WHTC University application subject guides

Physics

This guide has been written to help support you in your application to university. It contains the following information relevant to your subject to help you decide where to apply and put together the best application that you possibly can:

1. Links to the top courses for this subject in the UK (according to
2. Entrance requirements
3. Recommended A-levels
4. Admissions tests
5. Recommended reading
6. Interesting MOOCs
7. Useful additional resources
8. Related courses
9. Oxbridge example interview questions

---

1. Course links

Below are links to the top courses for this subject in the UK (according to The Complete University Guide). Click on the links to find information about what the course is like, what you'll learn, and loads of information about things such as fees and accommodation. However, remember that there are loads of other great universities out there, so check out The Complete University Guide or just google studying your subject at university.

Most universities offer physics undergraduate degrees as either a 3 year BSc or 4 year MPhys programme. These are typically very similar (if not identical) in the first two years, but the final year of the MPhys offers an opportunity for the student to take on a research project.

1. University of Oxford – Physics (Physics & Philosophy also offered)
   http://www.ox.ac.uk/admissions/undergraduate/courses-listing/physics
2. University of St Andrews – Multiple Physics Programmes
   https://www.st-andrews.ac.uk/subjects/physics/
3. University of Cambridge – Natural Sciences
   https://www.undergraduate.study.cam.ac.uk/courses/natural-sciences
4. Durham University – Multiple Physics Programmes
   https://www.dur.ac.uk/physics/undergraduate/courses/
5. University of Birmingham – Multiple Physics Programmes
   https://www.birmingham.ac.uk/schools/physics/undergraduate/index.aspx
6. Imperial College London – Multiple Physics Programmes
   https://www.imperial.ac.uk/study/ug/courses/physics-department/
7. University of Warwick – Multiple Physics Programmes
   https://warwick.ac.uk/fac/sci/physics/prospective/undergraduate_study/
8. University of Manchester – Multiple Physics Programmes
   https://www.physics.manchester.ac.uk/study/undergraduate/courses/2021/
9. Lancaster University – Multiple Physics Programmes
   https://www.lancaster.ac.uk/physics/study/undergraduate/
10. University College London – Multiple Physics Programmes
    https://www.ucl.ac.uk/physics-astronomy/study/undergraduate-degrees

Here are some more excellent physics courses that offer lower entry requirements:

1. University of Surrey – Multiple Physics Programmes
   https://www.surrey.ac.uk/undergraduate/physics
2. University of Liverpool – Multiple Physics Programmes
   https://www.liverpool.ac.uk/study/undergraduate/courses/physics-mphys/overview/
3. Queen Mary – Multiple Physics Programmes
   https://www.qmul.ac.uk/undergraduate/coursefinder/courses/2021/physics/
4. University of Portsmouth – Multiple Physics Programmes
   https://www.port.ac.uk/study/courses/mphys-hons-physics

5. Keele University – Multiple Physics Programmes https://www.keele.ac.uk/study/undergraduate/undergraduatecourses/physics/

---

2. Entrance requirements

Here are the grades that the university suggests you need to get in to that course, and the likely offer that they will give you, in order of entry requirement.

1. University of Cambridge – A*A*A
2. Durham University – A*A*A
3. Imperial College London – A*A*A
4. University of Manchester – A*A*A/ A*AA
5. University of Oxford – A*AA
6. University of Birmingham – A*AA
7. University of Warwick – A*AA
8. University of St Andrews – AAA
9. Lancaster University – AAA
10. University College London – AAA
11. University of Surrey - AAB
12. University of Liverpool – ABB
13. Queen Mary - ABB
14. University of Portsmouth – BBB
15. Keele University – BBB/ ABC

---

3. Recommended A-levels

Different universities may differ as to what A-levels they ask you for. Some might list one subject as ‘essential’, while another might list the same subject as just ‘helpful’, so make sure to check out the course page (under Section 1 of

this document, or on the university website) to be sure what your chosen university expects!

However, for physics courses, you would be hard pressed to find a course that does not demand both Physics and Maths A-level. It is recommended that Mechanics modules are taken in Maths, and Further Maths A-level is usually the most desirable 3rd A-level.

For natural sciences courses, it may be desirable to study more than one of the three sciences at A-level. Chemistry is often a favourite studied alongside physics.

---

4. Admissions tests

What admissions tests are you typically required to sit in addition to submitting your application? This also differs from uni to uni, so if your chosen university isn't on this list, make sure you check out the course page so you know exactly what you need to apply.

In addition and prior to live interviews, Oxford and Cambridge will require applicants to sit an admissions test.

Oxford Physics Aptitude Test (PAT):
http://www.ox.ac.uk/admissions/undergraduate/applying-to-oxford/tests/pat

Cambridge Natural Sciences Admissions Assessment:
https://www.undergraduate.study.cam.ac.uk/files/publications/nsaa_specification_2020.pdf

Other universities are unlikely to require an admissions assessment.

5. Recommended reading

Reading some relevant books or articles is a really great way to demonstrate your passion for your chosen subject in your personal statement, and show how you've gone beyond the curriculum. Plus, if you really want to spend three years or more studying this subject at university, it should be enjoyable! Try taking notes and jotting down your thoughts as you're reading so that you can share some of this in your personal statement

Books

The following books are recommended as general reading for physics. Bill Bryson offers an engaging overview of the history and development of physics, right from the time of Aristotle, while Feynman teases out a number of interesting physics problems and phenomena from a more technical perspective:

A Short History of Nearly Everything – Bill Bryson

Six Easy Pieces – Richard Feynman

Six Not-So-Easy Pieces – Richard Feynman

Why does $E = mc^2$? – Brian Cox and Jeff Forshaw

Chaos – James Gleick

The following books give a gripping introduction to the wonders of space and the universe:

A Brief History of Time – Stephen Hawking

The Elegant Universe – Brian Greene

Hyperspace – Michio Kaku

The Fifth Essence – Lawrence Krauss

The following books provide a captivating introduction to some of the strange physics underlying the behaviour of particles on the smallest scales – quantum theory:

QED – Richard Feynman

How to Teach Quantum Physics to your Dog – Chad Orzel

Quantum – Manjit Kumar

Magazines

Physics Review – Perhaps the most relevant magazine resource for aspiring physics students at school, Physics Review offers topical articles, cutting-edge research and expert exam advice. It is an excellent companion to the sixth form physics experience.

New Scientist – One of the most widely read popular science magazines, NS publishes articles from across the spectrum of sciences and communicates the latest discoveries in a particularly accessible way. An excellent resource for getting to grips with where physics research is now.

Scientific American – The oldest continuously published monthly magazine in the US, SA is a more challenging and prestigious publication that may be of interest to many STEM enthusiasts.

6. Interesting MOOCs

Another great way of learning more about your chosen subject and demonstrating your interest is to take a MOOC, or Massive Open Online Course. These are free courses delivered by universities that you can take online. If the ones below don't take your fancy, try looking at Class Central - they have a huge list of different courses for every subject imaginable, and they're all free!

- **A Brief Guide to Everything** - Web Video - John Ellis, King's College London, CBE
- **Exploring Black Holes: General Relativity & Astrophysics** - Free Online Video - Free iTunes Video - Course Info & Free Video - Edmund Bertschinger, MIT
- **Fundamentals of Physics** - Free Online Video - Free iTunes Audio - Free Video & Course Materials - Ramamurti Shankar, Yale
- **Introductory Physics** - Free Online Video - Melvin Pomerantz, UC Berkeley
- **Physics I: Classical Mechanics** - Free Online Video - Walter Lewin, MIT
- **Physics II: Electricity and Magnetism** - Free Online Video - Walter Lewin, MIT
- **Physics III: Vibrations and Waves** - Free Online Video - Walter Lewin, MIT

More quantitative STEM subjects will look favourably on candidates that have some experience coding. This is by no means essential, and indeed very few applicants will have significant coding experience. However, if you do, you have demonstrated that you are committed to learning a skill that becomes very useful in research and academia. With that in mind, subscribing to one of these online Python courses could be a good idea:

- Codacademy - Learn Python 2

- Udactiy – Introduction to Python Programming

---

7. Useful additional resources

There are loads of other great things out there that you might want to look at to develop your interest and strengthen your application, from videos to podcasts, to websites. Here are a few suggestions:

Websites

It is worth noting that while you are encouraged to explore the exciting and bizarre aspects and history of modern physics, some universities may place more emphasis on your problem solving and analytical skills than how well-read you are. Helpfully, there are online resources to address this!

- *Isaac Physics:* This website contains lots of maths and physics problem solving questions.
- *British Physics Olympiad*: This website contains lots of past papers and solutions of problem solving type questions.
- *Next time*: This website contains some quite fun questions designed to make you think about physical concepts.
- *I want to study Engineering*: This website is just as useful for all applicants not just those applying to engineering.
- *Brilliant.org*: This website has some resources to test your mathematical and physics knowledge.
- *Gresham College:* Rather than offering questions and challenges, this website offers many live and recorded lectures delivered by researchers and academics - https://www.gresham.ac.uk/watch/?subject=science&subcat=physics

Scientific magazines and publications

Nature – www.nature.com

Free to access articles

Nature is a British multidisciplinary scientific journal, first published on 4 November 1869. It is one of the most recognizable scientific journals in the world, and was ranked the world's most cited scientific journal by the Science Edition of the 2018 *Journal Citation Reports* and is ascribed an impact factor of 43.070, making it one of the world's top academic journals.

New Scientist – www.newscientist.com

Free to access articles

New Scientist, first published on 22 November 1956, is a weekly English-language magazine that covers all aspects of science and technology. Based in London, it publishes editions in the UK, the United States, and Australia. Since 1996 it has been available online.

Discover – www.discovermagazine.com

Free to access articles

Discover is an American general audience science magazine launched in October 1980 by Time Inc.

Science - https://www.sciencemag.org

Free to access scientific articles

Science, also widely referred to as Science Magazine, is the peer-reviewed academic journal of the American Association for the Advancement of Science and one of the world's top academic journals.

Scientific journals

Warwick Journal Club

https://warwick.ac.uk/fac/sci/physics/outreach/journalclub

'This is aimed at people aged 16-18 who are studying physics and want to learn more about research within physics. Every Monday, we'll look at a different scientific paper covering completely different aspects of physics to attempt to understand some of the ideas and thoughts at the forefront of scientific thinking.'

Reading a scientific paper is a skill and Warwick have put together an incredible programme to help you do it. Each week they send out a new paper along with a list of comprehension questions designed to guide you through to understanding the implications of a paper.

I could list half a dozen other journals easily but honestly just go here. It'll be a consistent, handpicked paper designed to develop you as a physicist, what more could you want?

Youtube

Don't let your allergy to picking up a book prevent you from engaging with amazing physics content that will enhance your understanding and enthusiasm in the subject! The following youtube channels are extremely well produced and give concise and clear explanations and visualisations of physics concepts and phenomena.

- Kurzgesagt – A fascinating channel with awesome illustrations and a variety of topics. While the channel discusses many areas, from philosophy to biology, it's content on physics and the universe is outstanding.

- Veritasium – Maths, science and engineering content for the enthusiasts, answering the questions you've always (or never) wondered.

- 3Blue1Brown – Much more of a maths channel but with superb visualizations and a number of interesting physical applications.

- Physics Girl – Interesting videos and interviews exploring the depth and breadth of modern physics research.

- minutephysics – As the name would suggest, the channel offers some particularly succinct videos on topics in and beyond the school syllabus.

- **Practical Engineering-** A youtube channel which focuses on civil engineering with some additional mechanical/aerospace engineering content too. Well produced videos which will make you look at the built up area around you a little differently.

8. Related courses

At university, there are loads of different combinations of subjects that you can do. Maybe you might find one of these alternatives more interesting? A few ideas are listed below with a sample link, but in most cases there are lots of universities that offer these different combinations so make sure to have a good look around!

As well as pure physics degrees, there are many joint honours degrees that you may be interested in pursuing: Mathematics, Chemistry, Philosophy and even Music are sometimes offered as a joint school. Some universities (such as Cambridge and UCL) offer a Natural Sciences undergraduate programme in which students start from a broad curriculum of sciences and may only decide to specialise in Physics in the later years of the degree.

- University of Oxford - Physics & Philosophy: http://www.ox.ac.uk/admissions/undergraduate/courses-listing/physics-and-philosophy
- Imperial College London – Physics with Theoretical Physics: https://www.imperial.ac.uk/study/ug/courses/physics-department/theoretical-physics-msci/
- University College London - Chemical Physics: https://www.ucl.ac.uk/chemistry/study-here/undergraduate-degrees/msci-chemical-physics-f323
- University of Manchester – Mathematics and Physics: https://www.manchester.ac.uk/study/undergraduate/courses/2021/01684/mmathphys-mathematics-and-physics/
- University of Bath – Natural Sciences: https://www.bath.ac.uk/courses/undergraduate-2021/natural-sciences/

- Royal Holloway – Physics with Music: https://www.royalholloway.ac.uk/studying-here/undergraduate/physics/physics-with-music/

---

9. Oxbridge example interview questions

As you will know, applicants to Oxford and Cambridge have to take an interview in order to get a place. It is normal to get open-ended questions, as well as being given charts or pieces of writing to analyse. Here is a sample of the kind of questions you might get asked. Remember, you're supposed to not know the answer! They often deliberately choose topics that they think no one will have studied in order to make the questions fair. What they're looking for is to see how you think under pressure, and how you can present your ideas and your logic.

1) When an ice cube melts in a glass of water, does the water level increase, decrease or stay the same?
2) A tennis ball is placed on top of a basketball. The balls are dropped. To what height does the tennis ball bounce?
3) How high can you go up a mountain on just a Mars bar?
4) If you dig a hole right through the Earth and jump into it, what is your motion?
5) If you leave a fridge turned on in a thermally isolated room, what happens to the room?
6) If you could fold a piece of paper as many times as possible, how many times must you fold it to reach the moon?
7) Sketch the displacement time and velocity time graph for a skydiver jumping out of a plane.
8) Why can't you light a candle in a spaceship?
9) Why is the sky blue?
10) Two identical beakers with the same volume of water are placed on each pan of a double-pan balance. A steel ball is suspended from a string and submerged in the water of one of the containers. A hollow plastic ball of the same volume is submerged in the water of the other container and fastened

to the bottom of the beaker by a string. Will the balance move, and if so in which direction?

A ball, initially at rest, is pushed upwards by a constant force for a certain amount of time. Sketch the velocity of the ball as a function of time, from start to when it hits the ground.

Physics interview questions often start with a question like this which looks as though it could have come from the Physics Admissions Test. In this example, I've asked the student to sketch a graph, and then I'd help him or her to get through the problem. Students do make mistakes, and that's fine as I don't expect them to know all the material, especially as the interview progresses. It's not assumed that a less-talented student will need more help on any given problem, and for this reason it can be difficult for students to judge how well they're doing during the interview.

If a student gets things correct straight away, I just move on, either to further aspects of the original question, or to others. For instance, the above line of questioning could easily result in a discussion of satellites, orbits, weightlessness or dark matter. It's usually a guided discussion rather than a matter of getting answers right or wrong straight away. I want to see how students respond to guidance and how they correct themselves, hopefully less by guessing than by thinking through what they know and what I've told them. Or in other words, while I am looking for a correct answer in the end, I'm even more interested in rigorous thinking.