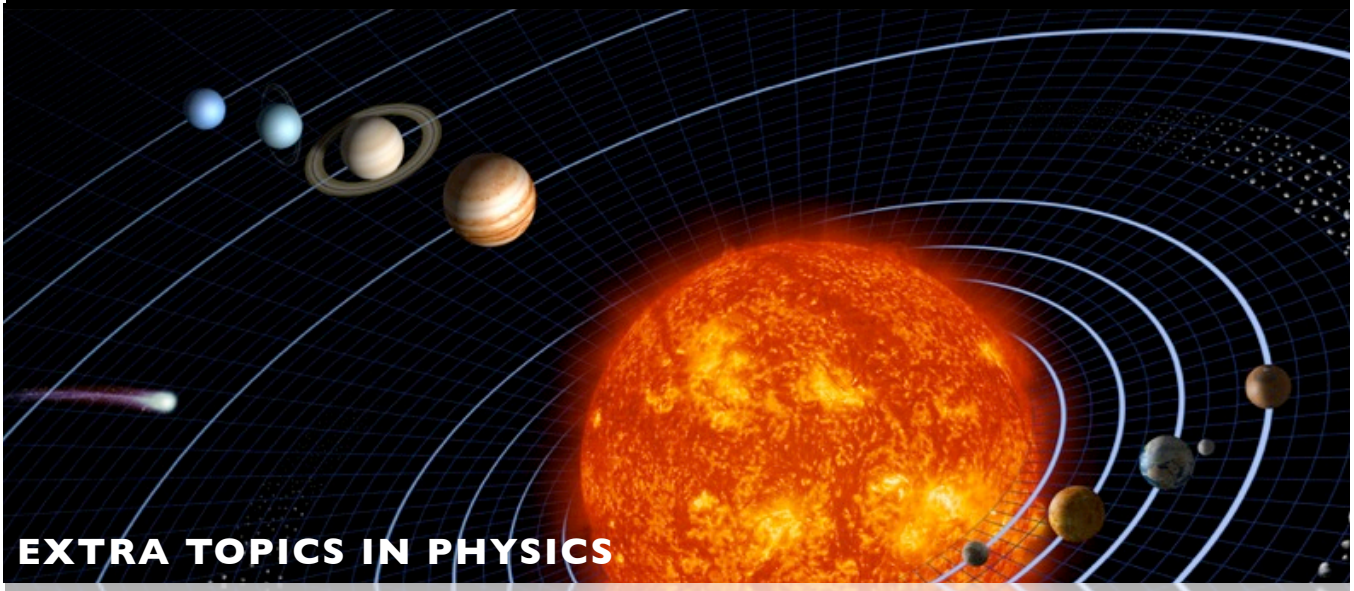

EXTRA TOPICS IN PHYSICS

PHY 203 902 LA

This course is designed to provide IB Diploma students with the necessary complement of topics in Physics to complete the requirements of the IB Higher Level Physics syllabus

Place in the program

Physics 902 is a complement to the three obligatory Ministerial Physics courses that have to be taken by all students in a Science Program. IB students take this course during their last semester.

The topics covered in this course (which are of great importance to modern scientific and technological pursuits) are selected from the following:
thermodynamics, special and general relativity, nuclear and particle physics, astrophysics, and cosmology.

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Several essential components of this class are only available through the website.

Be sure to check this site regularly.

Contribution to exit profile

This course being part of the International Baccalaureate (IB) diploma, it is designed to fulfill the IB learner profile. The aim of all IB programmes is to develop internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world. IB learners strive to be:

- **Inquirers**: They develop their natural curiosity. They acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives.
- **Knowledgeable**: They explore concepts, ideas and issues that have local and global significance. In so doing, they acquire in-depth knowledge and develop understanding across a broad and balanced range of disciplines.
- **Thinkers**: They exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions.
- **Communicators**: They understand and express ideas and information confidently and creatively in more than one language and in a variety of modes of communication. They work effectively and willingly in collaboration with others.
- **Principled**: They act with integrity and honesty, with a strong sense of fairness, justice and respect for the dignity of the individual, groups and communities. They take responsibility for their own actions and the consequences that accompany them.
- **Open-minded**: They understand and appreciate their own cultures and personal histories, and are open to the perspectives, values and traditions of other individuals and communities. They are accustomed to seeking and evaluating a range of points of view, and are willing to grow from the experience.
- **Caring**: They show empathy, compassion and respect towards the needs and feelings of others. They have a personal commitment to service, and act to make a positive difference to the lives of others and to the environment.
- **Risk-takers**: They approach unfamiliar situations and uncertainty with courage and forethought, and have the independence of spirit to explore new roles, ideas and strategies. They are brave and articulate in defending their beliefs.
- **Balanced**: They understand the importance of intellectual, physical and emotional balance to achieve personal well-being for themselves and others.
- **Reflective**: They give thoughtful consideration to their own learning and experience. They are able to assess and understand their strengths and limitations in order to support their learning and personal development.

Course Content

Teaching Schedule

This is a compressed course, in order to be completed before International Baccalaureate exams in May. As such, we meet four hours a week. There is no lab component for this course.

Students are expected to be in class on time, and to behave themselves in a dignified manner. Attendance is necessary but not sufficient to ensure success. While it is suggested that students spend at least three hours every week to complete the requirements of the course, most students will require close to five hours. It is absolutely essential that students arrange their schedule to include this period of preparation.

Textbook

The textbook used in this course, is **Essential University Physics**) by Richard Wolfson (2 volumes), available at the bookstore.

The IB topics are very well summarized in Tim Kirk's **Physics for the IB Diploma**, Standard and Higher Level. Oxford University Press. Oxford, 2008. This certainly does not constitute a manuel where to learn the material, but it is a great study guide, and I encourage you to purchase it if you do not already have it.

All problem sessions, additional material, and other relevant documents and information, will be available on your class website. It is your responsibility to download and print the documents BEFORE class. The website will be updated regularly, you must therefore check it often in order to keep informed with the latest news and information about the class.

Problem Solving

This should become your mantra; **solve problems... solve problems...** This class is problem-solving oriented. I wish to see if you are able to translate a written problem into mathematical notation, and solve it using the techniques learned in class. A list of suggested problems from the textbook is available on the website, as well as additional problems will be presented during problem sessions. The more problems you solve the easier the tests and exams will be. As a rule of thumb, you should solve **at least two problems a day!**

Previous years IB exams will be available for practice. Do not wait until the end of the semester to start looking at those exams.

Quizzes

These are 15-minutes questions requiring the solution of short problems, generally similar to those encountered in assignments. Spaced at roughly weekly intervals, throughout the semester, except when a test is scheduled.

Tests

These are 100-minutes tests, in class, requiring the solution of harder problems. There will be **four tests** during the semester.

Final Exam

Due to the IB exams, there is no final exam for this course.

Marking Scheme

The following is the marking scheme that will be used to attribute the final mark in this course. No alternate marking scheme is provided.

Quizzes	20%
Tests (4)	80%

The Omnivox LEA system, will be used to communicate the grade to students. However the official grade is calculated in the professor's markbook. In case of disagreement between the LEA calculation and the professor's, the latter will be considered correct.

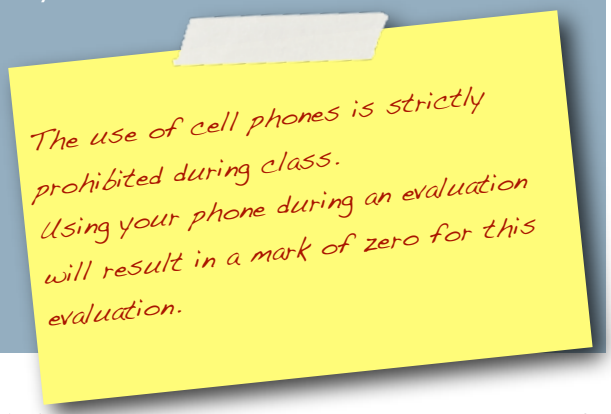
ABSENCE DURING AN EVALUATION

Students should be present for all classes, unless there is a serious emergency. A student who is absent for a test, a quiz must provide a medical note to the **Office of the Registrar** to justify their absence.

The Office of the Registrar will notify the teacher of the validated absence once the medical note has been received and validated. Unless the teacher receives a confirmation from the Office of the Registrar in due time, the absent student gets a zero mark for the evaluation.

PLAGIARISM

Cooperation between students during tests or quizzes is strictly prohibited; cases of cheating will be dealt with severely.



Topics discussed

The following lists the topics discussed during the course with the corresponding chapters in your textbook.

1. Thermodynamics

(Chapters 19, 20, 21, 22)

Temperature

Temperature and zeroth law of thermodynamics; Thermometers and the temperature scales; Thermal expansion of solids and liquids; Macroscopic description of an ideal gas.

Heat

Heat and internal energy; Specific heat and calorimetry; Latent heat; Work and heat; First law of thermodynamics and applications; Energy transfer mechanisms

Kinetic Theory of gases

Molecular model of an ideal gas; Molar specific heat of an ideal gas; Adiabatic processes; Equipartition of energy; Boltzmann distribution; Distribution of molecular speeds; Mean free path

Heat engines and Entropy

Heat engines and second law of thermodynamics; Heat pumps and refrigerators; Reversible vs Irreversible; Carnot engine; Gasoline and Diesel engines; Entropy

2. Nuclear Physics

Nuclear Physics

Nuclear Binding Energy; Radioactivity; Decay process; Nuclear Reactions; Fission/Fusion.

Chapter 44 and 45

Particle Physics

Beyond the nucleons, introduction to standard model of particles and interactions.

Chapter 46 and additional material

3. Special Relativity

Galilean relativity; Light as an EM wave; Michelson-Morley experiment; Einstein's principle of relativity; Time dilation; Length contraction; Space-time graphs; Twin paradox; Doppler effect; Lorentz transformation equations; Lorentz velocity transformations; Linear momentum and Newton's laws; Energy; Mass-Energy

(Chapter 39)

4. Astrophysics

(Supplied material and class notes)

The solar system and beyond

The night sky; General structure of the Solar System; Survey of the bodies comprising the Universe; Stellar clusters vs Constellations; Relative distances between stars and galaxies; Lightyear

Stars

Energy source, thermonuclear fusion; Equilibrium of a star; Luminosity and brightness; Blackbody radiation; Stellar spectra; Types of stars; Binary Systems; Hertzsprung-Russel diagrams

Stellar evolution

proto-star; main sequence; post-main sequence; late stages of stars

Stellar distances

Parallax method; Absolute and apparent magnitudes; Spectroscopic parallax; Cepheid variables

Cosmology

Olber's paradox; Big Bang Model; Development of the Universe; The particle connection

5. Energy, Power and Climate Change

Supplied material

6. Digital Technology

Supplied material