Physics 12 / Advanced Physics 12

General Curriculum Outcomes

STSE

1. Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.

Skills

2. Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Knowledge

3. Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

Attitudes

4. Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

Specific Curriculum Outcomes

Students in Advanced Physics 12 will be expected to achieve the outcomes for Physics 12 as well as those for Advanced Physics 12.

Students will be expected to

Force, Motion, Work, and Energy (55%) (Advanced, 45%)

DYNAMICS EXTENSION

- use vector analysis in two dimensions for systems involving two or more masses, relative motions, static equilibrium, and static torques (ACP-1)

COLLISIONS IN TWO DIMENSIONS

- apply quantitatively the laws of conservation of momentum to two-dimensional collisions and explosions (326-3)
- determine in which real-life situations involving elastic and inelastic interactions the laws of conservation of momentum and energy are best used (326-4)

PROJECTILES

- construct, test, and evaluate a device or system on the basis of developed criteria (214-14, 214-16)
- analyze quantitatively the horizontal and vertical motion of a projectile (325-6)

CIRCULAR MOTION

- describe uniform circular motion using algebraic and vector analysis (325-12)
- explain quantitatively circular motion using Newton's laws (325-13)

SIMPLE HARMONIC MOTION (SHM)

- identify questions, analyze, compile, and display evidence and information to investigate the development over time of a practical problem, issue, or technology (212-3, 214-3, 115-5)
- explain qualitatively the relationship between displacement, velocity, time, and acceleration for simple harmonic motion (327-2)
- explain quantitatively the relationship between potential and kinetic energies of a mass in simple harmonic motion (327-4)
- compile and organize data, using data tables and graphs, to facilitate interpretation of the data (213-5)

UNIVERSAL GRAVITATION

- explain qualitatively Kepler's first and second laws and apply quantitatively Kepler's third law (ACP-2)
- explain and apply the law of universal gravitation to orbital notations by using appropriate numeric and graphic analysis (215-2)
- distinguish between scientific questions and technological problems as applied to orbital situations (115-1)

Fields (21%) (Advanced, 15%)

MAGNETIC, ELECTRIC, AND GRAVITATIONAL FIELDS

- explain the roles of evidence, theories and paradigms, and peer review in the development of the scientific knowledge associated with a major scientific milestone (114-2, 114-5, 115-3)
- communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others (215-1)
- describe magnetic, electric, and gravitational fields as regions of space that affect mass and charge (328-1)
- describe magnetic, electric, and gravitational fields by illustrating the source and direction of the lines of force (328-2)

- describe electric fields in terms of like and unlike charges, and magnetic fields in terms of poles (328-3)

Coulomb's Law

- define and delimit problems, estimate quantities, interpret patterns and trends in data, and infer or calculate the relationships among variables (212-2, 213-4, 214-5)
- compare Newton's law of universal gravitation with Coulomb's law, and apply both laws quantitatively (328-4)

Electric Circuits (Optional)

- apply Ohm's law to series, parallel, and combination circuits (ACP-3)
- carry out procedures controlling the major variables, selecting and using instruments effectively, accurately, and safely, and adapting or extending procedures where required (213-2, 213-3, 213-8)
- state a prediction and a hypothesis based on available evidence and background information (212-4)
- design an experiment and identify specific variables (212-6)

Electromagnetism and Electromagnetic Induction

- describe the magnetic field produced by a current in a long, straight conductor, and in a solenoid (328-6)
- analyze qualitatively the forces acting on a moving charge in a uniform magnetic field (328-5)
- analyze qualitatively electromagnetic induction by both a changing magnetic flux and a moving conductor (328-7)

Generators and Motors

- compare and contrast the ways a motor and generator function, using the principles of electromagnetism (328-9)
- describe and compare direct current and alternating current (ACP-4)

Waves and Modern Physics (12%) (Advanced, 10%)

Quantum Physics

- apply quantitatively the law of conservation of mass and energy using Einstein's mass-energy equivalence (326-9)
- explain how quantum physics evolved as new evidence came to light and as laws and theories were tested and subsequently restricted, revised, or replaced, and use library and electronic research tools to collect information on this topic (115-7, 213-6)
- describe how the quantum energy concept explains both black-body radiation and the photoelectric effect (327-9)
- explain qualitatively and apply the formula for the photoelectric effect (327-10)

Compton and de Broglie

- explain how a photon momentum revolutionized thinking in the scientific community (115-3)
- apply and assess alternative theoretical models for interpreting knowledge in a given field (214-6)

- explain quantitatively the Compton effect and the de Broglie hypothesis, using the laws of mechanics, the conservation of momentum, and the nature of light (329-1)

Particles and Waves

- summarize the evidence for the wave and particle models of light (327-11)

Bohr Atoms and Quantum Atoms

- explain quantitatively the Bohr atomic model as a synthesis of classical and quantum concepts (329-2)
- explain the relationship among the energy levels in Bohr's model, the energy difference between levels, and the energy of the emitted photons (329-3)
- use the quantum-mechanical model to explain naturally luminous phenomena (329-7)

Radioactivity (12%) (Advanced, 10%)

Natural and Artificial Sources of Radiation

- describe sources of radioactivity in the natural and constructed environments (329-5)
- identify, analyze, and describe examples where technologies were developed based on scientific understanding, the design and function of these technologies as part of a community's life, and science- and technology-related careers (116-4, 116-6, 117-5, 117-7)
- use quantitatively the law of conservation of mass and energy using Einstein's mass-energy equivalence (326-9)
- select and integrate information from various print and electronic sources or from several parts of the same source (213-7)
- develop appropriate sampling procedures (212-9)
- select and use apparatus and materials safely (213-8)
- demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials (213-9)

Radioactive Decay

- describe the products of radioactive decay and the characteristics of alpha, beta, and gamma radiation (329-4)
- analyze data on radioactive decay to predict half-life (214-2)

Fission and Fusion

- compare and contrast fission and fusion (329-6)
- analyze examples of Canadian contribution to a particular development of science and technology (115-5, 117-11)
- identify, develop, present, and defend a position or course of action based on identifying multiple perspectives that influence the issue, and on interpreting data and the relationship among variables (214-15, 215-4, 215-5)
- analyze and evaluate, from a variety of perspectives, using a variety of criteria, the risks and benefits to society and the environment of a particular application of scientific knowledge and technology (118-2, 118-4)

Advanced Physics 12 Outcomes (Draft)

Specific curriculum outcomes are organized in four units. Each unit is organized by topic. Advanced Physics 11 and Advanced Physics 12 units and topics use Physics 11 and Physics 12 outcomes, but the following are done in more depth.

Students will be expected to

IN-DEPTH TREATMENT (COMPLETED WITHIN THE UNITS)

- use vector analysis in two dimensions for systems involving two or more masses, relative motions, static equilibrium, and static torques (ACP-1)
- analyze quantitatively the horizontal and vertical motion of a projectile (325-6)
- develop questions related to these topics (AP-09)
- apply Kirchoff ‘s laws of voltage and current to circuits with two sources of emf (AP-11)
- explain the design and results of the Michelson-Morley experiment (AP-12)
- explain how Einstein developed the special theory of relativity, and its implications (AP-13)
- explain qualitatively thought experiments on spontaneity and time dilation (AP-14)

Literature Search and Report (5%)

- collect, organize, edit, and present a summary of current information related to a specific topic (AP-03)
- write a report as a formal research paper (AP-04)

Investigation: An Independent Study/Experiment (15%)

- collaborate and investigate on an independent research project (AP-07)
- maintain a research log, including personal reflection and data collection (AP-08)
- use technology and other skills effectively to communicate their results publicly (AP-10)