AP Physics B
Syllabus

Course Overview
Advanced Placement Physics B is a rigorous course designed to be the equivalent of a college introductory Physics course. The focus is to provide students with a broad conceptual background in Physics and necessary problem solving skills to apply those concepts in practical situations. It is recommended that students have a strong background in algebra and trigonometry. This course is a laboratory-based course with an emphasis on hands on experience. This course is designed to prepare students to take the AP Physics B examination. Class meets three days a week, one period of 50 minutes and two block periods of 100 minutes each. Labs take place during one of the 100 minute block periods.

Text
Giancoli, Douglas C. *Physics: Principles with Applications.* 6th edition. Upper Saddle River, NJ: Prentice Hall.

Course Outline

Newtonian Mechanics

A. Introduction and Kinematics – *3 weeks*
   (Chap. 2 & 3)
   1. Mathematical methods of analysis
   2. Motion in one dimension
   3. Motion in two dimensions (projectile motion)

B. Force and Newton's laws of motion – *2.5 weeks*
   (Chap. 4)
   1. Forces (including friction and centripetal force)
   2. Static equilibrium (first law)
   3. Dynamics of a single particle (second law)
   4. Systems of two or more bodies (third law)

C. Circular motion, oscillations, and gravitation – *2 weeks*
   (Chap. 5 & 11)
   1. Uniform circular motion
   2. Simple harmonic motion
   3. Mass on a spring
   4. Pendulum and other oscillations
   5. Newton's law of gravity
   6. Orbits of planets and satellites

D. Work, energy, and power – *2 weeks*
(Chap. 6)
1. Work and energy theorem
2. Conservative forces and potential energy
3. Conservation of energy
4. Power

E. Linear and angular momentum (including rotation) – *2.5 weeks*
(Chap. 7 & 8)
1. Impulse and momentum
2. Conservation of linear momentum, collisions
3. Angular momentum and its conservation
4. Torque and rotational statics

Fluid Mechanics and Thermal Physics

F. Fluid Mechanics – *2 weeks*
(Chap. 10)
1. Hydrostatic pressure
2. Buoyancy
3. Fluid flow continuity
4. Bernoulli's equation

G. Kinetic theory, temperature, and heat – *3 weeks*
(Chap 13 & 14)
1. Kinetic model
2. Thermal expansion
3. Ideal gas law
4. Mechanical equivalent of heat
5. Specific and latent heat (calorimetry)
6. Heat transfer

H. Laws of thermodynamics – *1 week*
(Chap. 15)
1. First law of thermodynamics
2. Second law of thermodynamics

Semester II:

Electricity and Magnetism

A. Electrostatics, conductors, and capacitors – *2 weeks*
   (Chap. 16 & 17)
   1. Charge, field, and potential
   2. Coulomb's law and field and potential point charges
   3. Fields and potentials of planer charge distributions
   4. Electrostatics with conductors
   5. Capacitors

B. Electric circuits – *3 weeks*
   (Chap. 18 & 19)
   1. Current, resistance, power
   2. Steady-state direct current circuits with batteries and resistors only
   3. Capacitors in circuits

C. Magneto-statics – *1 week*
   (Chap. 20)
   1. Forces on moving charges in magnetic fields
   2. Forces on current-carrying wires in magnetic fields
   3. Fields of long current-carrying wires

D. Electromagnetism – *1 week*
   (Chap. 21)
   1. Electromagnetic induction (Faraday's law and Lenz's law)

Waves and Optics

E. Wave motion and sound – *2 weeks*
   (Chap. 11 & 12)
   1. Properties of traveling waves
   2. Properties of standing waves
   3. Doppler effect
   4. Superposition

F. Physical optics – *1.5 weeks*
   (Chap. 24)
   1. Interference and diffraction
   2. Dispersion of light and the electromagnetic spectrum

G. Geometric optics – *2.5 weeks*
(Chap. 23 & 25)
1. Reflection and refraction
2. Mirrors
3. Lenses

Atomic and Nuclear Physics

H. Atomic physics and quantum effects – *1 week*
(Chap. 27 & 28)
1. Photons and the photoelectric effect
2. Bohr model and energy levels
3. Wave-particle duality

I. Nuclear physics – *1 week* (Chap. 30 & 31)
1. Nuclear reactions
2. Mass-energy equivalence

AP Physics Test in May

J. Relativity – *2 weeks*
(Chap. 26) (After AP test)
1. Postulates of special relativity
2. Results of special relativity
3. Space-Time

Final Project – *1 week*

Laboratory

Labs are conducted throughout the year within the context of the appropriate unit. The laboratory experiences are hands-on and are intended to support concept development. At the beginning of each lab, students are presented with a problem. For example, “Determine the focal length of a given convex lens?” Students then participate in a brief guided discussion of the context and application of the Physics principles currently being studied in class. Students collaborate in their lab groups to formulate a hypothesis and create their experimental design. Each group is provided with the necessary resources and equipment to conduct their experiment and gather data. The students perform the necessary calculations to analyze the data. In some cases, data will be represented graphically. Students may use computer spreadsheet software or graphing calculators to graph the data. Students will express their findings in a formal lab report which includes the following components:

- Statement of the problem
- Hypothesis

- Experimental Procedure
- Data/Observations (including graphs and calculations when necessary)
- Conclusions and Error Analysis

Students are required to keep a lab notebook containing all their lab reports.

Lab Experiments

Semester I

1. *Graphical Analysis of Motion*
   Topic: One-Dimensional Motion
   Objective: Graphically analyze the differences between constant velocity and accelerated motion of a lab cart.

2. *Acceleration Due to Gravity*
   Topic: One-Dimensional Motion
   Objective: To experimentally determine the value of the acceleration due to gravity by analyzing a falling object.

3. *Range Prediction of a Horizontal Projectile*
   Topic: Projectile Motion
   Objectives: Determine the horizontal launch velocity of a projectile. Predict the range from a new launch height.

4. *Newton's 2nd Law*
   Topic: Force
   Objective: To analyze the acceleration of a lab cart while varying mass and/or force.

5. *Coefficient of Friction*
   Topic: Force
   Objective: Determine the coefficients of static and sliding friction for various objects and surfaces.

6. *Circular Motion*
   Topic: Two-Dimensional Motion
   Objective: Determine the relationship between centripetal force, velocity, and radius of an object moving in a horizontal circle.

7. *Pendulum Investigation*
   Topic: Simple Harmonic Motion
   Objectives: Determine the relationship between mass, length, and release angle of a pendulum. Determine the acceleration due to gravity using a pendulum.

8. *Inclined Plane and Work/Energy*
   Topic: Work and Energy
   Objective: Use an inclined plane to determine the relationship between work and potential energy.

9. *Analyzing Collisions*
   Topic: Momentum
   Objective: Observe the conservation of momentum in elastic and inelastic collisions using collision carts.

10. *Density and Archimedes' Principle*
    Topic: Fluid Dynamics
    Objective: Determine the density of an unknown material using a balance Archimedes' Principle.

11. *Specific Heat*
    Topic: Thermodynamics
    Objective: Determine the specific of unknown materials using a calorimeter.

<u>Semester II</u>

12. *Electroscope Lab*
    Topic: Electrostatics
    Objective: Use an electroscope to do a qualitative investigation of a variety of charged objects.

13. *Circuit Lab*
    Topic: Current Electricity
    Objective: Design and analyze series, parallel, and combination electric circuits.

14. *Mapping a Magnetic Field*
    Topic: Magnetism
    Objective: Map the magnetic field around various arrangements of magnets.

15. *Speed of Sound*
    Topic: Waves
    Objective: Determine the speed of sound using a closed pipe and a tuning fork.

16. *Reflection and Refraction*
    Topic: Optics
    Objectives: Determination of the law of reflection using a mirror.
    Determine the index of refraction for a transparent object.

17. *Optics Lab*
    Topic: Optics
    Objective: Determine the focal length of various mirrors and lenses using an optics bench.

18. *Wavelength of Light*
    Topic: Optics
    Objective: Determine the wavelength of light using a diffraction grating and a laser.

Classroom Activities

A typical day would involve a combination of any of the following activities.

- Lecture with demonstrations.
- Problem solving in cooperative groups involving critical thinking skills.
- Lab activities.
- Homework assignment review and discussion.
- Class discussion of current applications of Physics concepts.
- Quizzes and end of unit Exams. Exams include multiple choice and free response questions.