

GRADE 12 PHYSICS

Summer 2019

Class Time

- Tuesdays & Fridays 1:30–4:00pm (Dr. T. Leung)
- Tuesdays & Fridays 7:00–9:30pm (Dr. T. Leung)
- Saturdays & Sundays 4:00–6:30pm (Dr. T. Leung)
- Mondays, Tuesdays, Thursdays & Fridays 7:00–9:30pm (August only) (Mr. R. Lin)

Course Objectives

- Develop analytic skills, strategies, and habits of mind required for scientific inquiry, including critical thinking and inferring
- Develop communicative skills, strategies, and habits required for scientific inquiry
- Learn fundamental concepts of introductory high school physics
- Extend fundamental concepts beyond the mandate of the Ontario curriculum
- Gain exposure to both mainstream and unconventional applications of scientific concepts

Course Material

- No textbook required
- Course outline, presentation slides, homework assignments and solutions are downloadable from school website
- Please bring
 - A pen/pencil for note-taking
 - A scientific calculator for working in-class example problems

Course Outline

1. **Fundamentals of Dynamics** We extend our understanding of the concepts in kinematics and dynamics introduced in Grade 11 Physics, and apply them to problems of connected bodies and pulleys. We will also learn about uniform circular motion.
 - Kinematics: uniform motion and uniformed acceleration
 - Newton's laws of motion
 - Connected bodies, pulleys, tension
 - Uniform circular motion
2. **Energy and Momentum** We will introduce the concept of linear momentum, which is crucial in understanding Newton's laws of motion, and also in collisions. We will also strengthen our understanding of energy, including kinetic, gravitational potential and elastic energy, and apply conservation of energy in elastic collision problems.
 - Work and conservation of energy
 - Simple harmonic motion
 - Definition of momentum and impulse
 - Conservation of momentum
 - Elastic and inelastic collisions
 - Hooke's Law and elastic potential energy

3. **Force Fields** In this unit we study one of the most important concepts in physics: fields. We will study the three most common force fields that we experience every day: gravitational, electrical and magnetic fields.

- Gravitational force, field and potential energy
- Kepler's laws of planetary motion
- Newton's universal gravitation
- Orbital and escape velocities
- Potential and kinetic energies of objects in orbit
- Electric force, field, and
- Electric potential energy, electric potential, and electric potential difference
- Magnetic field
- Particle accelerators & mass spectrometers

4. **Wave Nature of Light** In this unit we gain understanding that light is a wave in nature. We will study how light propagates through a medium and through openings. Finally we study the nature of electromagnetic waves, which include light, infrared, ultraviolet and radio waves (among others).

- Reflection and refraction of light through a medium
- Dispersion of light
- Diffraction and interference of light through an opening
- Optical resolution and the Raleigh Limit
- Thin-film interference of light
- Nature of electromagnetic waves

5. **Modern Physics** In this unit we are introduced to two most important discoveries in physics: relativity, and quantum mechanics. In special relativity, we will revisit our fundamental understanding of space and time in order to describe motion close to the speed of light. We will then learn about the relativity of simultaneity, time dilation and length contraction. From there, relativistic mass, momentum, kinetic energy and mass-energy equivalence. In quantum mechanics, we study the seemingly contradictory notion of wave-particle duality. We will learn the discoveries that show that light behaves like particles and not waves, and probabilistic behaviour of electrons to gain some understanding in the fundamental nature of the relationship between waves and particles.

6. **Special Relativity**

- Postulates of special relativity
- Speed of light
- Relativity of Simultaneity
- Time dilation and length contraction
- Relativistic mass, momentum and kinetic energy
- Black-body radiation & the quantization of energy
- Photoelectric effect & the quantization of light (photon)
- Wave behaviour in particles
- Atomic structure
- Particle in a box

Tests

There will be two tests:

- A take-home midterm test due at the end of Class 8
- A 90-minute in-class final test on the last day

Classroom Expectations

Students are expected to:

- Be in your seat and ready to learn and participate during class.
- Stay on task without disturbing or distracting others.
- Raise your hand if you have any questions or comments and wait to be called. Don't wait too long before you ask a question.
- If you need to leave the class early, your parent needs to pick you up at the classroom door, or be brought to the front desk by a secretary.
- Be respectful for yourself, others, and the facilities; act in a responsible manner in everything you do.

Homework Expectation

- Homework is assigned after every class based on the topics covered
- Not regularly completing the homework prompts a phone call to communicate with the parents in order to help you better manage your time and achieve your goal.
- Late homework is accepted.
- For problem-solving questions, show *all* work by providing complete and organized steps. Answer the questions as if the reader is learning the concept from you, not as if s/he already understands it.
- If a question requires you to *explain*, please do so using complete sentences with supporting detail. There is no need to write full paragraphs.
- Proper math format must be used, e.g. proper use of "=" sign, units, etc.
- Circle or box all your final answers.
- Some of the more difficult questions will be taken up during class. However, this does *not* mean you don't need to do your homework at home. Always do your best.
- Please keep all returned homework assignments in your binder until the end of the term.
- The homework is marked with "P" for pass and "I" for incomplete. If you do get an "I", your teacher will let you know how to fix it so you can re-submit to pass the homework.

Pre-requisites

- **Physics 11:** Student will need to be familiar and comfortable with the concepts and topics covered in Grade 11 Physics. Some topics from Grade 10 Science and Grade 11 Physics are covered more in-depth in this course.