ST. JOSEPH'S INSTITUTION INTERNATIONAL MALAYSIA

PHYSICS HANDBOOK 2017-18

Why study Physics?

Physics is crucial to understanding the world around us, the world inside us, and the world beyond us. It is the most basic and fundamental science. Topics range from the very small in Particle Physics to the very large in the gravitational effects of planets. Also, physicists are problem solvers in nature. Their analytical skills make them versatile and adaptable.

There is a constant interplay between theoretical models and their relation to real world examples. This makes experimentation an essential part of the course. Students will be expected to critically reflect on methodology and precision of measurements to comment on the validity of their results and the mathematical relationships that are developed. If you have a passion for understanding how things work and enjoy scientific experiments and mathematics, then you should study physics.

As a subject, many universities require Physics for the study of engineering, physics, and computer science. The various skills that studying physics develops are useful far beyond the lab and are valued in a vast range of careers.

At SJII Malaysia, Physics is offered at both higher level (HL) and standard level (SL).

Approaches to teaching and learning in Physics

The Physics course is “concept based”. That means that it is based on a number of “big ideas”. This includes ideas like:

- Experimental relationships may be demonstrated and analysed using graphs and equations.
- The fundamental concept of energy and its conservation is the basis upon which much of science is built.
- Modelling a system allows scientists to predict and test implications of theory in situations that are too small to see or to extreme to be in.

Learning to learn in the context of big ideas, rather than thinking every lesson is separate, is a very empowering way of appreciating learning in general.

In addition, the Physics course considers the very nature of science and asks students to think about these deeply. For example:

- Scientific research brings evidence through experimentation

- Science is based on principles that have supporting evidence or theory that includes being testable and hence falsifiable

- Scientific work is highly collaborative and many innovative ideas come from different approaches to the same problem

Thus the teacher will not expect you to simply learn information then repeat it in an examination. The teacher will expect you to apply concepts and principles presented in class to new situations. This is the same in all IB DP subjects, not just Physics.

This means that we expect you to develop a ***broad set of skills***. How these skills can relate to Physics is outlined below.

Research skills – how to look up information and find things out for yourself in constructive ways, how to tell if information you have found is trustworthy and how to use information honestly. For example, you may need to research background information to support your findings in an experiment

Communication skills – this means expressing your judgements and views distinctly, writing responses to questions succinctly, and writing your individual assessment report well. This also includes in class discussions and how you write your calculations so that your problem solving is clearly understood.

Social skills – in Physics students often work in groups, for example during practical work. You are expected to participate fully. Collaboration involves being a listener as well as a leader.

Thinking skills – these skills are required in Physics in all aspects of the course. You must be prepared to learn how to analyse, explain, evaluate, discuss, make connections between theory and real-life as well as between topics and other IB courses.

Self-management skills – these are crucial to success in the IB DP, because you will be studying a lot of subjects and participating in a lot of activities. You must be able to work independently, effectively and in an organised manner.

This means that your teacher will also use a ***broad set of approaches***, including:

Inquiry – whilst teachers know that they have to give students information, they know that students finding things out and coming to conclusions by themselves rather than always being told is very good. Physics goes beyond what you have been told in class and successful students look to improve their problem solving skills to extend to new situations.

Emphasising concepts – teachers will try to encourage you to see the connections between topics, like some of the ideas above. For example, the conservation of energy and data analysis will be used in almost every unit but in different contexts. You cannot learn something and then not use it in the next unit.

Differentiation – teachers will use a variety of teaching strategies and approaches so that everyone's different needs and preferred ways of learning can be addressed. These may include group work, problem solving and presenting your ideas in front of the class

Development of independence – your teacher will set challenging tasks to do on your own, and have high expectations of you, so they will help you to develop their self-management skills.

Assessment – your teacher will use a variety of assessment methods and give feedback in different ways; he or she will also expect you to be able to assess your own and your classmates' work in a useful way. The aim is that you will not simply be looking to see what marks you have got – but what you *need to do next in order to improve.*

Physics and the IB learner profile

While you progress through your diploma programme studies and activities, you will develop a number of attributes. The IB calls this the IB "learner profile". This table shows you what the learner profile attributes are and some examples of how Physics develops these qualities.

We hope you will become …	Example in Physics
Inquirers	Students will use experimentation and video analysis to compare real-life examples to theory.
Knowledgeable	Students will develop a basic understanding of key concepts such as conservation of energy in order to solve problems.
Thinkers	Students will demonstrate evidence of critical reflective thinking on results from experimentation.
Communicators	Students will express their ideas and understandings orally during group discussions, in written form through solutions to mathematical problems as well as graphically.
Principled	Students will act with integrity and honesty is presenting their work while acknowledging the work of others.
Open-minded	Students will learn to appreciate there are many different ways to tackle a problem and that other methods may be valid even if they do not agree with them.
Caring	Students will learn how to respect and support others learning in class.
Risk-takers	Students will need to attempt problems that they have not encountered before and present their solutions without proof of being correct.
Balanced	IB Physics is just one part of the DP and together they make a whole student.
Reflective	Students will evaluate different experimental models to determine strengths and weaknesses in the methodology.

Topics studied

- Mechanics
- Thermal physics
- Waves
- Electricity and magnetism

- Circular motion and gravitation
- Atomic, nuclear and particle physics
- Energy production

Additional higher level (AHL)

- Further Wave phenomena
- Electric, Magnetic and Gravitational Fields
- Electromagnetic induction
- Quantum and nuclear physics

PLUS

One option, which is chosen by the teacher from the following:

A. Relativity

B. Engineering physics

C. Imaging

D. Astrophysics

Physics in the timetable at SJIIM

The IB requires 240 hours of teaching for HL and 150 hours of teaching for SL. At SJIIM, HL Physics is allocated three double lessons per week and SL Physics is allocated two double lessons per week.

It sometimes happens that HL and SL Physics are taught in the same class. In this case, the teacher will let the SL students know when they do not need to come to lessons. Sometimes students will find they need to go to all three lessons in a week; sometimes they will only attend one or two of the lessons in a week and sometimes there will be periods of time when they will not be required to attend at all.

The IB Physics course

The knowledge component or the theory behind the concepts is the basis on which experimental work is based. Students will spend approximately 25% of the class time doing practical work. Some topics will be introduced through experimentation. Both theory and practical work may be examined in the examination papers at the end of the course. Completed examination papers are sent to IB and marked by IB examiners.

In addition, students will complete a 10 hour Group 4 Project that focuses on collaboration between students and across the Science disciplines. There is also a 10 hour individual investigation, that each student much complete. The student, with

the teacher's guidance, chooses his or her own topic. Students will use the practical skills developed in the course to complete a 6-12 pages report. The investigation is marked by the teacher according to a set of criteria, then sent to IB and checked by IB moderators.

Assessment criteria for the Physics individual investigation

Here are the criteria that teachers use to mark the individual investigation.

CRITERION	EVIDENCE
Personal engagement	Has the student created and experiment that demonstrates originality? This does not have to be university level Physics, but it should not be a standard high school experiment. Where has the student made it their own through changes in methodology or variables investigated?
Exploration	Has the student created an experiment that is valid and produces sufficient data of a suitable quality and reliability?
Analysis	Has the student processed the data appropriately to demonstrate a relationship between the variables?
Evaluation	Has the student reflected on the method to determine strengths and weakness? Can the conclusions be applied to other situations?
Communication	Is the report easy to read using the correct terminology? Did the student properly cite resources that were used?

Difference between higher and standard level Physics

The difference between higher and standard level Physics is both the amount of content and the complexity of the material. Additional higher level topics usually are more abstract and involve more demanding problem solving techniques. Since the level of abstract thinking and problem solving is similar, many students take the same level in IB Mathematics and IB Physics. This is not a requirement. Students wishing to pursue a university level course in Physics or a related subject such as engineering or similar, should take higher level.

Final assessment in Physics

An overview of how you will be assessed on the final set of skills and knowledge that you have acquired is as follows.

LEVEL	ASSESSMENT	WEIGHTING (%)
HIGHER	3 exam papers	80
STANDARD	3 exam papers	80
EVERYONE	Individual investigation	20

Physics course outline

This table reflects the topics covered but not necessarily the order in which they will be taught.

Year 1	Topic 1	Scientific Inquiry	3 weeks
	Topic 4 Topic 9 HL only	Waves Wave Phenomena	10 weeks
	Topic 2	Mechanics	6 weeks
	Topic B4 HL only	Forced Oscillations and Resonance	2 weeks
	Topic 6	Circular Motion and Gravitation	4 weeks
	Topic 10 HL only	Gravitational Potential	2 weeks
	Topic 3	Thermal Physics	4 weeks
	Topic 7	Atomic, Nuclear and Particle Physics	6 weeks
Year 2	Topic 5	Electricity and Magnetism	8 weeks
	Topic 12 HL only	Quantum and Nuclear Physics	6 weeks
	Topic 8	Energy Production	3 weeks

	Topic 11 HL only	Electromagnetic Induction	4 weeks
	Option B	Engineering Physics	5 weeks
	Topic 10 HL only	Remainder of Electric, Magnetic and Gravitational Fields	4 weeks
	Examinations revision		8 weeks

Physics resources

Textbooks

The textbook we use is the Physics 2nd edition for the IB Diploma from Pearson Baccalaureate. It is written by Chris Hamper. (ISBN: 978 1 447 95902 1). It is available to the students both as a book and online version.

There are many other appropriate level textbooks that the students could use:

- IB Physics Course Book: 2014 Edition: Oxford IB Diploma Program 1st Edition by Michael Bowen-Jones and David Homer (ISBN-13: 978-0198392132)
- Physics for the IB Diploma Coursebook 6th Edition by K. A. Tsokos, Peter Hoeben and Mark Headlee (ISBN-13: 978-1107628199)
- Physics for the IB Diploma, 2nd edition by John Allum (ISBN-13: 978-1471829048)

Physics flash cards

There are boxed sets of Physics flash cards available for reference in the school library.

Websites and apps

There are many websites and apps – not all of them reputable, so beware. Reputable and useful ones include:

Khan Academy (app)
Inthinking Physics site (to which the school subscribes):
https://www.thinkib.net/physics

IBDP Physics Course outline

Year	Term	Topics Covered	Summative Assessment
1	1	Topic 1 Topic 4/9 Topic 2 part 1	Scientific Inquiry Report Unit tests
	2	Topic 2 part 2 Topic B4 Topic 6 Topic 10	Unit tests
	3	Topic 3 Topic 7	Unit tests INTERNAL EXAMINATIONS

Year	Term	Topics Learned	Summative Assessment
2	1	Internal Assessment Topic 5 Topic 12	Unit tests
	2	Topic 8 Topic 11 Option B Topic 10 part 2	Unit tests MOCK EXAMINATIONS
	3	Exam Preparation	EXTERNAL EXAMINATIONS