising as a result of the air resistance. We also know that the initial segment of the graph should closely resemble an upward parabola 0.5gt2 as air resistance is negligible at very low velocities.

It looks like option A is the only one that meets this description! At this stage, it is, of course, very sensible to review the remaining options and confirm that they cannot be correct.

If you are unable to predict an answer, your next best friend is the process of elimination. For example, identifying terminal velocity helps us narrow down our choices to A and C. Then, our rudimentary analysis of the equation s=ut+0.5at2 allowsus to eliminate option C, leaving us once again with option A.

SHORT ANSWER AND EXTENDED RESPONSE QUESTIONS

As with the MCQs, there are ways to streamline the process of answering short and extended response questions. The following are tips for tackling questions of this variety.

TIP #1

READ THE QUESTION AND ITS MARK ALLOCATION

Unlike MCQs, these questions can have varying marks assigned to them. How many marks a question givesis important information as it quantifies an examiner's expectation of depth or brevity, as the case may be.

Note that the number of marks does not always correlate with how difficult a question might be. Don't get discouraged if a one-mark question seems impossible; it could be more tricky than a three-mark one. The marks only reliably indicate how thoroughly you should explain an answer. More often than not, one mark correlates to one crucial idea.

TIP #1

READ THE QUESTION AND ITS MARK ALLOCATION

Example

State the law of conservation of momentum. [2]

The command term 'state' corresponds to the least in-depth class of command terms (refer to the IB physics guide for the entire list), and the question is worth 2 marks. These two thingsimply that the examiner expects a brief response, which must comprise two crucial ideas to gain full marks. In our case, the examiners are looking for a mention of the following;

"Total momentum does not change/is constant" - 1 mark. The main idea."provided the system is isolated/no external forces are applied" - 1 mark. You clearly state the condition, too.

TIP #2

ELUCIDATE YOUR THOUGHT PROCESS FOR EXTENDED RESPONSES

Your answer is quite literally worth less than the explanation of your answer. Examiners seek evidence that the student has understood the underlying concept and methodology required to tackle an unfamiliar problem. This is good news, as careless numerical mistakes happen to the best of us, and we can minimize their impact by clearly presenting our method.

If you're not convinced, here is an example illustrating this scheme in action.

Example

A cyclist is moving up a slope that is at an angle of 19° to the horizontal. The mass of the cyclist and the bicycle is 85 kg. At the bottom of the slope, the cyclist has a speed of 5.5ms-1. The cyclist stops pedalling and applies the brakes, which provide an additional decelerating force of 250 N. Determine the distance taken for the cyclist to stop. Assume air resistance is negligible and that there are no other frictional forces.

[4 marks]

While we won't go through a detailed answer, we can gain some insightful information from the steps in the answer key:

- Calculate the total decelerating force
- Calculate the acceleration of the cycle
- Choose the correct equation of motion to calculate the distance
- Present the final answer, which is the distance taken for the cycle to come to rest.

> Going back to tip 1, notice how there are 4 ideas to earn us 4 marks? Further, the final answer counts for just 1 out of the 4. In other words, your methodology is **very important.**

TIP #3

PICK YOUR BATTLES

Sometimes, strategy can be the difference between a good score and a great one. It's not unusual to face extreme time pressure during the IB physics papers. So, it is worth preparing for such a scenario.

- Remember that for structured questions, you don't necessarily need to have solved parts a, b and c to be able to answer part d. If you're stuck on a sub-part of a question, scan through the rest of it to see if there's anything else you can solve. Often, you will find that you can attempt a later part without needing to use a prior answer.
- Questions generally draw from one or two related topics. Assess your strong and weak areas before the exam and start with a question from a topic you are strong in, instead of progressing chronologically.
- For questions that completely stump you, try writing down a related formula or drawing a diagram. Even if you don't reach the answer, the partial method may count for something.

DATA-BASED QUESTIONS

> Data-based questions can often puzzle students, but this is more likely due to a lack of practice than the inherent level of challenge in these questions. Nailing down a few fundamental data processing ideas can go a long way in tackling these questions.

As there are not many focussed resources for data-based questions, use the following pointers as a (non-exhaustive) checklist to spot any deficiencies in your understanding that you need to address.

- Vocabulary to describe a relationship between two variables (direct, inverse, positive, negative, proportional, linear, non-linear). A widespread mistake is loosely using the term proportional. Remember that a proportional relationship, when graphed, must necessarily pass through the origin. Make sure that you really understand proportionality.
- Combining uncertainties when performing arithmetic operations on quantities.
- Presenting errors and uncertainties in fractional, percentage and absolute form
- Interpreting and drawing error bars.
- Spotting sources of systematic and random error in an experimental set-up (and knowing the difference between the two)
- Converting between units and their orders of magnitude (e.g., going from MJ to kJ).

The best way to ensure you develop solid data analysis skills is to brush up on Topic 1: Measurements and Uncertainties and to solve plenty of past paper questions.
The more you do, the easier it gets!

GENERAL GUIDANCE

PAST PAPERS AND THE ERROR LOG

Once you've covered your entire physics syllabus, the most important thing to improve your grade is to dig into past papers. Your guiding principle should be quality over quantity - completing a few past papers followed by a thorough review and reflection is far superior to breezing through several papers and markschemes with little thought.

It can be challenging to know how to go about the process of reflecting on your performance and how to extract valuable insight from it. An exam error log is a handy yet simple tool that can help in this regard. We have illustrated an example of this below.

Question Identifier	Topic	Error	Remedial action
May 1998 Paper 2, Q2b	Circular motion	Incorrectly identified centripetal force from the free body diagram, ignored a force that I should have taken into account	Conceptual insight: centripetal force is the resultant force acting on the body towards the centre of its circular motion. To practise: set up Newton's second law in centripetal motion scenarios.

An error log is so valuable because it forces you to engage with your areas of weakness, come up with concrete steps to address them and burn it into your memory so that you are unlikely to repeat the mistake.

There is no right or wrong way to fill in an entry - framing a conceptual error in your own words can improve understanding. It can be challenging to hold yourself accountablein this manner, but it is worth it!

CALCULATOR

> Calculators can be effective aids when used right. As you complete practice questions, take note of common computations and ensure you can perform these on the calculator. There are plenty of resources online that can help you with this.

THERE ARE TWO CAVEATS TO USING THE CALCULATOR.

1.

First, it may diminish our intuitive feel for what the answer should approximate. Counter this by performing common sense checks. Does the solution have the sign you expect? Does the order of magnitude make sense?

2.

The second issue pertains to significant figures. A calculator is limited only by its processing power, which means that it will output as “precise” an answer as it can. However, based on our knowledge of measurement and uncertainties, we know that an answer can only be as precise as its least precise input. The bottom line is this - use your calculator by all means. However, you must prepare yourself to round the output to have the correct number of significant figures or decimal places.

DATA BOOKLET

Knowing what information the data booklet does and does not hold can be a big time saver. Certain constants such as the Planck constant, Boltzmann constant and Avogadro constant almost always appear in questions, and you should be able to look these up quickly.

The data booklet can also be helpful in getting the ball rolling in problems where you are stuck, as it contains many commonly used formulae. Familiarize yourself with their location, so you aren’t searching for them on the big day!

CONCLUSION

WE HOPE THE TOOLS, TIPS AND STRATEGIES PRESENTED IN THIS GUIDE WILL EASE YOUR NERVES AND CONVINCE YOU THAT WITH SOME FOCUSED EFFORT, IB PHYSICS IS SURMOUNTABLE AFTER ALL.

If you are interested in personalised support with your revision and putting all this information into action on your own still seems daunting,

be sure to check out our Online Private Tutoring packages taught by top former IB students who were once in your shoes!

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HAVE ANY QUESTIONS?

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