AP Physics 2

Course Syllabus

Text

*College Physics, 7ed*.; Serway/Faughn; Thompson, Brooks/Cole Publishing; 0-534-99723-6.

Course Description

The Advance Placement Physics 2 is algebra-based course in general Physics. Its syllabus is designed by the College Board. It is equivalent introductory algebra-based university level physics course. This course will be covered in two semesters. The emphasis in the course is on understanding of the concepts and skills at using the concepts and formulae to solve problems. Laboratory work is an integral part of this course. Students coming out of the courses should have a strong conceptual understanding of physics and well-developed skills in performing and analyzing laboratory experiments. They should also be able to apply their understanding to approach and solve problems that are essentially new to them.

Schedule

This course meets 51 minutes, five times a week. Although labs do not happen every week, they comprise at least 25 percent of the course time. The last two weeks before the AP exam are spent reviewing problematic areas and solution strategies. Throughout the year, lunch and/or after-school tutoring is available.

Course Evaluation

Student’s grade will be based approximately on the following:

Tests and quizzes 40%

Homework 20%

Labs/Projects 20%

Final 20%

(Note: totals change year to year, so these are only approximations)

Prerequisite: (one year of physics is required prior to enrollment in this course, which should cover the following background material needed for this course).

**Introduction**

* Units and measurement
* Unit conversion (dimensional analysis)
* Graphing
* Basic calculus review
* Scalars and vectors

**Mechanics**

**Kinematics**

* Motion in one direction
* Motion in two directions
* Projectile motion
* Uniform circular motion

**Dynamics: Newton’s Laws of Motion**

* Force
* Newton’s three laws
* Force diagrams (free body diagrams)
* Weight and normal force

**Gravity**

* Newton’s law of universal gravitation
* Satellites and weightlessness
* Kepler’s Laws
* Escape velocity
* Gravitational potential energy

**Work and Energy**

* Work done by a constant force
* Work and kinetic energy

**Conservation of energy**

* Conservative and nonconservative forces
* Potential energy
* Kinetic energy
* Law of conservation of energy
* Power

**Linear momentum and collisions**

* Conservation of momentum
* Impulse
* Elastic and inelastic collisions
* Center of mass

**Rotational Kinematics**

* Constant angular speed
* Constant angular acceleration
* Relation between linear and angular quantities

**Rotational dynamics**

* Torque
* Rotational kinetic energy
* Rotation and Translation
* Conservation of angular momentum

**Oscillations**

* Simple harmonic motions
* Springs
* Simple pendulum
* Physical pendulum

**Physics 2 – Topics Covered**

**Fluids**

* Hydrostatics
* Fluid Pressure
* Pascal’s Principle
* Archimedes Principle
* Fluid Dynamics
* Continuity Equation
* Bernoulli’s Equation

**Heat and Thermodynamics**

* Heat
* Temperature
* Thermal Expansion
* Heat Transfer
* Ideal Gas Laws and PV diagrams
* Kinetic Theory and rms speed of gas molecules
* Avogadro’s number and Boltzmann’s constant
* First law of Thermodynamics
* Reversible Thermodynamic Processes
* Heat Engines and Carnot Cycle
* Second Law of Thermodynamics
* Entropy

**Electricity and Magnetism**

* Electrostatics
* Coulomb’s Law
* Electric Field
* Motion of Charged Particle in Electric Field
* Electric Potential Energy and Electric Potential
* Capacitors
* Electric Current, Resistance, and EMF
* Electrical Resistivity, Power, and Energy
* Resistors in Series and Parallel
* Kirchoff’s Rules
* Magnetic Fields
* Magnetic Force on Electric Current
* Magnetic Field due to I
* Magnetic Flux
* Electromagnetic Induction

**Waves and Optics**

* Traveling Waves
* Properties of Sound
* Standing Wave and Beats
* Doppler Effect
* Reflection: Law of Reflection
* Refraction
  + Snell’s Law
  + Total Internal Reflection
* Image Formation by Plane and Spherical Mirrors
* Image Formation by Lenses
* Image Formation by a Two-Lens System
* Interference
  + Superposition Principle
  + Double-Slit Interference
  + Thin Film
  + Newton’s Rings
  + Non-reflective Coating for Glass
* Diffraction
  + Single Slit
  + Double Slit: Superposition of Interference and Diffraction Patterns
  + Diffraction grating
  + Polarization: Qualitative
* Electromagnetic Spectrum
* Inverse Square Law

**Atomic and Nuclear Physics**

* Photoelectric Effect
* Energy and Linear Momentum of Photon
* Energy Levels in an Atom
  + Ionization Energy
  + Emission Spectrum
  + Absorption Spectrum
  + Lasers
* DeBroglie Hypothesis: Davisson-Germer experiment
* Production of X-rays
* Compton Effect
* Nuclear Symbols: Mass Number and Atomic Number
* Nuclear Reactions
* α, β, and γ decay
* Neutrino
* Nuclear Forces
* Nuclear Fission and Chain Reaction
* E = mc2 and applications to Nuclear Reactions

Laboratory

Students will work in small groups varying from 2-4 students depending on the complexity of the lab, equipment and space required. Many labs are designed to introduce new topics or verify covered topics. Some labs are designed with little to no guidance allowing students to design a lab to answer a particular question. The experience gained by manipulating equipment, recording and organizing data, and drawing conclusions is a vital part of this physics course. Students are to keep a portfolio of all laboratory investigations and reports.

Laboratory and project work will introduce and hone the Science and Engineering Practices (SEPs) as required by NGSS.

**Bungee Lab.** Determine the length of cord required to have a bungee stretch a specific length with a specified mass attached.

**Center of mass lab**. Determine the center of mass for a four particle system using masses hanging from a meter stick balance.

**Fluid lab 1-6**. Investigate the effects of pressure, flow rate, buoyancy and other fluid concepts through manipulating hands on equipment.

**Buoyancy lab**. Determine the buoyant force on a “raft” floating in a fluid.

**Themo lab**. Observer and recording linear and volumetric expansion for different metal objects.

**Intro to static electricity lab**. Determine the charge on objects by observing their attraction and repulsion.

**Equipotential map lab**. Diagram equipotential lines and electric field lines using a voltmeter and a tub of salty water with leads at each end.

**Coulomb’s Law lab**. Determine the charge on two small pith balls by measuring their repulsion.

**Circuit board lab 1-2**. Determine formula for adding resistors in series and in parallel

**Circuit board lab 3-8**. Complex circuits. Determine voltage and current in various parts of a complex circuit.

**Magnetic Field Lab**. To Map the magnetic field for permanent magnets and to demonstrate Biot-Savart’s Law.

**Standing Waves**. Teacher Demo Lab. Using a long spring to set up and measure wavelength and frequency of standing waves.

**Mirror lab**. Discover the geometric optics of reflection with three types of mirror.

**Convex and Concave lens lab**. Determine the geometric optics of refraction with two different lenses.

**Diffraction Lab.** Discover the diffraction patterns with single and double-slit sources.

Each lab will require:

* The formation of an hypothesis or hypotheses, based on in-class discussion of the presented problem or focus of each experiment
* Design of (an) experiment(s), also based on in-class discussion, to test the hypothesis or hypotheses
* Collection of data and observations
* Calculations using the collected data
* Conclusions about how well the hypothesis or hypotheses held up based on the experiment
* Class discussion of variance and error analysis
* Written report