Year 12 / IB1 Intensive Revision course – Physics

This course is aimed at providing students with an opportunity to thoroughly revise their 1st–year IB topics during fully-customizable tutorial sessions, according to the request of students and/or parents. The course will also allow students to "catch up and patch up" – address misunderstandings that they may have accrued during their first year of IB studies.

A standard course will feature 8 to 12 hours of revisions on typical first year school topics, with emphases on the following points:

- The need to render fundamental physics concepts (unit conversions, commonly–used equations, fundamental properties of matter, and application of force and energy) second–nature
- The usage of ratios in problem–solving
- Analysis of graphs, with emphasis on gradients and areas
- Problem-solving – when to use and when not to use the formula booklet
- New material in the 2016 syllabus

Examples of problem solving include:

- Data–processing: Experimental physics – graphical analysis
- Mechanics: Resolution of forces, book–keeping of energy
- Electricity: Kirchhoff's law practices, combined series and parallel circuit analysis
- Magnetism: Visualizing fields and forces, and solving 3D problems on paper

Students will be pre-evaluated based on their performance on a customized multiple-choice test, with a mix of adapted IB past exam questions and in-house questions. These questions are exclusively based on topics that students should have covered at school. Samples of the diagnostic tests can be found on our Resources page on www.akademiatuition.com.

Sample excerpts from applications of equations and definition of terms are included.

Excerpts from our course material: In–depth analysis of trivial and advanced problem–solving

<table>
<tr><th>Situation</th><th>Akademia Experts' take on these equations – basic examples on how to use it</th><th>Further considerations</th></tr>
<tr><td>Error propa–gation</td><td>An example involving addition and subtraction: The starting and final temperatures of oil are 98.4 ^{o}C and 103.7 ^{o}C, both measured using a probe with an absolute uncertainty of 0.1 ^{o}C. How should we report the change in temperature?
• The change in temperature is 103.7 – 98.4 = 5.3 ^{o}C and the uncertainty in the change in temperature is 0.1 + 0.1 = 0.2 ^{o}C, hence the temperature change is reported as 5.3 ± 0.2 ^{o}C.

An example involving multiplication and division: A toy car travels 25.0 ± 0.5 meters in 8.0 ± 0.1 seconds. How should we report its speed?
• The average speed of the toy car is $\frac{25.0}{8.0} = 3.125 = 3.1\ m\ s^{-1}$.
• The relative uncertainty in this figure (3.1 m s$^{–1}$) is $\frac{0.5}{25.0} + \frac{0.1}{8.0} = 0.0325$.
• The absolute uncertainty in this figure (3.1 m s$^{–1}$) is 0.0325 × 3.125 = 0.1015625 = 0.1 m s$^{–1}$ (1 d. p.).
• Therefore the final value is quoted as 3.1 ± 0.1 m s$^{–1}$.

An example involving powers: A 2.50 ± 0.05 Ohm resistor is experiencing a current of 0.040 ± 0.001 A. How should we report the power?
• The power dissipated = I^{2}R = 0.040^{2} × 2.50 = 0.0040 W = 4.0 × 10$^{–3}$ W.
• The relative uncertainty in this figure (4.0 × 10$^{–3}$ W) = $2 \times \frac{0.001}{0.040} + \frac{0.05}{2.50} = 0.07$.
• The absolute uncertainty in this figure (4.0 × 10$^{–3}$ W) = 0.07 × 4.0 × 10$^{–3}$ W = 2.8 × 10$^{–4}$ W = 0.3 × 10$^{–3}$ W (1 s. f.).
• Therefore the final value is quoted as (4.0 ± 0.3) × 10$^{–3}$ W .</td><td>To calculate the uncertainty in a quantity which is not a subject of a given equation, you must rearrange for that quantity to become the subject before you propagate the errors.

For example, the resistance, length and cross–section area of a wire are measured with relative uncertainties 13%, 3% and 2% respectively. To calculate the relative uncertainty of ρ ($\frac{\Delta\rho}{\rho}$) involving $R = \frac{\rho L}{A}$, you MUST REARRANGE FOR ρ first. From $\rho = \frac{RA}{L}$ you can deduce that the relative uncertainty of ρ = 13% + 3% + 2% = 18%. A common trap that students step into is to subtract the 3% and 2% from the 13%. This is wrong because we are not back–deducing the uncertainty of ρ as a directly–measured quantity.</td></tr>
<tr><td>Vector resolution</td><td colspan="2">Examples involving vector resolution:</td></tr>
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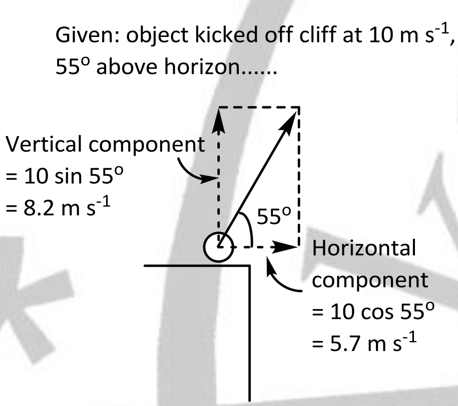
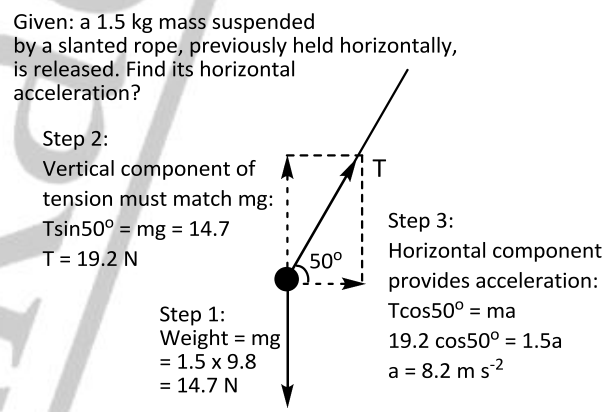
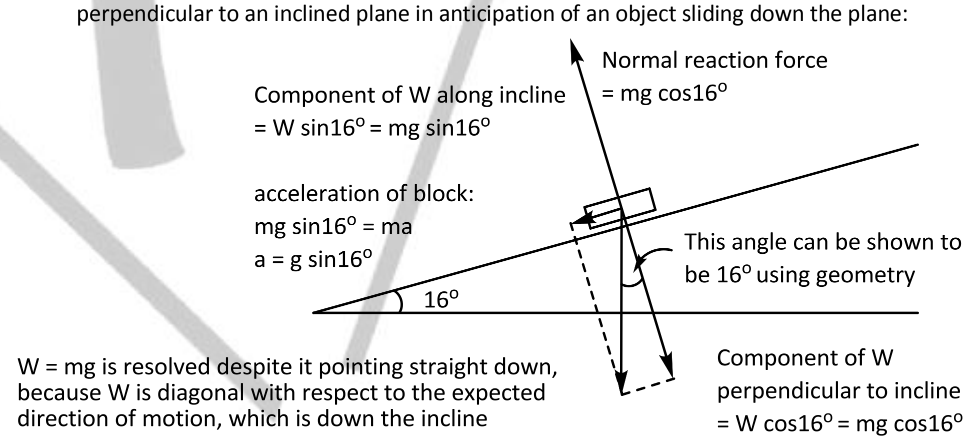




The directions of resolution should be ALONG and PERPENDICULAR TO the expected direction of resultant force, which means you should not always resolve vertically and horizontally. The classical example would be resolving along and perpendicular to an inclined plane in anticipation of an object sliding down the plane:



Excerpts from our course material – glossary definitions

Unit	Term	IB definition or description as required by the syllabus	Akademia experts' take
7.1	Radioactive decay	A phenomenon that involves an unstable nucleus spontaneously and randomly decaying by emitting alpha / beta / gamma rays and energy.	Radioactive decay is random – it is impossible to predict which particular nucleus will next decay, although it is possible to deduce the probability of a nucleus undergoing decay within a given timeframe.
7.1	Antineutrino	A small chargeless particle that accompanies the ejected electron during a beta-minus decay	
7.1	Ionizing radiation		Radiation that interacts with matter, causing atoms and molecules to lose electrons and become chemically unstable. As a result, chemical reactions (such as biological mutations) take place.
7.1	Radioactive half-life	The amount of time for the amount of a radioactive sample to decay to half its original amount.	Radioactive decay is a constant-half-life process. The half-life is independent of the initial amount.
7.1	α–decay	A decay that features a nucleus emitting a helium nucleus	This helium nucleus is the alpha particle. The remaining daughter nuclide will have 2 fewer protons and 4 fewer nucleons than the parent nuclide.
7.1	β^- decay	A decay that features a neutron being converted into a proton, an electron and an electron antineutrino	Students must be aware that the beta-particles (β^+ or β^-) have a range of energies as opposed to discrete energies. A 3-particle "fission" involving neutrinos travelling a random direction is postulated to explain the many possible energy contents of beta particles.
7.1	β^+ decay	A decay that features a proton being converted into a neutron, a positron and an electron neutrino	
7.1	Background radiation		Radioactivity due to radioactive atoms in the surroundings, radioactive atoms that were created and have yet to decay since the beginning of the universe
7.1	Activity	The number of decays per second	1 Becquerel = 1 decay per second