

Robert Morgan Educational Center

AP Physics B: Syllabus

Course Overview

Class meets 5 times in a 2 week period. Each class lasts for 2 hours; one of these periods is used for laboratory practices. Peer-coaching, peer-teaching and peer-review are essential part of the course. Students are encouraged from the first day to join a study group to work with in and out of class.

Course goals include developing each student's intuition, creativity and investigative skills to do the following:

- Read, understand, and interpret physical information.
- Use the scientific method to analyze a particular physical phenomenon or problem.
- Use basic mathematical reasoning in a physical situation or problem.
- Perform experiments, interpret the results of observations and communicate results, including uncertainty assessment.

Introduction

AP Physics B is a college level course that uses advanced algebra and trigonometry as the primary tools for problem solving. The course covers topics in:

- I. Newtonian Mechanics
- II. Fluid Mechanics and Thermal Physics
- III. Electricity and Magnetism
- IV. Waves and Optics
- V. Atomic and Nuclear Physics

This course provides a systematic introduction to the main principles of physics and emphasizes the development of conceptual understanding and problem-solving ability using algebra and trigonometry, but rarely calculus. Throughout the course, emphasis is placed more on the concepts and method of solution or analysis, and less on the actual final product or answer.

As we get closer to May, the emphasis will shift towards preparing the students for the AP Physics exam by reviewing released exams, past free-response questions and test-taking skills.

Textbooks

Primary Text Book:

- Serway, Raymond A., and Jerry S. Faughn. 2006. *College Physics*, 7th ed. Belmont, Calif.: Thompson Brooks/Cole Publishing.

Laboratory Manual:

- Loyd, David H. 2002. *Physics Laboratory Manual*, 2nd ed. Belmont, Calif.: Thompson Brooks/Cole Publishing.

Review Text:

- The Princeton Review: *Cracking the AP Physics Exam*. 2005-2006 ed.

Course Outline

The following is a course outline based on the percentages listed in the AP Physics course description manual. Chapters listed correspond to the appropriate chapters in the afore-mentioned text.

I. Newtonian Mechanics (35%) 10 WEEKS

A. Kinematics (7%)

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| 1. Motion in one dimension | Chapter 2 |
| 2. Motion in two dimensions, projectile motion | Chapter 3 |

B. Newton's laws of motion (9%)

Chapter 4

1. Static equilibrium (First law)
2. Dynamics of a single particle (Second law)
3. Systems of two or more bodies (Third law)

C. Work, energy, power (5%)

Chapter 5

1. Work and work-energy theorem
2. Conservative forces and potential energy
3. Conservation of energy
4. Power

D. Systems of particles, linear momentum (4%)

Chapter 6

1. Center of mass

2. Impulse and momentum
 3. Conservation of linear momentum, collisions
- E. Circular motion and rotation (4%) Chapter 7
1. Uniform circular motion
 2. Torque and rotational static's
- F. Oscillations and gravitation (6%) Chapter 8
1. Simple harmonic motion
 2. Mass on a spring
 3. Pendulum and other oscillations
 4. Newton's law of gravity
 5. Orbits of planets and satellites
- II. Fluid Mechanics and Thermal Physics (15%) 4 WEEKS
- A. Fluid Mechanics (6%) Chapter 9
1. Hydrostatic pressure
 2. Buoyancy
 3. Fluid flow continuity
 4. Bernoulli's equation
- B. Temperature and heat (2%) Chapter 10/11
1. Mechanical equivalent of heat
 2. Heat Transfer and thermal expansion
- C. Kinetic theory and thermodynamics (7%) Chapter 12
1. Ideal gases
 - a. Kinetic model
 - b. Ideal gas law
 2. Laws of thermodynamics
 - a. First law (including processes on pV diagrams)
 - b. Second law (including heat engines)

III. Electricity and Magnetism (25%) 8 WEEKS

A. Electrostatics (5%) Chapter 15

1. Charge, field, and potential
2. Coulomb's law and field and potential of point charges
3. Fields and potentials of other charge distributions

B. Conductors and capacitors (4%) Chapter 16

1. Electrostatics with conductors
2. Capacitors
 - a. Parallel plate

C. Electric circuits (7%) Chapter 17/18

1. Current, resistance, power
2. Steady-state direct current circuits
3. Capacitors in circuits

D. Magnetic Fields (4%) Chapter 19

1. Forces on moving charges in magnetic fields
2. Forces on current-carrying wires in magnetic fields
3. Fields of long current-carrying wires

E. Electromagnetism (5%) Chapter 20

1. Electromagnetic induction (including Faraday's law and Lenz's law)

IV. Waves and Optics (15%) 4 WEEKS

A. Wave motion (5%) Chapter 21

1. Properties of traveling waves
2. Properties of standing waves
3. Doppler effect
4. Superposition

B. Physical optics (5%)

1. Interference and diffraction
2. Dispersion of light and the electromagnetic spectrum

C. Geometric optics (5%)

Chapter 22/23

1. Reflection and refraction
2. Mirrors
3. Lenses

PART V. Atomic and Nuclear Physics (10%)

2 WEEKS

A. Atomic physics and quantum effects (7%)

Chapter 26/27/28

1. Photons, the photoelectric effect, Compton scattering, x-rays
2. Atomic energy levels
3. Wave-particle duality

B. Nuclear physics (3%)

Chapter 29/30

1. Nuclear reactions
2. Mass-energy equivalence

Laboratory

Labs are performed throughout the year; attempts are made to perform them after the concept has been taught. For each experiment, a laboratory manual is given to the students to study and prepare for the experiment. Students then come up with their own hypothesis and are guided on how to test it. The students are also allowed to design their own procedure and carry out a supervised experiment. Students collect data and analyze it, recording all information in their Lab notebook. Students are required to turn in a Lab report by the next class period. The report must include:

- A statement of the problem,
- an hypothesis,
- an abstract or a discussion or outline of how the procedure will be carried out,
- the data recorded,
- an analysis-a discussion or outline of how the data was analyzed,
- tables, graphs, calculations and error analysis must also be included in the report,
- A conclusion including error analysis and topics for further study.

The following is a list of the laboratories; we will perform during the school year:

General Labs

1. Measurement of Length

Objectives:

- To demonstrate the concept of experimental uncertainty in simple measurements using a meter stick.
- To apply to these measurements, statistical concepts of mean, standard deviation from the mean, and standard error.

2. Velocity and Acceleration

Objective:

- Analysis of the measurements of position and time of a toy car to calculate its velocity.

3. Projectile Motion:

Objective:

- Using a pre-recorded video to confirm that the parabolic motion of an object in two dimensions can be analyzed.

4. Newton's Laws and Vectors

Objective:

- Verification of Newton's Second Law, by calculating acceleration down an incline and oscillations on an incline.

5. Coefficient of Friction

Objective:

- Determination of static and kinetic coefficient of friction for various materials.

6. Work, Momentum and Energy, Circular Motion

Objectives:

- Demonstration of conservation of momentum for two carts pushing away from each other.
- Demonstration of conservation of momentum in explosions, using the dynamic cart experiment.

7. Temperature and Heat

Objective:

- Determination of specific heat capacity of various metals.

8. Latent Heat of Fusion and Vaporization

Objective:

- Determination of latent heat of fusion and vaporization of water.

9. Ohm's Law

Objective:

- Investigation of the 3 variables involved in the mathematical relationship of ohm's law.

10. Resistances in Circuits

Objective:

- To experiment with the variable that contributes to the operation of electrical circuits:

Part 1: series and parallel resistances

Part 2: voltages in circuits

Part 3: currents in circuits

11. Kirchhoff's Rules

Objective:

- To experimentally demonstrate Kirchhoff's rules for electrical circuits.

12. Magnetic Induction (Variable Gap Magnet)

Objective:

- Demonstration of Magnetic Induction in Circuits.

13. Magnetic Force on a current-carrying wire

Objective:

- To demonstrate that there is a magnetic force developed on a current carrying wire.

14. Wave Properties

Objective:

- Relationship among wave variables using a ripple tank.

15. The Speed of Sound

Objective:

- Determination of the speed of sound using a tuning fork and a column of water.

16. Laws of Reflection and Snell's Law

Objective:

- Analysis of reflection and determination of the index of refraction of a material.

17. Curved Mirrors, Convex and Concave Lenses

Objective:

- Experimental, geometrical and analytical determination of the formation of images.

18. Wavelength of Light

Objective:

LABORATORY LIST

Area	General area of study	Order	Specific topic	Lab Title	Demo or hands on	Time (min)
I	Mechanics	1	Measurement of length	Using the Vernier and micrometer calipers to measure lengths	Students hands on	30
I	Mechanics	2	Velocity and Acceleration	Determination of velocity of a toy car	Students hands on	50
I	Mechanics	3	Projectile motion	Determining the initial speed and direction of a projectile	Demo or hands on	40
I	Mechanics	4	Newton's Laws	Verification of Newton's Second Law, by calculating acceleration down an incline	Students hands on	50
I	Mechanics	5	Coefficient of Friction	Determining the coefficient of Static and kinetic friction	Students hands on	50
I	Mechanics	6	Work, Energy and Motion	Demonstration of conservation of momentum in explosions.	Demo or hands on	80
II	Thermodynamics	7	Specific Heat	Determination of the specific heat capacity of various metals	Students hands on	50
II	Thermodynamics	8	Latent Heat	Determination of latent heat of fusion and vaporization of water	Students hands on	50
III	Electricity and Magnetism	9-10	Circuits	Investigation of Ohms Laws Resistances in circuits	Students hands on	60
III	Electricity and Magnetism	11	Circuits	Using electric circuits to verify Kirchhoff's Rules.	Students hands on	50
III	Electricity and Magnetism	12	Magnetic fields	Demonstration of magnetic induction in circuits	Students hands on	50
III	Electricity and Magnetism	13	Magnetic Fields	Determination of force on a current carrying conductor	Students hands on	50
IV	Waves	14	Waves Properties	Determination of relationship among wave variables using ripple tank	Demo or hands on	50
IV	Waves	15	Speed of Sound	Determining the speed of sound	Students hands on	50
IV	Optics	16	Refraction	Determination of the index of refraction	Students hands on	50
IV	Optics	17	Geometric optics	Determination of the focal length of a lens	Students hands on	50
V	Modern	18	Wavelength	Determination of wavelength of light	Students hands on	60