

Physics Advanced Subsidiary (AS) and Advanced Level (AS + A2)



How the new curriculum will affect HE

1. The new advanced-level scene

Following the Dearing 'Review of Qualifications for 16-19 Year Olds', there has been a significant change in the pattern of provision in the school curriculum at 'sixth form' level. From September 2000, the traditional advanced level courses have been replaced by the Advanced Subsidiary (AS) and Advanced Level (AS + A2) programmes.

Advanced Subsidiary programmes are typically followed by students in the lower sixth (Year 12) and the intention is that they should form a broad-based course of four or more subjects, each leading to a qualification in its own right. The AS programmes are designed to provide an appropriate assessment of knowledge, understanding and skills expected of candidates who have completed the first half of a full Advanced Level qualification. The level of demand of the AS examination is thus that expected of candidates half-way through a full A-level course of study.

At the end of the first year of advanced study, there is the possibility of following up AS studies in some subjects (typically three in the upper sixth-Year 13) by taking further programmes at A2 level and thus gaining full advanced level qualifications in those subjects.

Most Advanced Level courses are modular in design, with the AS comprising three teaching and learning modules and the A2 comprising a further three modules. Each teaching and learning module is normally assessed through an associated assessment unit.

With the two-part format of Advanced-Level courses, schools may design an assessment schedule to meet their own and candidates' needs. Thus, for example:

- Assessment units may be taken at stages throughout the course, at the end of each year, or at the end of the total course;
- AS assessment may be completed at the end of the first year and A2 at the end of the second year;
- AS and A2 assessment may be completed at the end of the second year.

50% of the total award can be gained through assessment at AS level and 50% through assessment at A2 level.

2. Three Examination Boards (Awarding Bodies) and six Syllabuses (Specifications)

Following a rationalisation of Examination Boards, three unitary Awarding Bodies have been set up and each of these offers two advanced syllabuses, or *specifications*, in physics.

a. EDEXCEL: www.edexcel.org.uk

Edexcel foundation has been developed from BTEC (a leading provider of applied and vocational qualifications) and the London Examinations examining board. The two AS/A level specifications in physics offered by Edexcel are:

1. Advanced Subsidiary Physics, 8540 and Advanced Physics, 9540.
2. Advanced Subsidiary Physics (Salters Horners) 8552 and Advanced Physics (Salters Horners) 9552.

b. AQA: Assessment and Qualifications Alliance: www.aqa.org.uk

AQA has been formed from the Associated Examining Board (AEB), City and Guilds and the Northern Examinations and Assessment Board (NEAB). The two AS/A level specifications offered by AQA are:

1. Specification A (Manchester, NEAB): Advanced Subsidiary Physics, 5451 and Advanced Physics, 6451
 2. Specification B (Guildford, AEB): Advanced Subsidiary Physics, 5456 and Advanced Physics, 6456
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c. **OCR: Oxford, Cambridge & RSA Examinations:** www.ocr.org.uk

OCR has been formed from the Cambridge and Oxford A-level boards, the Midlands Examining Group (MEG) and the RSA Examinations Board. The two AS/A-level specifications offered by OCR are:

1. Physics A: Advanced Subsidiary Physics 3883 and Advanced Physics 7883.
2. Physics B: Advanced Subsidiary Physics (Advancing Physics) 3888 and Advanced Physics (Advancing Physics) 7888.

3. How much do the different physics specifications have in common?

In order to ensure some degree of commonality between the six advanced physics specifications listed above, the Qualifications, Curriculum and Assessment Authority (QCA) has defined a set of *subject criteria* for physics which can be found at: www.qca.org.uk/a-as/physics.htm.

The AS and A-level subject criteria set out the knowledge, understanding, skills and assessment objectives which must be common to *all* AS and A level specifications in a given subject. They provide the framework within which any awarding body must create the detail of their specification. The subject criteria are intended to:

- help ensure consistent and comparable standards in the same subject across the awarding bodies;
- define the relationship between the AS and A level specifications, with the AS as a subset of the A level;
- ensure that the rigour of A level is maintained;
- help higher education institutions and employers know what has been studied and assessed.

The knowledge, understanding and skills set out in these criteria should comprise about 60% of an AS specification and about 60% of an A level specification. The remainder of both the AS and A level specifications allows for further study and amplification of the areas of study set out, the introduction of different areas of study or a combination of both approaches. In addition to setting out the content which must be covered, the specifications also require students to carry out experimental and investigative activities which allow them to use their knowledge of physics in planning, carrying out and evaluating such activities, and which should involve the use of IT in data-processing and capture.

The Subject Criteria also prescribe the Assessment Objectives which must be addressed in each specification. The assessment objectives are set out in four areas:

AO1: Knowledge with understanding

AO2: Application of knowledge and understanding, synthesis and evaluation

AO3: Experiment and investigation

AO4: Synthesis of knowledge, understanding and skills

All A-level (AS plus A2) specifications in physics may have a maximum *internal assessment* weighting of 30%. All specifications should include a minimum of 15% *synoptic assessment* which involves the drawing together of knowledge, understanding and skills learned in different parts of the overall A-level course.

4. What physics is covered in the new specifications?

Given the fact that the contents listed in the subject criteria account for about 60% of the AS and A2 specifications, there is clearly the opportunity to develop specifications with their own distinctive features with regard to the physics included. Of the six specifications on offer, two stand out as offering a significant departure from more traditional approaches to advanced level physics, these are the EDEXCEL *Salters Horners* and the OCR *Advancing Physics* specifications. In both of these cases the pattern of physics provision has been re-thought, both in terms of the content of the specifications and the approach to assessment (particularly with regard to the nature of internally assessed coursework).

4.1 EDEXCEL

I. AS Physics, 8540: the modules offered are,

Unit 1: Mechanics and radioactivity

Unit 2: Current electricity and Thermal physics

Unit 3: Topics, students study one out of the following four topics...

3a: Astrophysics 3b: Solid materials 3c: Nuclear and particle physics 3d: Medical physics

The modules offered to complete the **Advanced Physics, 9540** are:

Unit 4: Waves and our Universe

Unit 5: Fields and forces

Unit 6: Synthesis

Comment

This specification has been designed to be ‘simple and transparent’ with some flexibility in choice of options. There is ‘continuity of provision’ from its predecessor the London Board Advanced-Level Physics syllabus, which allows for the use of existing resources. On-going coursework is not a requirement, with the Experiment and Investigation assessment objectives being addressed through Practical Tests in Units 3 and 5. The synoptic assessment is all carried out in Unit 6.

II. AS Physics (Salters Horners) 8552: the modules offered are,

Unit 1: Physics at work, rest and play; The sound of music; Technology in space; Higher, faster, stronger

Unit 2: Physics for life; Good enough to eat; Digging up the past; Spare part surgery

Unit 3: Working with physics; Coursework

The modules offered to complete the **Advanced Physics (Salters Horners) 9552** are:

Unit 4: Moving with physics; Transport on track; The medium is the message; Probing the heart of matter

Unit 5: Physics from creation to collapse; 5.1 Coursework; 5.2 Reach for the stars; Build or bust?

Unit 6: Exploring physics; Synoptic test

Comment

It is clear from the listing of modules that this specification departs from traditional formats and contents. Salters Horners Advanced Physics has been developed by the University of York Science Education Group, working with teachers, academic physicists and industrialists. The underlying rationale to the specification is that contexts and applications provide access points to the physics, thus providing interest and motivation for students.

For example, the unit ‘Good Enough to Eat’ involves a study of the production, testing and packaging of chocolate-covered biscuits, and other aspects of the food industry. The main physics content areas covered are: viscosity and fluid flow; mechanical properties of materials; refraction and polarisation.

Coursework is an integral part of this specification. The AS coursework assessment is based on laboratory practical activities that students have carried out as part of their normal school-based work and on a short written assignment relating to physics that students have observed during an out-of-school visit. The A-level coursework assessment is based on a two-week individual practical project for which students submit a written report.

4.2 AQA: Assessment and Qualifications Alliance

I. Specification A, AS Physics, 5451: the modules offered are,

Module 1: Particles, radiation and quantum phenomena

Module 2: Mechanics and molecular kinetic theory

Module 3: Current electricity and elastic properties of solids

The modules offered to complete **Specification A, Advanced Physics, 6451** are:

Module 4: Waves, fields and nuclear energy

Module 5: Nuclear instability

Module 6: students study one out of the following five topics...

Astrophysics, Medical physics, Applied physics, Turning points in physics, Electronics

Comment

Specification A has been designed to ‘offer continuity’ from its predecessor, the NEAB (Manchester) syllabus. There is the provision of optional topic areas in A2, Module 6, and coursework is offered as an alternative to practical examinations in both AS and A2.

II. Specification B: AS Physics, 5456: the modules offered are,

Module 1: Foundation physics

Module 2: Waves and nuclear physics

Module 3: Experimental work

The modules offered to complete **Specification B, Advanced Physics, 6456** are:

Module 4: Further physics

Module 5: Fields and their applications

Module 6: Experimental work

Comment

Specification B has been ‘derived from’ its predecessor, the AEB (Guildford) syllabus. The subject content is broadly based and has no optional topics. Assessment of practical skills is part of the scheme of assessment for both AS and A2. Practical assessment is by examination for AS and by externally set and marked exercises for A2.

4.3 OCR: Oxford, Cambridge & RSA Examinations

I. Physics A, AS Physics, 3883: the modules offered are,

- Module 1:* Forces and motion
- Module 2:* Electrons and photons
- Module 3:* Wave properties

The modules offered to complete **Physics A, Advanced Physics, 7883** are:

- Module 4:* Forces, fields and energy
- Module 5:* students study one out of the following five topics:
01: Cosmology, 02: Health physics, 03: Materials, 04: Nuclear and particle physics,
05: Telecommunications
- Module 6:* Unifying concepts in physics

Comment

Specification A covers all the content identified in the Physics Subject Criteria in compulsory modules, whilst including optional modules (Module 5) to give students the opportunity to explore an area of physics in depth. Some options deal with modern applications of physics, whilst others cover more traditional areas. The assessment of experimental skills is flexible, with coursework and practical examination alternatives in both AS and A.

II. Physics B: AS Physics (Advancing Physics), 3888: the modules offered are,

- Unit 1:* Physics in action
- Unit 2:* Understanding processes
- Unit 3:* Physics in practice...
Instrumentation task, Research and presentation, Making sense of data

The modules offered to complete **Physics B, Advanced Physics, (Advancing Physics) 7888** are:

- Unit 4:* Rise and fall of the Clockwork Universe, Practical investigation
- Unit 5:* Field and particle pictures, Research report
- Unit 6:* Advances in physics

Comment

Advancing Physics is a completely new programme which has been developed to reflect physics as it is practised and used today. It has been produced by a team of teachers and University physics educators, attached to the Institute of Physics and follows along the path of innovation charted by the Nuffield Advanced Physics projects.

In the AS course Units 1 and 2 are each set out in two parts and internally assessed coursework ('Physics in Practice') is integrated into those modules. For example, 'Understanding Processes' is organised around different ways of understanding processes of change, the focus being on 'curiosity-driven' physics. The first part of the unit, 'Wave and Quantum Behaviour' is mainly about superposition phenomena of waves, especially electromagnetic waves, with a brief account of the quantum behaviour of photons. The second part, 'Space, Time and Motion' develops classical mechanics, including vectors.

In A2, Unit 4 'Rise and fall of the Clockwork Universe' develops the grand conception of the world as a 'mathematical machine' which transformed Western culture. Within this unit, for example, 'Models and Rules' covers the core physics of random decay and the decay of charge on a capacitor, energy and momentum, the harmonic oscillator and circular orbits. The two internally assessed coursework components (Practical Investigation and Research Report) are less closely tied to the content of the course, allowing students to choose their own context for further study.

For each year of the course there is a Students' Book and CD-ROM and for the teacher and enhanced CD-ROM and Handbook, all published by IOP Publishing. The Advancing Physics website, <http://post16.iop.org/advphys>, maintained by the IOP, provides up-to-date material to support students and teachers and offers the means for teachers to share teaching ideas.