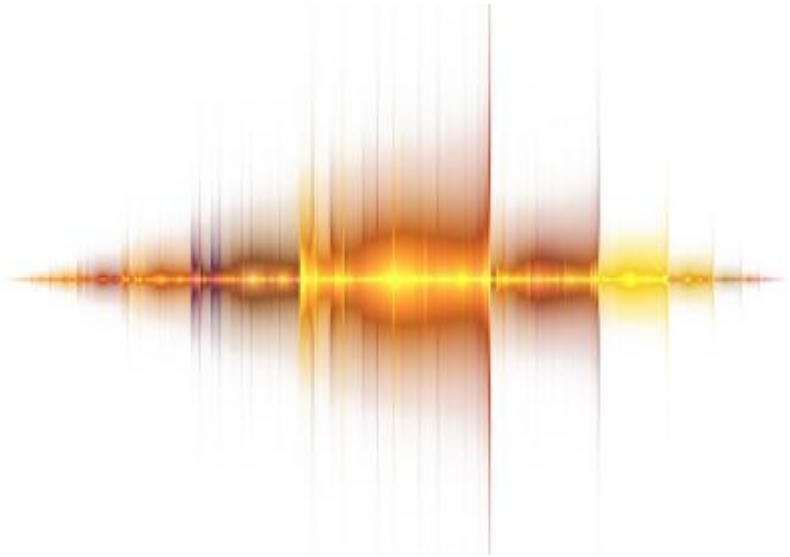
Cambridge Assessment International Education

Next Steps

Cambridge IGCSE™ Physics 0625 and Cambridge International AS & A Level Physics 9702

For Cambridge IGCSE examination from 2020

For Cambridge International AS & A Level examination from 2022



Version 1

Cambridge Pathway

In order to help us develop the highest quality resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

We invite you to complete our survey by visiting the website below. Your comments on the quality and relevance of our resources are very important to us.

www.surveymonkey.co.uk/r/GL6ZNJB

Would you like to become a Cambridge consultant and help us develop support materials?

Please follow the link below to register your interest.

www.cambridgeinternational.org/cambridge-for/teachers/teacherconsultants/

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Introduction

The focus of this guide is on moving on from teaching and studying the **Cambridge IGCSE Physics 0625** syllabus to the **Cambridge International AS & A Level Physics 9702** syllabus.

This guide will help you and your learners to:

- understand better what to expect when you start the AS & A Level course
- prepare for the AS & A Level course
- think about ways to achieve success and gain confidence.

You may be using this document at the end of the academic year for Cambridge IGCSE Physics, or at the start of the academic year for Cambridge International AS & A Level Physics. Either way, the aim is to motivate and inspire learners. If there is to be a time gap between delivering this session and starting the International AS & A Level course, then the aim is for every learner to look forward to the new course positively.

This Introduction, the Resources and Suggested classroom activity sections of this guide are written directly for you, the teacher. The rest of this guide has been written to make it easy for you to adapt and reproduce the content for use by your learners.

Frequently asked questions by learners

Listed below are some questions which learners frequently ask. The answers to each of the questions below are written as a direct communication to your learners. You could copy and paste these to make a PowerPoint, read them out to your group, or produce a booklet for them to read through and discuss.

Is it helpful to have taken the Cambridge IGCSE Physics course?

Yes. The move from Cambridge IGCSE to Cambridge International AS & A Level has been designed to be as smooth a transition as possible. Many of the topic headings are the same so you will already be familiar with the topic and will just progress from there. The style of questions may be similar and the skills you have developed will be useful.

What extra work will I have to do, if I have not taken Cambridge IGCSE Physics?

This will depend on the course you have taken. Many learners without a Cambridge IGCSE background have the same skills and subject knowledge and generally adjust quickly to the 'Cambridge' style when they start their AS & A Level.

You may not have covered some topics that are a useful base for AS & A Level. This is not a problem – you will probably find that your teacher goes over some IGCSE work as a start to a new AS & A Level topic, or if not, you can easily develop your research skills and read up what you need to know. You will find that teaching yourself subject matter at IGCSE level is much easier when you are working at AS & A Level.

What is the syllabus?

The syllabus for Cambridge International AS & A Level Physics 9702 is a complete description of the content, examinations and what you need to do to be successful in the qualification. '9702' is the reference number of the Physics syllabus.

An important part of the syllabus for you is the subject content, which details all the subject material you should cover during the course. This content is divided into topics, each of which Is divided into sections with numbered 'learning outcomes'. These are statements explaining what you should know and understand about the topic.

Your teacher may give you a copy of the subject content of the syllabus. Or go to the Cambridge website at http://www.cambridgeinternational.org/9702, for the full copy of the syllabus.

How do I make the transition from Cambridge IGCSE Physics to Cambridge International AS & A Level Physics?

This guide will help you prepare for the transition, so there are no surprises in what to expect.

You may find you hardly notice the transition to AS & A Level, or you may find it more difficult to adjust at first and need a bit of time to settle into the new course. Try and assess your own situation and then decide your best course of action.

What are the differences?

Some of the main differences you will find when you study Cambridge International AS & A Level compared to Cambridge IGCSE are listed in the table below.

Fewer subjects	Hopefully you will have chosen the subjects that you really enjoy, are really good at or those which you need to take you on to university and/or your chosen career.
Smaller classes	You will have an opportunity to contribute more to lessons and have more one-to-one interaction with your teacher. You will have more lessons each week: the recommended guided learning hours for IGCSE Physics are 130, compared with 180 guided learning hours for AS and 360 learning hours for the full A Level qualification.
Detailed and specialist content	You will find increased challenge as you study in greater depth, work more independently and begin to develop your own ideas. You will be able to explore topics in much more depth than at IGCSE, maybe finding answers to unanswered questions and learning about certain topics which are completely new.
Independent study	Greater independence is a key part of AS & A Level qualifications which helps prepare you for study at university. It is important that you use this independent study time well. You can use this time in a variety of constructive ways – for completion of homework tasks, assignments, research or for completing additional reading around the subject.
Revision	Try to build in some time for revision throughout the course – consolidating and learning notes as you go along makes it much easier to remember when it comes to examination time.
Read around your subject	Use a range of textbooks and internet sites, though you will probably find the Cambridge endorsed textbooks the most helpful.
Take notes	When you take notes, try to summarise the main information that you need. Use headings and bullet points to reduce the content, and colours to highlight key pieces of information. If using the internet, don't just print pages of information, make notes from them or highlight text to show the key points. Always use your own words where possible.
Independent research	You might have completed some research tasks at IGCSE but you can expect this to be a more regular feature of homework tasks. Ask your teacher for a recommended list of textbooks and websites that you can use so you have a good starting point. Save useful websites to your favourites bar so you know where to find them again.

Folders	You will probably move from exercise books to folders to record your learning and it is important to be organised. Divide your folder into topic sections and keep your notes in date order. Keep copies of past questions, mark schemes and example answers alongside any completed assessed work. Highlight examination tips in your notes and keep key documents about examinations in a separate section of your folder.
Key information	You will find mathematical requirements and a summary of key quantities, symbols and units for the AS & A Level in the Additional Information section of the syllabus. All the required concepts are generally accessible to those who have previously studied IGCSE Mathematics.
Terminology	You will learn many new terms at AS & A Level, but before the course you may find it useful to familiarise yourself with the terms: prefixes, units, quantities, concepts, conservation rules, graphs, mechanics, electricity, fields, waves, quantum physics.
Command words	These are the words in an exam question that explain to you what you need to do such as: define, explain, state, calculate. You may have underlined these when looking at example examination questions. At Cambridge International AS & A Level, you may be introduced to some new command words. There is a helpful list of command words in the syllabus.
Assessment	You need to know what examinations you will sit; how long each examination is; whether you have a choice of questions or not; how many marks each question/paper carries and what the structure of the questions is like. It is a good idea to have an assessment overview and copies of past papers and mark schemes.
Key concepts	The key concepts for Cambridge International AS & A Level Physics are: • Models of physical systems - Physics is the science that seeks to understand the behaviour of the Universe. The development of models of physical systems is central to physics. Models simplify, explain and predict how physical systems behave. • Testing predictions against evidence - Physical models are usually based on prior observations, and their predictions are tested to check that they are consistent with the behaviour of the real world. This testing requires evidence, often obtained from experiments. • Mathematics as a language and problem-solving tool - Mathematics is integral to physics, as it is the language that is used to express physical principles and models. It is also a tool to analyse theoretical models, solve quantitative problems and produce predictions. • Matter, energy and waves - Everything in the Universe comprises matter and/or energy. Waves are a key mechanism for the transfer of energy and are essential to many modern applications of physics.

	• Forces and fields - The way that matter and energy interact is through forces and fields. The behaviour of the Universe is governed by fundamental forces with different magnitudes that interact over different distances. Physics involves study of these interactions across distances ranging from the very small (quantum and particle physics) to the very large (astronomy and cosmology). These key concepts will help you to develop a deeper understanding of physics and make links between the different topics.

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Skills, topics and assessment

What are the skills needed for the Cambridge International AS & A Level course?

For the examinations taken at AS & A Level, you will be assessed on assessment objectives (AOs) which detail the skills and knowledge you need to display in order to fulfil the requirements of the assessment. These skills are divided into three main groups:

AO1 Knowledge and understanding	**AO2** Handling, applying and evaluating information	**AO3** Experimental skills and investigations

Each of AO1, AO2 and AO3 is divided further into specific skills.

How will I be assessed?

Each of the three AS Level papers are different in style. As part of your assessment, you will have multiple-choice questions and structured questions. You will also have a practical test.
At A Level there are an additional two papers. Paper 4 contains structured questions and Paper 5 is based on the practical skills of planning, analysis and evaluation.

You should have the opportunity to increase your experience of handling simple apparatus during your course. You can gain good marks through sensible and quite simple thinking, rather than rote learning, both in the practical and theory papers.

What topics will be studied?

Cambridge IGCSE Physics 0625 serves as a foundation for Cambridge International AS & A Level Physics 9702 which prepares you for the study of physics and engineering at university. There are some areas of the Cambridge International AS & A Level syllabus which you will already have studied and some areas that will be new to you. The table below details similarities and areas of progression between the IGCSE and the International AS & A Level syllabus.

Where topics are completely new, there may be more terminology to familiarise yourself with and you may need to read around these topics more widely to consolidate your knowledge and understanding.

Six areas of progression from Cambridge IGCSE Physics 0625
Kinematics • All of the equations of uniformly accelerated motion are studied, giving a complete description of one-dimensional motion with uniform acceleration • You will study projectile motion in two dimensions
Dynamics, Forces, Density and Pressure • Conservation of momentum is covered in one and two dimensions • You will study forces in more detail including vector triangles for 3 forces in equilibrium
Waves • You will study the change in observed frequency caused by the Doppler Effect • This topic also includes polarisation, interference, and stationary waves

Electricity and D.C. circuits • You will study the way moving charge carriers make an electrical current and calculate the speed at which they move • Kirchhoff's Laws for analysing circuits are introduced and potential dividers are studied in more detail
Magnetic Fields • You define what is meant by a magnetic field and go on to describe the motion of charged particles in magnetic fields, such as in the Large Hadron Collider or a mass spectrometer
Nuclear Physics • You will understand the equivalence between energy and mass as represented by $E = mc^2$ • You will study the importance of binding energy in nuclear reactions, particularly involving fission and fusion

Six new topics or skills at Cambridge International AS & A Level Physics 9702
Particle Physics • You study antimatter and fundamental particles including some of the different types of quark and lepton to extend your understanding of the standard model of the atom
Gravitational Fields • You will use Newton's law of gravitation to study the motion of objects in orbit • You will see how gravitational potential can be used to predict the behaviour of objects in space, and use it to calculate quantities such as the escape velocity from the Earth or the Moon.
Oscillations and Simple Harmonic Motion • You study simple harmonic motion which explains the complete motion of a mass on a spring or a simple pendulum • You learn about forced oscillations, making structures vibrate strongly when resonance occurs
Quantum Physics • You will study the photoelectric effect and its explanation in terms of photons • You will look at evidence that light and matter both act like waves and particles and study the consequences of this
Medical Physics • You will study the production and use of ultrasound and X–rays in medicine • You will look at the role of positrons and gamma-ray photons in PET scanning
Astronomy and Cosmology • You will study how stars can act as standard candles when measuring astronomical distances • You will use Hubble's Law and ideas about redshift to provide evidence for the Big Bang theory of the Universe

Resources

Although some of the resources for AS & A Level are similar to those for Cambridge IGCSE, such as past papers and endorsed textbooks, your learners may not have much experience of looking for themselves on websites or reading around a topic for interest and understanding. Learning new skills and tackling new resources is all part of the challenge for learners of stepping up to Cambridge International AS & A Level Physics.

Past/specimen papers and mark schemes

Past examination papers and specimen papers provide opportunities for learners to become familiar with the assessment requirements of the course. Learners should try to get as much practice in as they can before their final exams. You can refer to the accompanying mark schemes to guide your learners as to how they will be assessed and how they can improve their responses.

Textbooks

There is a wide variety of textbooks available, some which cover the entire course and others which specialise in certain topics. Give your learners a list of suggested reading materials. There are several endorsed textbooks which are currently available for this course.

To find a list of the endorsed textbooks go to www.cambridgeinternational.org

Websites

There are some specific AS & A Level Physics revision sites which are great to use. You can also use general search engines to find information although some sites might be more relevant than others. Sometimes, teachers put lesson presentations on the internet that you can use. Remember to check all internet resources for suitability, making sure that the content is relevant for your syllabus. Also, some websites tend to match a certain syllabus. That does not mean that they are not useful, you will just need to be selective about the topics that you choose from them.

www.cambridgeinternational.org
Provides access to the syllabus, past papers and mark schemes.

www.stem.org.uk
Navigate via ‘resources’ to Secondary and A Level Science. You will need to create an account if you have not used this resource before. The physics section is subdivided in familiar topics and each topic contains (or is linked to) a wide range of resources, e.g. detailed lesson plans, videos and interactive animations.

https://spark.iop.org
Navigate to ‘Teaching Advanced Physics’. This site gives ideas and resources for teaching physics, grouped in familiar topics.

https://phet.colorado.edu
This site contains a vast range of physics simulations, often of experiments which are difficult to perform within the laboratory. You will need to register to gain full functionality, for example to download the teacher notes which are essential for each activity.

www.youtube.com/user/minutephysics
This site contains some entertaining and thought provoking ‘sketch type’ videos which are particularly useful for wave particle duality and explaining the Universe.

www.particleadventure.org
This is an excellent resource to accompany the Particle Physics topic. It provides a comprehensive set of resources and activities for all the aspects covered in this topic, with plenty of scope for independent and

active learning. In the additional features section, there is a link to a highly useful wall chart on Fundamental Particles and their interactions.

Suggested classroom activity

The plan below could be used to deliver a bridging lesson that supports the transition to AS & A Level study.

Subject: Physics	**Syllabus reference: 2. Measurement techniques**
Lesson objectives: To introduce the equation $s = ut + \frac{1}{2}at^2$ and gain experience with the uncertainty of measurements.	**Lesson outcomes:** Having measured reaction times using each hand, learners are able to use uncertainty to conclude whether the reaction times are the same or different.
Introduction: Introduce the equation of motion. If time allows, prove using $s = (u + v)\,t/2$ and $v = u + at$ and show a few examples of its use.	**Resources:** 30 cm ruler.
Main activities: • Hold the ruler near the 30 cm mark and let it hang vertically downwards. • Your partner places their thumb and index finger either side of the 0 cm mark ready to catch the ruler when it falls – make sure their fingers are not touching the ruler at the start. • Without warning let go of the ruler. Your partner then presses their fingers together to catch the ruler. (Note: sometimes pretend to let go and vary the time before you drop the ruler.) • Record the distance (in cm) along the ruler where the ruler is caught. This is the 'catching distance'. • Repeat five times with the same hand and calculate the average of the results (add all five numbers together and then divide by five). Decide if any result is so ridiculous (anomalous) it can be ignored. • Calculate the uncertainty in each 'catching distance' – this is half the difference between the largest and smallest values. • Now measure the 'catching distance' with your partner's other hand. • Swap over and measure your own 'catching distance' for each hand. • Calculate t the 'reaction time' for each hand using the formula $s = ut + \frac{1}{2}at^2$ where s is the 'catching distance', u the initial velocity (zero in this case), and a is the acceleration due to gravity 9.8 m s^{-2}. Calculate the uncertainty in each hand's reaction time by finding the maximum and minimum values. **Homework:** To make notes on the equations of motion from the textbook and answer simple questions.	
Organisation: Divide the class into groups of two or three learners.	**Plenary:** After learners have measured the reaction times of their two hands, introduce uncertainty – half the range of the readings. Ask learners to calculate their maximum and minimum reaction times to see whether there is any overlap between these times for each hand. If there is a clear difference, only then can it be concluded that the reaction times are different.

	Learners quote the average reaction time and the uncertainty and conclude whether each hand has the same reaction time and whether anyone in the class clearly has a shorter reaction time than everyone else.
Challenge: More able learners can calculate the percentage uncertainty in the catching distances and reaction times and compare.	**Assessment opportunities:** Formative assessment principles can be used to establish whether each learner is able to handle the rearrangement of the formula to calculate *t.*

Bridging exercise

Note for teachers

This activity is designed to follow on from the learning in the classroom activity. It makes use of a specimen question to give an indication of how each learner has gained knowledge and understanding from completing the earlier activity. Learners will need access to at least one of the endorsed textbooks. They will also need a copy of Question 2 from November 2017 Paper 21 and the accompanying mark scheme. These are available from the School Support Hub. As this is the first activity they have attempted, it would be a good idea to pair learners together, providing each with a study partner for support.

Learner task

You will now have completed your classroom activity and we hope you have enjoyed learning about a new equation of motion. You are going to complete the following activity to give you an idea of how you might work independently as part of a Cambridge International AS & A Level course. Make sure that you first use your resources, then your study partner and lastly your teacher for support.

Aim: We want you to:

- Read the following pages from an endorsed Cambridge International AS & A Level textbook to consolidate your understanding of the equations of motion, for example pages 20–23 of the coursebook by Sang *et al* **or** pages 14–17 of the revision guide by Hutchings **or** pages 8–10 of the workbook by Sang. You may also use similar pages from any other A Level textbook or workbook. Answer any of the short questions in these books as you go along.
- Use internet research to add some extra ideas to your notes. It is a good idea to keep a note of the websites that you used in case you want to return to them later. Try:

  www.khanacademy.org (you need to register) or www.bbc.com/education/guides/zgbggk7/revision/1
- See if you can find some other websites that you can share with your study partner and add to your useful website list.
- Work with a study partner to compare your ideas and answers. Try to support each other's note-taking. Add in any extra information that you have learned from your discussion with each other in a different colour pen.
- Now look at the past question you have been given – Question 2 from November 2017 Paper 21 – and underline the key terms and command words. Make sure that you understand what the question is asking you to do before you start.
- Work with a study partner to plan your answer and to write a first draft for the question. Remember, this is the first time that you have seen an AS Level question so don't worry if you find it challenging at this stage. You can use some of the ideas from IGCSE such as the gradient of the speed–time graph being equal to the acceleration, and the area under the graph being the distance covered, or you can calculate accelerations and distance using the equations of motion. Show that both methods give the same answer where they both apply.
- Now look at the mark scheme provided to self-assess your first draft. Answer these questions: what has gone well, and what could be improved? Add any additional ideas you might have into your answer in a different colour. If there is anything that you are not sure about, do some extra note-taking, chat to your study partner about it or ask your teacher.
- Fasten all your work together and submit it to your teacher. You have successfully completed an independent research task and your first AS Level-standard question. Great work!

Your completed activity will include: note-taking; internet research; example questions; first draft; and self-assessment.

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