



Introducing updated
Cambridge International
AS & A Level syllabuses for

SCIENCE

Biology 9700
Chemistry 9701
Physics 9702

The revised Cambridge International AS & A Level Biology, Chemistry and Physics syllabuses are available for first examination in June 2016.

For Cambridge schools in India, the first assessment of these syllabuses will be in March 2016.

Cambridge International AS & A Levels – international recognition

Cambridge International AS & A Levels are internationally recognised qualifications providing excellent preparation for university education.

Taken in more than 125 countries and offering a choice of more than 60 subjects, Cambridge International AS & A Level qualifications are designed to help students develop a deep understanding of subjects, as well as independent learning and constructive thinking skills which are valued by universities. We believe that well-designed curriculum and assessment practices provide an opportunity for learners to demonstrate their ability for creativity, critical thinking and problem-solving skills.

Schools and learners find Cambridge International AS & A Levels very flexible. Schools can offer almost any combination of the wide choice of subjects available. Learners have the freedom to select the subjects that are right for them – they either follow a broad course of study or specialise in a particular area.

The Cambridge approach supports schools to develop learners who are equipped for success in the fast-changing modern world. With over 150 000 learners around the world each year, and doubling every five years, Cambridge International AS & A Levels have been proven to be not just about getting into university but also helping learners to get on – at university, in life and employment beyond. They are widely recognised by employers and, every year, thousands of Cambridge International A Level learners gain places at the world's top universities.



Ofqual

Cambridge International Examinations is recognised by the Office of Qualifications and Examinations Regulation (Ofqual) – the regulator of examinations in England – to award qualifications. This means you can be sure our assessments and qualifications are monitored and meet appropriate standards. We work closely with Ofqual to maintain our recognised status.

Learn more!

More details about support available for these syllabuses can be found at www.cie.org.uk/alevelsupport. If you have any questions about implementing a new subject, our support teams are always happy to help. Contact us at info@cie.org.uk

As part of our regular review process, we're pleased to introduce updates to seven of our most popular Cambridge International AS & A Levels for examinations starting in 2016.

The refreshed syllabuses retain the familiar features of the qualification and continue to give students the opportunity to demonstrate their ability for creativity, critical thinking and problem solving skills.

Following a worldwide consultation to check the syllabuses develop the skills universities require, we have updated our Accounting, Business, Chemistry, Economics, Biology, Physics and Literature in English syllabuses.

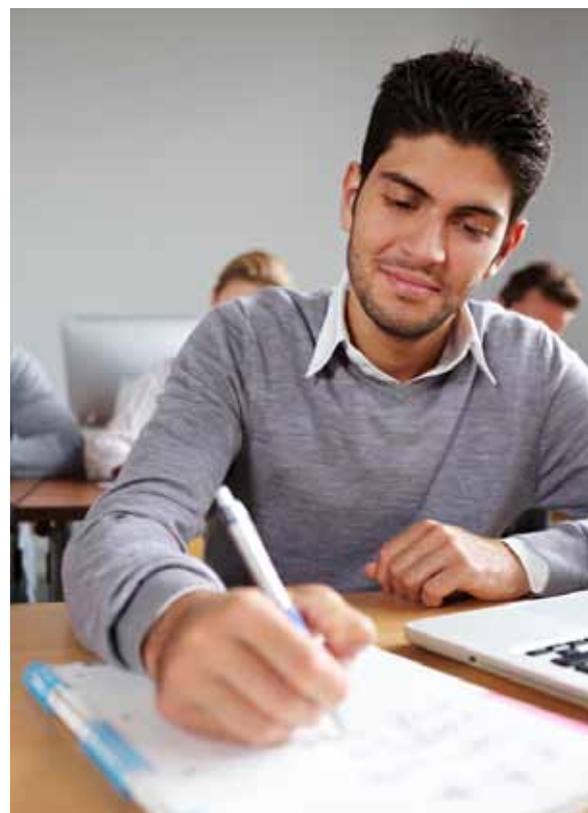
This document gives an overview of developments in Cambridge International AS & A Level Biology, Chemistry and Physics. Please refer to the full syllabus document before planning to teach these courses.

Important information



If your candidates studied the 2015 syllabus please note the following:

- Assessments in the 2016 examination series are based on the revised syllabus.
- Candidates can carry forward the result of their AS Level assessments in 2015 to complete the A Level in 2016 (subject to the usual time limit rules for carry forwards).
- Assessments for candidates retaking the AS or A Level in 2016 are based on the revised syllabus.



Cambridge International AS & A Level – Biology

Universities value learners who have a thorough understanding of key concepts in biology, an in-depth knowledge of biology’s most important themes and strong practical skills.

Cambridge International AS & A Level Biology encourages creative thinking and problem-solving skills, which are transferable to any future career path. The syllabus provides opportunities for well-designed studies of experimental and practical biological science. Practical skills are assessed in a timetabled practical examination.

The syllabus follows on from Cambridge IGCSE® and Cambridge O Level (or equivalent) and helps learners to develop the knowledge and skills that will prepare them for successful university study. It is ideal for learners who want to study Biology or a wide variety of related subjects at university or want to follow a career in science. Our course will help learners to develop lifelong skills of scientific enquiry, communication and teamwork as well as confidence in technology.

Key Concepts

We have identified the following key concepts for Cambridge International AS & A Level Biology. These concepts help teachers to encourage learners to make links between syllabus topics and develop a deeper understanding of the subject:

- **Cells as the units of life** A cell is the basic unit of life and all organisms are composed of one or more cells. There are two fundamental types of cell: prokaryotic and eukaryotic.
- **Biochemical processes** Cells are dynamic: biochemistry and molecular biology help to explain how and why cells function as they do.
- **DNA, the molecule of heredity** Cells contain the molecule of heredity, DNA. Heredity is based on the inheritance of genes.
- **Natural selection** Natural selection is the major mechanism to explain the theory of evolution.
- **Organisms in their environment** All organisms interact with their biotic and abiotic environment.
- **Observation and experiment** The different fields of biology are intertwined and cannot be studied in isolation: observation and enquiry, experimentation and fieldwork are fundamental to biology.

Quick view of changes

The Cambridge International AS & A Level Biology syllabus has been updated. **Please read the whole syllabus before planning your teaching programme.** This syllabus is for examination in 2016, 2017 and 2018.

Key concepts

- We have identified key concepts to help learners make links more easily between the different topics and develop a deeper understanding of their subject.

Assessment

- We have changed the weighting and wording of the assessment objectives to bring the three sciences closer together. This encourages learners to apply their knowledge and understanding when solving problems, enabling them to use biology knowledge in different (and sometimes unfamiliar) contexts.

Syllabus content

- The mathematical requirements for this syllabus have changed to support progression. Mathematics is an increasingly important part of any Biology course at university. Updating the mathematical requirements to include statistical tests means that learners can make better sense of quantitative and qualitative data.
- Syllabus content has been reviewed and reorganised and the breadth and depth reviewed. Some content has been removed to make sure the course as a whole is more manageable. Some topics have been brought up-to-date to keep up with scientific developments. Combining applications and theory together supports coherent delivery and helps learners to understand what the theory is actually used for, and how it fits together with other topics.

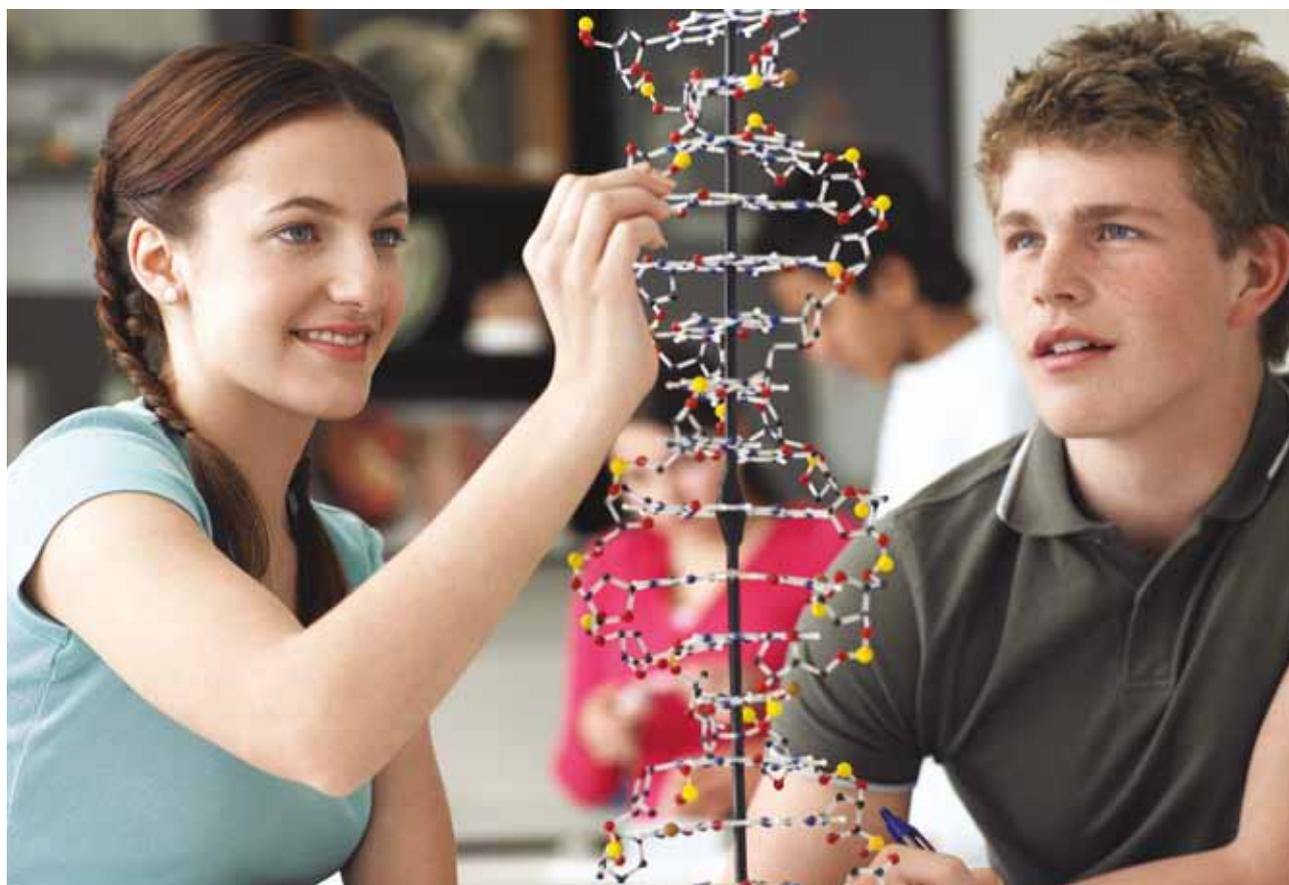
“The syllabus provides an appropriate introduction across topics, with breadth and depth traded off against each other effectively. The greater focus on application and practical skills is a real strength in terms of preparing students for university.”

Dr Mark Winterbottom, University Senior Lecturer in Science Education, University of Cambridge.



Syllabus content

AS Level topics	A Level topics
<p>Cambridge International AS Level Biology learners study the topics listed below.</p> <ul style="list-style-type: none"> ■ Cell structure ■ Biological molecules ■ Enzymes ■ Cell membranes and transport ■ The mitotic cell cycle ■ Nucleic acids and protein synthesis ■ Transport in plants ■ Transport in mammals ■ Gas exchange and smoking ■ Infectious disease ■ Immunity 	<p>Cambridge International A Level Biology learners study the AS topics and the topics listed below.</p> <ul style="list-style-type: none"> ■ Energy and respiration ■ Photosynthesis ■ Homeostasis ■ Control and coordination ■ Inherited change ■ Selection and evolution ■ Biodiversity, classification and conservation ■ Genetic technology



Assessment structure

Cambridge International AS Level candidates take Papers 1, 2 and 3.

Cambridge International A Level candidates take Papers 1, 2, 3, 4 and 5.

Component	Weighting	
	AS Level	A Level
<p>Paper 1 Multiple Choice This paper consists of 40 multiple choice questions, all with four options. All questions will be based on the AS syllabus content. Candidates answer all questions on the answer sheet.</p> <p>40 marks 1 hour</p>	31%	15.5%
<p>Paper 2 AS Level Structured Questions This paper consists of a variable number of questions, of variable mark value. All questions will be based on the AS Level syllabus content. Candidates answer all questions on the question paper.</p> <p>60 marks 1 hour 15 minutes</p>	46%	23%
<p>Paper 3 Advanced Practical Skills This paper requires candidates to carry out practical work in timed conditions. This paper will consist of two or three experiments drawn from different areas of the AS Level syllabus. Candidates will answer all questions on the question paper.</p> <p>40 marks 2 hours</p>	23%	11.5%
<p>Paper 4 A Level Structured Questions This paper consists of a variable number of structured questions, each with a variable mark value (Section A) and a choice of one free response style question worth 15 marks (Section B). All questions will be based on the A Level syllabus but may require knowledge of material first encountered in the AS Level syllabus. Candidates will answer on the question paper.</p> <p>100 marks 2 hours</p>	–	38.5%
<p>Paper 5 Planning, Analysis and Evaluation This paper consists of a variable number of questions of variable mark value based on the practical skills of planning, analysis and evaluation. Candidates will answer on the question paper.</p> <p>30 marks 1 hour 15 minutes</p>	–	11.5%

Assessment objectives

There has been a change in the weighting of the assessment objectives (AOs) so that AO1 (Knowledge with understanding) is now 40% instead of 45% and AO2 (Handling information and solving problems) is now 37% instead of 32%.

AO1 Knowledge with understanding (40% weighting)

A candidate should be able to demonstrate knowledge and understanding of:

- scientific phenomena, facts, laws, definitions, concepts and theories
- scientific vocabulary, terminology and conventions (including symbols, quantities and units)
- scientific instruments and apparatus used in biology, including techniques of operation and aspects of safety
- scientific quantities and their determination
- scientific and technological applications, with their social, economic and environmental implications.

AO2 Handling information and solving problems (37% weighting)

Candidates should be able to handle information and solve problems, using written, symbolic, graphical and numerical forms of presentation, in particular to:

- locate, select, organise and present information from a variety of sources
- translate information from one form into another
- manipulate numerical and other data
- use information to identify patterns, report trends and draw conclusions
- give reasoned explanations for phenomena, patterns and relationships
- make predictions and hypotheses
- apply knowledge, including principles, to new situations
- demonstrate an awareness of the limitations of biological theories and models
- solve problems.

AO3 Experimental skills and investigations (23% weighting)

Candidates should be able to:

- plan experiments and investigations
- collect, record and present observations, measurements and estimates
- analyse and interpret data to reach conclusions
- evaluate methods and quality of data, and suggest improvements.

Cambridge International AS & A Level – Chemistry

Cambridge International AS & A Level Chemistry builds on the skills acquired at Cambridge IGCSE, Cambridge O Level or equivalent level. The syllabus includes the main theoretical concepts that are fundamental to the subject, some current applications of chemistry, and a strong emphasis on practical skills.

The emphasis throughout is on the understanding of concepts and the application of chemistry ideas in novel contexts as well as on the acquisition of knowledge. Practical skills are assessed in a timetabled practical examination. The course encourages creative thinking and problem-solving skills, which are transferable to any future career path. Cambridge International AS & A Level Chemistry is ideal for learners who want to study chemistry or a wide variety of related subjects at university or to follow a career in science.

Key Concepts

We have identified the following key concepts for Cambridge International, AS & A Level Chemistry. These concepts help teachers to encourage learners to make links between topics and develop a deeper understanding of the subject.

- **Atoms and forces** Matter is built from atoms interacting and bonding through electrostatic forces. The structure of matter affects its physical and chemical properties, and influences how substances react chemically.
- **Experiments and evidence** Chemists use evidence gained from observations and experiments to build models and theories of the structure and reactivity of materials.
- **Patterns in chemical behaviour and reactions** By identifying patterns in chemical behaviour we can predict the properties of substances and how they can be transformed into new substances by chemical reactions. This allows us to design new materials of use to society.
- **Chemical bonds** The understanding of how chemical bonds are made and broken by the movement of electrons allows us to predict patterns of reactivity.
- **Energy changes** The energy changes that take place during chemical reactions can be used to predict both the extent and the rate of such reactions.

Quick view of changes

The Cambridge International AS & A Level Chemistry syllabus has been updated. **Please read the whole syllabus before planning your teaching programme.** This syllabus is for examination in 2016, 2017 and 2018.

Key concepts

- We have identified key concepts to help learners make links more easily between the different topics and develop a deeper understanding of their subject.

Assessment

- There has been a change in the weighting and wording of the assessment objectives to bring the three sciences closer together. This change in chemistry encourages learners to apply their knowledge and understanding when solving problems, and moves the focus of the syllabus away from just learning chemistry facts.
- Paper 4 (A Level Structured Questions): The assessment of core and applications topics will be integrated. There will no longer be a Section A and a Section B.
- Paper 5 (Planning, Analysis and Evaluation): The mark scheme has been adjusted.

Syllabus content

- This has been reorganised and the breadth and depth reviewed. A few topics have moved from AS to A Level and from A Level to AS Level. This is to improve progression through the course. Some topics have been brought up-to-date to keep up with scientific developments. Combining applications and theory together supports coherent delivery and helps learners to understand what the theory is actually used for, and how it fits together with other topics.
- The Data Booklet for use with Papers 1, 2 and 4 has been updated and modified to align with changes to the syllabus content.

“The qualification will provide learners progressing to chemistry degrees with an advantage in their university studies over many of their peers.”

Dr David Read, Principal Teaching Fellow, Head of Education Group and Director of Outreach (Chemistry), University of Southampton.

Syllabus content overview

The syllabus covers the following content. All learners study practical skills.

Physical chemistry	Inorganic chemistry	Organic chemistry and analysis
<ul style="list-style-type: none">■ Atoms, molecules and stoichiometry■ Atomic structure■ Chemical bonding■ States of matter■ Chemical energetics■ Electrochemistry■ Equilibria■ Reaction kinetics	<ul style="list-style-type: none">■ The Periodic Table: chemical periodicity■ Group 2■ Group 17■ An introduction to the chemistry of transition elements■ Nitrogen and sulphur	<ul style="list-style-type: none">■ An introduction to organic chemistry■ Hydrocarbons■ Halogen derivatives■ Hydroxyl compounds■ Carbonyl compounds■ Carboxylic acids and derivatives■ Nitrogen compounds■ Polymerisation■ Analytical techniques■ Organic synthesis



Assessment structure

Cambridge International AS Level candidates take Papers 1, 2 and 3.

Cambridge International A Level candidates take Papers 1, 2, 3, 4 and 5.

Component	Weighting	
	AS Level	A Level
<p>Paper 1 Multiple Choice This paper consists of 40 multiple choice questions, 30 of the direct choice type and 10 of the multiple completion type, all with four options. All questions will be based on the AS Level syllabus content. Candidates answer all questions on an answer sheet.</p> <p>40 marks 1 hour</p>	31%	15.5%
<p>Paper 2 AS Level Structured Questions This paper consists of a variable number of questions of variable mark value. All questions will be based on the AS Level syllabus content. Candidates answer all questions on the question paper.</p> <p>60 marks 1 hour 15 minutes</p>	46%	23%
<p>Paper 3 Advanced Practical Skills This paper requires candidates to carry out practical work in timed conditions. Candidates will be expected to collect, record and analyse data so that they can answer questions related to the activity. The paper will consist of two or three experiments drawn from different areas of chemistry. Candidates answer all questions on the question paper.</p> <p>40 marks 2 hours</p>	23%	11.5%
<p>Paper 4 A Level Structured Questions This paper consists of a variable number of free response style questions of variable mark value. All questions will be based on the A Level syllabus but may require knowledge of material first encountered in the AS Level syllabus. Candidates answer all questions on the question paper.</p> <p>100 marks 2 hours</p>	–	38.5%
<p>Paper 5 Planning, Analysis and Evaluation This paper consists of a variable number of questions of variable mark value based on the practical skills of planning, analysis and evaluation rather than their knowledge of theory. Candidates answer all questions on the question paper.</p> <p>30 marks 1 hour 15 minutes</p>	–	11.5%

The overall proportion of marks allocated to physical, inorganic and organic chemistry in Papers 1 and 2, taken together, and in Paper 4 will be in the approximate ratio 3:2:3.

Assessment objectives

There has been a change in the weighting of the assessment objectives (AOs) so that AO1 (Knowledge with understanding) is now 42% instead of 46%, AO2 (Handling, applying and evaluating information) is now 35% instead of 30% and AO3 (Experimental skills and investigations) is now 23% instead of 24%. There have been some minor changes to the descriptions of the assessment objectives.

AO1 Knowledge with understanding (42% weighting)

Candidates should be able to demonstrate knowledge with understanding in relation to:

- scientific phenomena, facts, laws, definitions, concepts, theories
- scientific vocabulary, terminology, conventions (including symbols, quantities and units)
- scientific instruments and apparatus, including techniques of operation and aspects of safety
- scientific quantities and their determination
- scientific and technological applications with their social, economic and environmental implications
- reasoned explanations for phenomena, patterns and relationships.

AO2 Handling, applying and evaluating information (35% weighting)

Candidates should be able (in words or by using symbolic, graphical and numerical forms of presentation to:

- locate, select, organise and present information from a variety of sources
- handle information, distinguishing the relevant from the extraneous
- manipulate numerical and other data and translate information from one form to another
- analyse and evaluate information so as to identify patterns, report trends and draw inferences
- construct arguments to support hypotheses or to justify a course of action
- apply knowledge, including principles, to new situations
- evaluate information and hypotheses.

AO3 Experimental skills and investigations (23% weighting)

Candidates should be able to:

- plan experiments and investigations
- collect, record and present observations, measurements and estimates
- analyse and interpret data to reach conclusions
- evaluate methods and quality of data, and suggest improvements.

Cambridge International AS & A Level – Physics

Cambridge International AS & A Level Physics builds on the skills acquired at Cambridge IGCSE, Cambridge O Level or equivalent level. The syllabus includes the main theoretical concepts, which are fundamental to the subject, some current applications of physics, and a strong emphasis on practical skills.

The emphasis throughout is on the understanding of concepts and the application of physics ideas in novel contexts as well as on the acquisition of knowledge. Practical skills are assessed in a timetabled practical examination.

The course encourages creative thinking and problem-solving skills, which are transferable to any future career path. Cambridge International AS & A Level Physics is ideal for learners who want to study physics or a wide variety of related subjects at university or want to follow a career in science.

Key Concepts

We have identified the following key concepts in Cambridge International AS & A Level Physics. These concepts help teachers to encourage learners to make links between topics and develop a deeper understanding of the subject.

- **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 that act over different length scales and magnitudes. These include the gravitational force and the electromagnetic force.

Quick view of changes

The Cambridge International AS & A Level Physics syllabus has been updated. **Please read the whole syllabus before planning your teaching programme.** This syllabus is for examination in 2016, 2017 and 2018.

Key concepts

- We have identified key concepts to help learners make links more easily between the different topics and develop a deeper understanding of their subject.

Assessment

- **Paper 1 (Multiple Choice)** – The time allowed for this question paper has been increased to 1 hour and 15 minutes so all candidates can engage with multi-step questions fully.
- **Paper 2 (AS Level Structured Questions)** – The time allowed for this question paper has been increased to 1 hour and 15 minutes following feedback from examiners and teachers.
- **Paper 3 (Advanced Level Practical Skills)** – The mark scheme has been adjusted. This offers a broader range of practical questions to be set and ensures assessment over time does not become predictable. It allows candidates to be rewarded for different skills in the assessment.
- **Paper 4 (A Level Structured Questions)** – The assessment of core and applications topics will be integrated. There will no longer be a Section A and a Section B.
- **Paper 5 (Planning, Analysis and Evaluation)** – The mark scheme has been adjusted.

Syllabus content

- This has been reorganised and the breadth and depth reviewed. A few topics have moved from AS to A Level and from A Level to AS Level. This is to improve progression through the course. Some topics have been brought up-to-date to keep up with scientific developments. Combining applications and theory together supports coherent delivery and helps learners to understand what the theory is actually used for, and how it fits together with other topics.
- Please refer to the full syllabus for changes to learning outcomes.
- Data and formulae sheet: please note changes as additional formulae have been included.

“The qualification is very good, in terms of developing and maintaining interest in the subject matter and mixing theory with application. The insertion of special relativity, using accessible mathematics, enhances this further.”

Dr A C H Cheung, Trinity College Research Fellow, University of Cambridge.

Syllabus content overview

AS Level topics	A Level topics
<p>Cambridge International AS Level Physics learners study the topics listed below.</p> <ul style="list-style-type: none"> ■ Physical quantities and units ■ Measurement techniques ■ Kinematics ■ Dynamics ■ Forces, density and pressure ■ Work, energy and power ■ Deformation of solids ■ Waves ■ Superposition ■ Electric fields ■ Current of electricity ■ D.C. circuits ■ Particle and nuclear physics 	<p>Cambridge International A Level Physics learners study the AS topics and the topics listed below.</p> <ul style="list-style-type: none"> ■ Motion in a circle ■ Gravitational fields ■ Ideal gases ■ Temperature ■ Thermal properties of materials ■ Oscillations ■ Communication ■ Capacitance ■ Electronics ■ Magnetic fields ■ Electromagnetic induction ■ Alternating currents ■ Quantum physics



Assessment structure

Cambridge International AS Level candidates take Papers 1, 2 and 3.
Cambridge International A Level candidates take Papers 1, 2, 3, 4 and 5.

Component	Weighting	
	AS Level	A Level
<p>Paper 1 Multiple Choice This paper consists of 40 multiple choice questions, all with four options. All questions will be based on the AS Level syllabus content. Candidates answer all questions on an answer sheet.</p> <p>40 marks 1 hour 15 minutes</p>	31%	15.5%
<p>Paper 2 AS Level Structured Questions This paper consists of a variable number of questions of variable mark value. All questions will be based on the AS Level syllabus content. Candidates answer all questions on the question paper.</p> <p>60 marks 1 hour 15 minutes</p>	46%	23%
<p>Paper 3 Advanced Practical Skills This paper requires candidates to carry out practical work in timed conditions. The paper will consist of two experiments drawn from different areas of physics. The experiments may be based on physics not included in the syllabus content, but candidates will be assessed on their practical skills rather than their knowledge of theory. Candidates answer both questions on the question paper.</p> <p>40 marks 2 hours</p>	23%	11.5%
<p>Paper 4 A Level Structured Questions This paper consists of a variable number of questions of variable mark value. All questions will be based on the A Level syllabus but may require knowledge first encountered in the AS Level syllabus. Candidates answer all questions on the question paper.</p> <p>100 marks 2 hours</p>	–	38.5%
<p>Paper 5 Planning, Analysis and Evaluation This paper consists of two questions of equal mark value based on the practical skills of planning, analysis and evaluation. The context of the questions may be outside the syllabus content, but candidates will be assessed on their practical skills of planning, analysis and evaluation rather than their knowledge of theory. Candidates answer both questions on the question paper.</p> <p>30 marks 1 hour 15 minutes</p>	–	11.5%

Assessment objectives

AO1 Knowledge with understanding (37% weighting)

Candidates should be able to demonstrate knowledge and understanding of:

- scientific phenomena, facts, laws, definitions, concepts and theories
- scientific vocabulary, terminology and conventions (including symbols, quantities and units)
- scientific instruments and apparatus, including techniques of operation and aspects of safety
- scientific quantities and their determination
- scientific and technological applications with their social, economic and environmental implications.

AO2 Handling, applying and evaluating information (40% weighting)

Candidates should be able (in words or by using symbolic, graphical and numerical forms of presentation) to:

- locate, select, organise and present information from a variety of sources
- translate information from one form to another
- manipulate numerical and other data
- use information to identify patterns, report trends, draw inferences and report conclusions
- present reasoned explanations for phenomena, patterns and relationships
- make predictions and put forward hypotheses
- demonstrate an awareness of the limitations of physical theories and models.

AO3 Experimental skills and investigations (23% weighting)

Candidates should be able to:

- plan experiments and investigations
- collect, record and present observations, measurements and estimates
- analyse and interpret data to reach conclusions
- evaluate methods and quality of data, and suggest improvements.



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Cambridge International AS & A Level subjects

Biology, Chemistry and Physics are available at Cambridge International AS & A Level. They focus on the understanding of concepts and the application of scientific ideas in novel contexts. The syllabuses develop creative thinking and problem-solving skills which are transferable to any future career path. They are ideal for learners who want to study Biology, Chemistry or Physics or related subjects at university, or for those who want to follow careers in science or medicine.

Cambridge International AS Level

Environmental Management

Physical Science

Cambridge International AS & A Level

Biology

Chemistry

Marine Science

Physics

Cambridge International AS & A Levels syllabuses build on the foundations of Cambridge IGCSE, the world's most popular international qualification for 14 to 16 year olds. For our full list of Cambridge IGCSE syllabuses visit www.cie.org.uk/igcse

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