

The IB Diploma Programme, for students aged 16 to 19, is an academically challenging and balanced programme of education that prepares students for success at university and life beyond. Students take courses in six different subject groups, maintaining both breadth and depth of study. Physics higher level is in group 4, experimental sciences. In addition, three core elements—the extended essay, theory of knowledge and creativity, action, service—are compulsory and central to the philosophy of the programme.

**About the IB:** For over 40 years the IB has built a reputation for high-quality, challenging programmes of education that develop internationally minded young people who are well prepared for the challenges of life in the 21st century and able to contribute to creating a better, more peaceful world.

The IB subject briefs illustrate key course components in the IB Diploma Programme.

- I. Course description and aims
- II. Curriculum model overview
- III. Assessment model
- IV. Sample questions

## Overview of the physics higher level course and curriculum model

### I. Course description and aims

The IB Diploma Programme physics higher level course exposes students to this most fundamental experimental science, which seeks to explain the universe itself—from the very smallest particles to the vast distances between galaxies. Students develop traditional practical skills and techniques and increase facility in the use of mathematics, the language of physics. They also develop interpersonal skills as well as information and communication technology skills, which are essential in modern scientific endeavours—and are important life-enhancing, transferable skills in their own right. Students, moreover, study the impact of physics on society, the moral and ethical dilemmas, and the social, economic and environmental implications of the work of physicists.

Throughout this challenging course, students become aware of how scientists work and communicate with each other. Further, students enjoy multiple opportunities for scientific study and creative inquiry within a global context. In addition, the course is designed to:

- provide opportunities for scientific study and creativity within a global context that will stimulate and challenge students
- provide a body of knowledge, methods and techniques that characterize science and technology
- enable students to apply and use a body of knowledge, methods and techniques that characterize science and technology
- develop an ability to analyse, evaluate and synthesize scientific information
- engender an awareness of the need for, and the value of, effective collaboration and communication during scientific activities
- develop experimental and investigative scientific skills
- develop and apply the students' information and communication technology skills in the study of science
- raise awareness of the moral, ethical, social, economic and environmental implications of using science and technology
- develop an appreciation of the possibilities and limitations associated with science and scientists
- encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

### II. Curriculum model overview

#### Physics higher level

| Theory                         |                                                                                                                                                                                                                                                                                                                                                            | 180 hours        |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <i>Core</i>                    | 80 hours of instruction on eight topics <ul style="list-style-type: none"> <li>• Physics and physical measurement</li> <li>• Mechanics</li> <li>• Thermal physics</li> <li>• Oscillations and waves</li> <li>• Electric currents</li> <li>• Fields and forces</li> <li>• Atomic and nuclear physics</li> <li>• Energy, power and climate change</li> </ul> | 80 hours         |
| <i>Additional higher level</i> | 55 hours of instruction on six topics <ul style="list-style-type: none"> <li>• Motion in fields</li> <li>• Thermal physics</li> <li>• Wave phenomena</li> <li>• Electromagnetic induction</li> <li>• Quantum physics and nuclear physics</li> <li>• Digital technology</li> </ul>                                                                          | 55 hours         |
| <i>Options</i>                 | 45 hours of instruction on two additional topics <ul style="list-style-type: none"> <li>• Astrophysics</li> <li>• Communications</li> <li>• Electromagnetic waves</li> <li>• Relativity</li> <li>• Medical physics</li> <li>• Particle physics</li> </ul>                                                                                                  | 45 hours         |
| <b>Practical work</b>          |                                                                                                                                                                                                                                                                                                                                                            | <b>60 hours</b>  |
| Investigations                 |                                                                                                                                                                                                                                                                                                                                                            | 50 hours         |
| Group 4 project                |                                                                                                                                                                                                                                                                                                                                                            | 10 hours         |
| <b>Total teaching hours</b>    |                                                                                                                                                                                                                                                                                                                                                            | <b>240 hours</b> |

### III. Assessment model

#### Assessment for physics higher level

The IB assesses student work as direct evidence of achievement against the stated goals of the Diploma Programme courses, which are to provide students with:

- a broad and balanced, yet academically demanding, programme of study
- the development of critical-thinking and reflective skills
- the development of research skills
- the development of independent learning skills
- the development of intercultural understanding
- a globally recognized university entrance qualification.

The assessments aim to test all students' knowledge and understanding of key concepts through:

- applying and using scientific methods, techniques and terminology
- constructing, analysing and evaluating scientific hypotheses, research questions and predictions, scientific methods and techniques, and scientific explanations
- demonstrating both the personal skills of cooperation, perseverance and responsibility appropriate for effective scientific investigation and problem-solving and the manipulative skills necessary to carry out scientific investigations with precision and safety.

Students' success in the physics higher level course is measured by combining their grades on external and internal assessment.

Even multiple-choice questions require that students know what each term or concept means in order to respond correctly, demonstrating an understanding of both basic facts and complex concepts. Calculators are not permitted in the multiple-choice examination but students are expected to carry out simple calculations.

The internal assessment is of each student's practical or laboratory work. This includes the group 4 project, a total of 10 hours within the higher level course of 240 hours, in which students from different group 4 subjects collaborate in addressing a scientific or technological topic, allowing for concepts and perceptions from across the disciplines that "encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method".

#### Assessment at a glance

| Type of assessment    | Format of assessment                                                                                           | Time (hours) | Weighting of final grade (%) |
|-----------------------|----------------------------------------------------------------------------------------------------------------|--------------|------------------------------|
| <b>External</b>       |                                                                                                                |              | <b>76</b>                    |
| <i>Paper 1</i>        | Multiple choice                                                                                                | 1            | 20                           |
| <i>Paper 2</i>        | Data analysis, short answer and extended response                                                              | 2.25         | 36                           |
| <i>Paper 3</i>        | Short answer and extended response                                                                             | 1.25         | 20                           |
| <b>Internal</b>       |                                                                                                                |              | <b>24</b>                    |
| <i>Practical work</i> | Computer simulations and data-gathering exercises, such as data-analysis exercises and general laboratory work |              |                              |
|                       | Group 4 collaborative, interdisciplinary project                                                               |              |                              |

### IV. Sample questions

The following questions appeared in previous IB Diploma Programme physics higher level examinations.\*

1. Two binary stars emit radio waves of wavelength  $6.0 \times 10^{-2} \text{ m}$ . The waves are received by a radio telescope whose collecting dish has a diameter of 120m. The two stars are just resolved if their **minimum** angular separation in radian is of the order of  
A.  $2 \times 10^4$ .  
B.  $2 \times 10^2$ .  
C.  $5 \times 10^{-2}$ .  
D.  $5 \times 10^{-4}$ .  
(Paper 1)
2. With reference to the concept of fuel enrichment in a nuclear reactor, explain the advantage of enriching the uranium used in a nuclear reactor. (Paper 2)
3. State **two** fundamental differences between the standard model for quarks and leptons and the theory of strings. (Paper 3)

\* the syllabus for examinations current until 2016

Learn more about how the IB Diploma Programme prepares students for success at university by going online to [www.ibo.org/universities](http://www.ibo.org/universities) or email us at [recognition@ibo.org](mailto:recognition@ibo.org).