GRADE 11 PHYSICS

Olympiads School
Winter 2019

Class Time

- Wednesdays 7:00pm–9:30pm (Dr. T. Leung)
- Saturdays 7:10pm–9:40pm (Dr. T. Leung)
- Sundays 10:40am–1:10pm (Dr. L. Jedral)

Course Objectives

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

Course Material

- No textbook required
- Presentation slides and homework assignments 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. **Kinematics** We look at the mathematical descriptions of objects in motion. We will introduce the concept of *vectors* and *scalars*, and introduce vector motion quantities: position, displacement, velocity and acceleration. We relate these motion quantities using kinematic equations.
   - Measurements, significant figures and scientific notation
   - Vector vs. scalar quantities
   - Displacement, velocity and acceleration
   - Kinematic equations and motion problems
   - Acceleration due to gravity
2. **Motion in A Plane (Two-dimensional kinematics)** We extend our knowledge of motion into two dimensions, with applications in relative motion an projectile motion.
   - Vector decomposition
   - Vector arithmetic: addition & subtraction, multiplication & subtraction with a scalar
   - Relative motion
   - Projectile motion–kinematic equations in horizontal and vertical directions

3. **Newton's Laws of Motion** We introduce Newton's three laws of motion, which answers the question of *what makes things move?* We will relate forces (push/pull) to motion, and examine different types of everyday forces. We will use free-body diagrams ("FBDs") to find the total force on objects.
    - Newton's laws of motion
    - Free-body diagram
    - Everyday forces: gravity, normal force, static & kinetic friction
    - Application of forces
    - Fundamental forces
4. **Work and Mechanical Energy** We introduce a new concept of *work*, which relates forces to energy. We will study different kinds of energy, and how they are conserved.
    - Definition of work
    - Kinetic energy
    - Gravitational potential energy
    - Conservation of energy
    - **Take-home midterm test due at the end of the unit**
5. **Energy Transformation** We study heat as a form of energy. We introduce the concepts of specific heat capacity and specific latent heat to relate the changes in temperature/phase to energy. We will also study the concepts of power and efficiency. Finally, we will study different forms of energy sources and alternative fuel sources.
    - Thermal energy
    - Heat transfer
    - Power and efficiency
    - Alternative energy sources
6. **Transfer of Energy Through Vibrations and Waves** We study how energy is transmitted through waves. We begin by studying the behaviour of vibrating objects.
    - Vibrations (simple-harmonic motion); mass on a spring
    - Hooke's law
    - Properties of vibrations: frequency, period, amplitudes
    - Transverse and longitudinal waves
    - Standing waves
7. **Wave Model for Sound** We turn our attention to a specific application: sound wave. We will study the nature of sound waves, how it is transmitted, and how it is related to noise and music.
    - Speed of sound, Mach number
    - Doppler effect
    - Beat frequency, resonance frequencies, harmonics and overtones
    - Musical instruments
8. **Electrical Energy and Magnetism** We will relate electricity to our understanding of energy, and how these concepts are applied in circuits. We will also study how magnetism is related to electricity.
    - Parallel and series circuits
    - Electricity inducing magnetic Field
    - Magnetic field inducing electricity
    - **Take-home final exam due at the end of the unit**