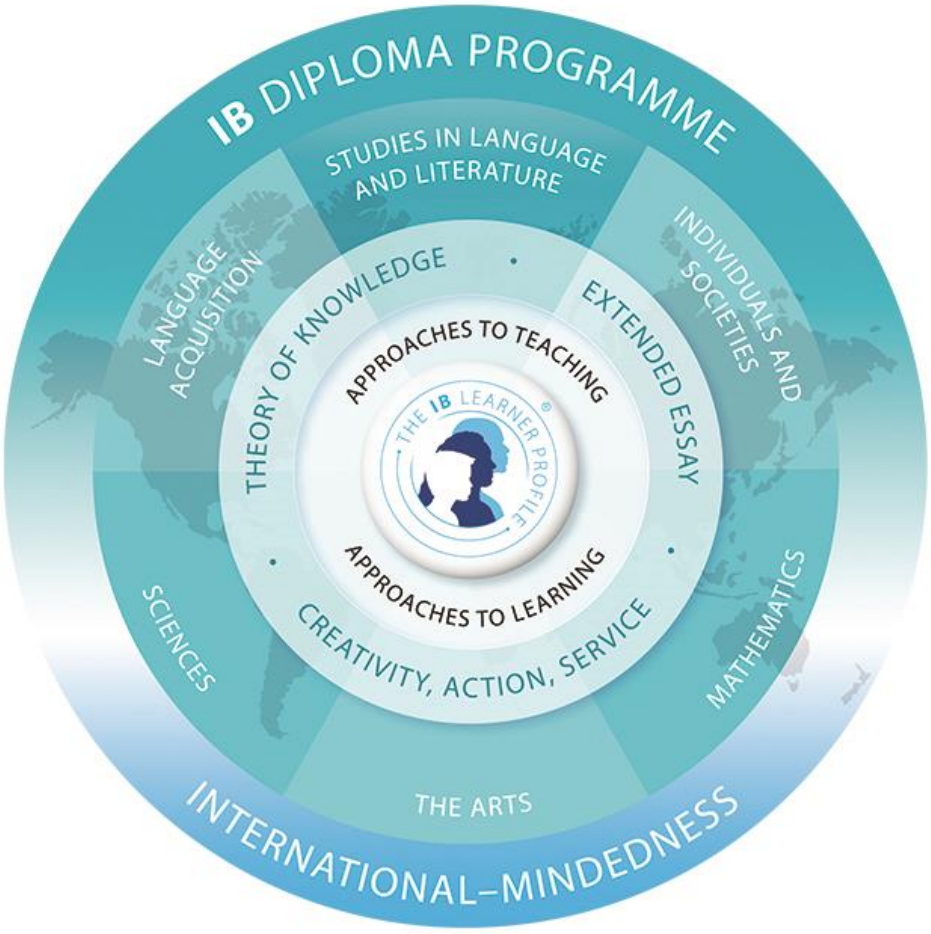
AYAZAĞA IŞIK LİSESİ

" Önce İyi İnsan Yetiştirir "

2019-2021 IB DIPLOMA PROGRAMME

PHYSICS SL

Course Booklet



Accredited by CIS

TABLE OF CONTENTS

INTRODUCTION

Physics is the most fundamental of the experimental sciences, as it seeks to explain the universe itself from the very smallest particles to the vast distances between galaxies. At the school level, both theory and experiments should be undertaken by all students. They should complement one another naturally, as they do in the wider scientific community.

The Diploma Programme physics course allows students to develop traditional practical skills and techniques and increase their abilities in the use of mathematics, which is the language of physics. It also allows students to develop interpersonal and digital communication skills which are essential in modern scientific endeavor and are important life-enhancing, transferable skills in their own right.

PHYSICS and NATURE OF SCIENCE (NOS)

The Nature of Science (NOS) is an overarching theme in the biology, chemistry and physics courses. Below mentioned how one or more of the NOS themes can be exemplified through the understandings, applications and skills in that particular topic. You should be familiar with NOS statements which will be mentioned in textbooks.

Topic 2 : Mechanics	**NOS Statement**
2.1 Motion	**Observations:** The ideas of motion are fundamental to many areas of physics, providing a link to the consideration of forces and their implication. The kinematic equations for uniform acceleration were developed through careful observations of the natural World. (1.8)

PHYSICS and THEORY OF KNOWLEDGE (TOK)

TOK lessons support students in their study of science, just as the study of science supports students in their TOK course. An example for TOK statement in physics course is below.

Topic 2 : Mechanics	**TOK Statement**
2.1 Motion (Projectile Motion)	The independence of horizontal and vertical motion in projectile motion seems to be counter-intuitive. **How do scientists work around their intuitions? How do scientists make use of their intuitions?**

PHYSICS and INTERNATIONAL MINDEDNES (IM)

Science itself is an international endeavor-the exchange of information and ideas across national boundaries has been essential to the progress of science. An example for IM in physics course is below.

Topic 2 : Mechanics	**IM Statement**
2.1 Motion	International cooperation is needed for tracking shipping, land based transport, aircraft and objects in space.

THE IB LEARNER PROFILE

The physics course contributes to the development of attributes of the IB learner profile. By following the course, students will have engaged with the attributes of the IB learner profile. For example, the requirements of the internal assessment provide opportunities for students to develop every aspect of the profile. For each attribute of the learner profile, a number of references from the Group 4 courses are given below.

Learner profile attribute	**Physics**
Inquirers	Aims 2 and 6 Practical work and internal assessment
Knowledgeable	Aims 1 and 10, international-mindedness links Practical work and internal assessment
Thinkers	Aims 3 and 4, Theory of knowledge links Practical work and internal assessment
Communicators	Aims 5 and 7, external assessment Practical work and internal assessment
Principled	Aims 8 and 9 Practical work and internal assessment. Ethical behaviour/practice (*Ethical practice* poster, *IB animal experimentation policy*), academic honesty
Open-minded	Aims 8 and 9, International-mindedness links Practical work and internal assessment, the group 4 project
Caring	Aims 8 and 9 Practical work and internal assessment the group 4 project, ethical behaviour/ practice (*Ethical practice* poster, *IB animal experimentation policy*)

Risk-takers	Aims 1 and 6 Practical work and internal assessment, the group 4 project
Balanced	Aims 8 and 10 Practical work and internal assessment, the group 4 project and fieldwork
Reflective	Aims 5 and 9 Practical work and internal assessment, the group 4 project

GROUP 4 AIMS

Through studying physics, students should become aware of how scientists work and communicate with each other. While the scientific method may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that characterizes these subjects.

The aims enable students, through the overarching theme of the Nature of science, to:

1. appreciate scientific study and creativity within a global context through stimulating and challenging opportunities
2. acquire a body of knowledge, methods and techniques that characterize science and technology
3. apply and use a body of knowledge, methods and techniques that characterize science and technology
4. develop an ability to analyze, evaluate and synthesize scientific information
5. develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities
6. develop experimental and investigative scientific skills including the use of current technologies
7. develop and apply 21st century communication skills in the study of science
8. become critically aware, as global citizens, of the ethical implications of using science and technology
9. develop an appreciation of the possibilities and limitations of science and technology
10. develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge.

SYLLABUS OUTLINE

Syllabus component of Physics	***Recommended teaching hours SL***
Core:	**95**
1. Measurements and uncertainties	5
2. Mechanics	22
3. Thermal physics	11
4. Waves	15
5. Electricity and magnetism	15
6. Circular motion and gravitation	5
7. Atomic, nuclear and particle physics	14
8. Energy production	8
Option:	**15**
A. Relativity	15
B. Engineering physics	15
C. Imaging	15
D. Astrophysics	15
Practical Scheme of Work (PSOW)	**40**
Practical activities	20
Individual investigation (internal assessment—IA)	10
Group 4 project	10
Total teaching hours	**150**

SEQUENCE OF TOPICS (SL)

Year 1 (11th Grade)	
	Topic
Semester - 1	Topic 1: Measurement and Uncertainities Topic 2: Mechanics Topic 6: Circular Motion and Gravitation Option B: Engineering Physics B.1: Rigid bodies and rotational dynamics Topic 3: Thermal Physics **Group 4 Projects**
Semester – 2	Option B: Engineering Physics B.2 : Thermodynamics Topic 8: Energy Production Topic 4: Waves **Group 4 Projects Presentations** **Investigations** **(Topic Choice and 1st draft)**

Year 2 (12th Grade)	
	Topic
Semester - 1	Topic 5: Electricity and Magnetism Topic 7: Atomic, Nuclear and Particle Physics **Investigations** **(2nd draft and final copy)**
Semester – 2	**Revision and Mock Exams** **May 2021 - Exams**

MATHEMATICAL REQUIREMENTS

All Diploma Programme physics students should be able to:

• perform the basic arithmetic functions: addition, subtraction, multiplication and division

• carry out calculations involving means, decimals, fractions, percentages, ratios, approximations and reciprocals

• carry out manipulations with trigonometric functions

• carry out manipulations with logarithmic and exponential functions (HL only)

• use standard notation (for example, 3.6 × 106)

• use direct and inverse proportion

• solve simple algebraic equations

• solve linear simultaneous equations

• plot graphs (with suitable scales and axes) including two variables that show linear and non-linear relationships

• interpret graphs, including the significance of gradients, changes in gradients, intercepts and areas

• draw lines (either curves or linear) of best fit on a scatter plot graph

• on a best-fit linear graph, construct linear lines of maximum and minimum gradients with relative accuracy (by eye) taking into account all uncertainty bars

• interpret data presented in various forms (for example, bar charts, histograms and pie charts)

• represent arithmetic mean using x-bar notation (for example, $\bar{x}$)

• express uncertainties to one or two significant figures, with justification.

DATA BOOKLET

The data booklet must be viewed as an integral part of the physics programme. It should be used throughout the delivery of the course and not just reserved for use during the external assessments. The data booklet contains useful equations, constants, data, structural formulas and tables of information. In the “Syllabus content” section of the subject guide, explicit links provide direct references to information in the data booklet which will allow students to become familiar with its use and contents. It is suggested that the data booklet be used for all in-class study and school-based assessments.

THE ASSESSMENT OBJECTIVES

The assessment objectives for physics reflect those parts of the aims that will be formally assessed either internally or externally. These assessments will center upon the nature of science. It is the intention of these courses that students are able to fulfill the following assessment objectives:

1. Demonstrate knowledge and understanding of:
   a. facts, concepts, and terminology
   b. methodologies and techniques
   c. communicating scientific information.

2. Apply:
- a. facts, concepts, and terminology
- b. methodologies and techniques
- c. methods of communicating scientific information.

3. Formulate analyses and evaluate:
- a. hypotheses, research questions and predictions
- b. methodologies and techniques
- c. primary and secondary data
- d. scientific explanations.

4. Demonstrate the appropriate research, experimental, and personal skills necessary to carry out insightful and ethical investigations.

ASSESSMENT OUTLINE—SL

Component	Overall weighting (%)	Approximate weighting of objectives (%)		Duration (hours)
		1+2	3	
Paper 1	**20**	**10**	**10**	**¾**
Paper 2	**40**	**20**	**20**	**1¼**
Paper 3	**20**	**10**	**10**	**1**
Internal assessment	**20**	**Covers objectives 1, 2, 3 and 4**		**10**

External assessment detailed mark schemes specific to each examination paper are used to assess students.

EXTERNAL ASSESSMENT DETAILS—SL

Paper 1

Duration: 3/4 hour

Weighting: 20%

Marks: 30

• 30 multiple-choice questions on core, about 15 of which are common with HL.

• The questions on paper 1 test assessment objectives 1, 2 and 3.

• The use of calculators is not permitted.

• No marks are deducted for incorrect answers.

• A physics data booklet is provided.

Paper 2

Duration: 1¼ hours

Weighting: 40%

Marks: 50

• Short-answer and extended-response questions on core material.

• The questions on paper 2 test assessment objectives 1, 2 and 3.

• The use of calculators is permitted.

• A physics data booklet is provided.

Paper 3

Duration: 1 hour

Weighting: 20%

Marks: 35

• This paper will have questions on core and SL option material.

• Section A: one data-based question and several short-answer questions on experimental work.

• Section B: short-answer and extended-response questions from one option.

• The questions on paper 3 test assessment objectives 1, 2 and 3.

• The use of calculators is permitted.

• A physics data booklet is provided.

May 2018 Physics SL Grade Boundaries for TZ 2

Subject: **PHYSICS** Level: **SL** Subject option: **PHYSICS** Timezone: **2**

PAPER 1 (MCQ)			PAPER THREE			PAPER TWO			PRACTICAL WORK			FINAL		
Grade	From	To	Grade	From	To	Grade	From	To	Grade	From	To	Grade	From	To
1	0	7	1	0	4	1	0	3	1	0	3	1	0	12
2	8	9	2	5	8	2	4	7	2	4	6	2	13	21
3	10	11	3	9	13	3	8	10	3	7	10	3	22	31
4	12	13	4	14	16	4	11	15	4	11	13	4	32	41
5	14	16	5	17	20	5	16	20	5	14	16	5	42	51
6	17	18	6	21	23	6	21	25	6	17	19	6	52	61
7	19	30	7	24	35	7	26	50	7	20	24	7	62	100

INTERNAL ASSESSMENT

Internal assessment enables you to demonstrate the application of your skills and knowledge, and to pursue your personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment should, as far as possible, be woven into normal classroom teaching and not be a separate activity conducted after a course has been taught.

The internal assessment, worth 20% of the final assessment, consists of one scientific investigation. The individual investigation should cover a topic that is commensurate with the level of the course of the study. Students work is internally assessed by the teacher and externally moderated by the IB. Internal assessment write up should be about 6 to 12 pages long. Some of the possible tasks include:

- a hands on laboratory investigation
- using a spreadsheet for analysis and modelling
- extracting data from a database and analyzing it graphically
- producing a hybrid of spreadsheet/database work with a traditional hands on investigation
- using a simulation, provided it is interactive and open ended

Internal assessment component

Duration: 10 hours
Weighting: 20%
• Individual investigation
• This investigation covers assessment objectives 1, 2, 3 and 4.

Internal assessment criteria
The new assessment model uses five criteria to assess the final report of the individual investigation with the following raw marks and weightings assigned:

Personal engagement	Exploration	Analysis	Evaluation	Communication	Total
2 (8%)	6 (25%)	6 (25%)	6 (25%)	4 (17%)	24 (100%)

Personal engagement

This criterion assesses the extent to which the student engages with the exploration and makes it their own. Personal engagement may be recognized in different attributes and skills. These could include addressing personal interests or showing evidence of independent thinking, creativity or initiative in the designing, implementation or presentation of the investigation.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1	The evidence of personal engagement with the exploration is limited with little independent thinking, initiative or creativity. The justification given for choosing the research question and/or the topic under investigation does not demonstrate personal significance, interest or curiosity. There is little evidence of personal input and initiative in the designing, implementation or presentation of the investigation.
2	The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or creativity. The justification given for choosing the research question and/or the topic under investigation demonstrates personal significance, interest or curiosity. There is evidence of personal input and initiative in the designing, implementation or presentation of the investigation.

Exploration

This criterion assesses the extent to which the student establishes the scientific context for the work, states a clear and focused research question and uses concepts and techniques appropriate to the Diploma Programme level. Where appropriate, this criterion also assesses awareness of safety, environmental, and ethical considerations.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	The topic of the investigation is identified and a research question of some relevance is stated but it is not focused. The background information provided for the investigation is superficial or of limited relevance and does not aid the understanding of the context of the investigation. The methodology of the investigation is only appropriate to address the research question to a very limited extent since it takes into consideration few of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of limited awareness of the significant safety, ethical or environmental issues that are relevant to the methodology of the investigation*.
3-4	The topic of the investigation is identified and a relevant but not fully focused research question is described. The background information provided for the investigation is mainly appropriate and relevant and aids the understanding of the context of the investigation. The methodology of the investigation is mainly appropriate to address the research question but has limitations since it takes into consideration only some of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of some awareness of the significant safety, ethical or environmental issues that are relevant to the methodology of the investigation.*
5-6	The topic of the investigation is identified and a relevant and fully focused research question is clearly described. The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation.

	The methodology of the investigation is highly appropriate to address the research question because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of full awareness of the significant safety, ethical or environmental issues that are relevant to the methodology of the investigation.*

Analysis

This criterion assesses the extent to which the student's report provides evidence that the student has selected, recorded, processed and interpreted the data in ways that are relevant to the research question and can support a conclusion.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	A conclusion is **outlined** which is not relevant to the research question or is not supported by the data presented. The conclusion makes superficial comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **outlined** but are restricted to an **account** of **the practical** or **procedural issues** faced. The student has **outlined** very few realistic and relevant suggestions for the improvement and extension of the investigation.
3-4	A conclusion is **described** which is relevant to the research question and supported by the data presented. A conclusion is described which makes some relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **described** and provide evidence of some awareness of the **methodological issues*** involved in establishing the conclusion. The student has **described** some realistic and relevant suggestions for the improvement and extension of the investigation.
5-6	A detailed conclusion is **described and justified** which is entirely relevant to the research question and fully supported by the data presented. A conclusion is correctly **described and justified** through relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **discussed** and provide evidence of a clear understanding of the **methodological issues*** involved in establishing the conclusion. The student has **discussed** realistic and relevant suggestions for the improvement and extension of the investigation.

Evaluation

This criterion assesses the extent to which the student's report provides evidence of evaluation of the investigation and the results with regard to the research question and the accepted scientific context.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1–2	A conclusion is **outlined** which is not relevant to the research question or is not supported by the data presented. The conclusion makes superficial comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **outlined** but are restricted to an **account** of the **practical** or **procedural issues** faced. The student has **outlined** very few realistic and relevant suggestions for the improvement and extension of the investigation.
3–4	A conclusion is **described** which is relevant to the research question and supported by the data presented. A conclusion is described which makes some relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **described** and provide evidence of some awareness of the **methodological issues*** involved in establishing the conclusion. The student has **described** some realistic and relevant suggestions for the improvement and extension of the investigation.
5–6	A conclusion is **described and justified** which is relevant to the research question and supported by the data presented. A conclusion is correctly described and justified through relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **discussed** and provide evidence of a clear understanding of the **methodological issues*** involved in establishing the conclusion. The student has **discussed** realistic and relevant suggestions for the improvement and extension of the investigation.

Communication

This criterion assesses whether the investigation is presented and reported in a way that supports effective communication of the focus, process and outcomes.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.
1-2	**The presentation of the investigation is unclear, making it difficult to understand the focus, process and outcomes.** The report is not well structured and is unclear: the necessary information on focus, process and outcomes is missing or is presented in an incoherent or disorganized way. The understanding of the focus, process and outcomes of the investigation is obscured by the presence of inappropriate or irrelevant information. There are many errors in the use of subject specific terminology and conventions*.
3-4	**The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes**. The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way. The report is relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.

	The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.

GROUP 4 PROJECT

The group 4 project is an interdisciplinary activity in which all Diploma Programme science students must participate. The intention is that students from the different group 4 subjects analyse a common topic or problem. The exercise should be a collaborative experience where the emphasis is on the processes involved in, rather than the products of, such an activity. In most cases students in a school would be involved in the investigation of the same topic. Where there are large numbers of students, it is possible to divide them into several smaller groups containing representatives from each of the science subjects. Each group may investigate the same topic or different topics—that is, there may be several group 4 projects in the same school. Students studying environmental systems and societies are not required to undertake the group 4 project.

The group 4 project allows students to appreciate the environmental, social and ethical implications of science and technology. It may also allow them to understand the limitations of scientific study, for example, the shortage of appropriate data and/or the lack of resources. The emphasis is on interdisciplinary cooperation and the processes involved in scientific investigation, rather than the products of such investigation. The choice of scientific or technological topic is open but the project should clearly address aims 7, 8 and 10 of the group 4 subject guides. Ideally, the project should involve students collaborating with those from other group 4 subjects at all stages. To this end, it is not necessary for the topic chosen to have clearly identifiable separate subject components. However, for logistical reasons, some schools may prefer a separate subject “action” phase

SCHOOL BASED ASSESSMENTS

The oral grades (2nd) for MEB reports will be given by using the following criteria.

FIRST YEAR (Grade 11)			**SECOND YEAR (Grade 12)**		
	1st term	**2nd term**		**1st term**	**2nd term**
Practicals	**20%**	**20%**	Practicals	**20%**	**-**
Quizzes	**30%**	**20%**	Quizzes	**20%**	**-**
Homeworks	**30%**	**20%**	Homeworks	**20%**	**-**
Participation	**20%**	**20%**	Participation	**20%**	**40%**
Mock Exams	**-**	**20%**	Mock Exams	**20%**	**60%**
TOTAL	**100**	**100**	**TOTAL**	**100**	**100**

- **Leading a practicle will be counted as 1st year 1st term’s first oral grade (performance)**
- **Group 4 project will be counted as 1st year 2nd term’s first oral grade (performance)**

- **Internal Assessment will be counted as 2nd year 1st term's first oral grade (performance)**
- **One of the mock exam will be counted as 2nd year 2nd term's first oral grade (performance)**

COMMAND TERMS FOR PHYSICS

Students should be familiar with the following key terms and phrases used in examination questions, which are to be understood as described below. Although these terms will be used frequently in examination questions, other terms may be used to direct students to present an argument in a specific way.

These command terms indicate the depth of treatment required.

Assessment objective 1

Command term	Definition
Define	Give the precise meaning of a word, phrase, concept or physical quantity.
Draw	Represent by means of a labelled, accurate diagram or graph, using a pencil. A ruler (straight edge) should be used for straight lines. Diagrams should be drawn to scale. Graphs should have points correctly plotted (if appropriate) and joined in a straight line or smooth curve.
Label	Add labels to a diagram.
List	Give a sequence of brief answers with no explanation.
Measure	Obtain a value for a quantity.
State	Give a specific name, value or other brief answer without explanation or calculation.
Write down	Obtain the answer(s), usually by extracting information. Little or no calculation is required. Working does not need to be shown.

Assessment objective 2

Command term	Definition
Annotate	Add brief notes to a diagram or graph.

Apply	Use an idea, equation, principle, theory or law in relation to a given problem or issue.
Calculate	Obtain a numerical answer showing the relevant stages in the working.
Describe	Give a detailed account.
Distinguish	Make clear the differences between two or more concepts or items.
Estimate	Obtain an approximate value.
Formulate	Express precisely and systematically the relevant concept(s) or argument(s).

Assessment objective 3

Command term	**Definition**
Analyse	Break down in order to bring out the essential elements or structure.
Comment	Give a judgment based on a given statement or result of a calculation.
Compare	Give an account of the similarities between two (or more) items or situations, referring to both (all) of them throughout.
Compare and contrast	Give an account of similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.
Construct	Display information in a diagrammatic or logical form.
Deduce	Reach a conclusion from the information given.
Demonstrate	Make clear by reasoning or evidence, illustrating with examples or practical application.
Derive	Manipulate a mathematical relationship to give a new equation or relationship.
Design	Produce a plan, simulation or model.
Determine	Obtain the only possible answer.
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Evaluate	Make an appraisal by weighing up the strengths and limitations.

Explain	Give a detailed account including reasons or causes.
Hence	Use the preceding work to obtain the required result.
Hence or otherwise	It is suggested that the preceding work is used, but other methods could also receive credit.
Justify	Give valid reasons or evidence to support an answer or conclusion.
Predict	Give an expected result.
Show	Give the steps in a calculation or derivation.
Show that	Obtain the required result (possibly using information given) without the formality of proof. “Show that” questions do not generally require the use of a calculator.

LESSON MATERIALS

The student should bring textbooks, portable computer, 4-ring binder, pens/pencils and Texas Instruments (TI-84 PLUS C) to class every day.

COURSE BOOK:

- Physics for the IB Diploma, Sixth Edition, K: A. Tsakos. Cambridge University Press 2014

  ISBN: 978-1-107- 62819-9

- Physics for the IB Diploma Exam Preparation Guide, Second edition, K. A. Tsakos, Cambridge University Press 2016

  ISBN: 978-1-107-49575-3

WEB ADDRESSES

https://phet.colorado.edu/

http://www.edumedia-sciences.com/en/

http://www.algodoo.com/

http://vcephysics.com/content/

http://www.phy.ntnu.edu.tw/ntnujava/

http://www.mrwaynesclass.com/

http://www.physicslab.co.uk/

RESPONSIBLE TEACHER

DİLARA AHSEN

dilara.ahsen@fmvisik.k12.tr

APPENDIX

See next page for 4/ICCS form which will be completed by the student

4/ICCS

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Candidate personal code:

Session:

Sciences: Individual candidate cover sheet

- The completed form should be retained by the school.

Title of the group 4 project:

Write a reflective statement of about 50 words outlining your involvement in the group 4 project: