



## Syllabus: AP Physics B

**Instructor:** Dr. Manju Prakash

**Year:** 2009-2010

*“What we need is not the will to believe but the will to find out”*

*- - - Bertrand Russell*

*“We cannot solve problems by using the same kind of thinking used when we created them”*

*- - - Albert Einstein.*

### **Course Goals & Philosophy:**

The goal of the course is to develop students' physical intuition, creativity, and investigative skills to understand fundamental physical laws that govern the phenomena occurring around us. This is a college-level science courses. Students will learn scientific vocabulary to describe physical phenomena. They will also learn to develop conceptual and analytical skills to express phenomena in terms of mathematical relations, and to solve these equations. This is a non-calculus based course that uses knowledge of algebra and geometry. Scientific calculators will be used to obtain final numerical answers. Laboratory work will reinforce students' understanding of physical laws through exploration and investigation.

### **What Should I do to Succeed in the Course?**

You should be an active participant in the learning process. With persistent and diligent work you will meet the goals of this course. To succeed in this course with a good grade you should follow these guidelines:

- Keep asking questions. Chances are very good that others are in the same situation as you.
- Take your homework seriously.
- Prepare your lab reports thoroughly. This will enable you to develop strong scientific vocabulary to describe physical phenomena.
- Try to identify key concepts while reading the textbook regularly and carefully.
- Focus on developing strong problem solving skills.

### **Course Requirements:**

- Textbook, Physics (4th AP Edition), James S. Walker
- Large classroom notebook
- Large 3-ring binder (homework)
- Netbook & Scientific calculator
- Internet access: [www.prenhall.com/Walkerphysics](http://www.prenhall.com/Walkerphysics)
- Open mind, alertness, and consistent work

## Grading Procedure:

- Your end of the year grade will be determined as follows:

First Trimester: 15%  
Second Trimester: 25%  
Third Trimester: 35%  
Mid-term exam: 10%  
Final Exam : 15%

- Each Trimester has a grade breakdown scheme as follows:

Laboratory: 15%  
Quizzes: 30%  
Tests: 55%

The grade-scale scheme is as follows:

A+: 97-100	D+: 67-69
A: 93-96	D: 63-66
A-: 90-92	D- 60-62
B+: 87-89	F: 0-59
B: 83-86	
B- 80-82	
C+: 77-79	
C: 73-76	
C-: 70-72	

All students are required to take the AP Physics B exam offered in the spring, 2010.

The year-long tests will contain practice tests from the AP Physics B exam. **Dates for the quizzes and tests will be announced a week before they are scheduled.**

## Homework Policies:

- Make a reasonable attempt at all assigned problems.
- Homework will be assigned everyday and will be due next day.
- Student groups can be effective. However, when a student submits an assignment, she is stating that the material submitted has been fully comprehended. Therefore, joint submissions and plagiarism are unacceptable.
- All returned homework and other submitted items (test, quizzes, and labs etc. ) are to be saved in your 3-ring binder.

## Lab Reports:

- Lab reports must be computer generated and follow the standard format as outlined in a separate handout.
- When returned homework (and all submitted items, tests, quizzes, labs etc.) is to be saved in your 3-ring binder.

All submitted assignments must begin with the student's name and the title of work.

**Classroom Policies:**

- Please do not talk during the lecture-it is rude and disturbs others.
- Be punctual, late arrival puts you at disadvantage and distracts others.
- Cell phones, pagers, and iPods are not allowed in the classroom.
- Come prepared and take charge of your learning process.
- Cheating or plagiarism may result in failing grade for the assessment. Such incidents may be reported to Honor Council.

**Trimester 1**

<b>Week</b>	<b>Chapters</b>	<b>Topics</b>
1	1	Scientific Process, Units, Dimensions, Graphing
2	2, 3	Vectors, Kinematics
3	3, 4	Kinematics in 1 and 2 Dimensions
4	5	Newton's Laws, Dynamics
5	6	Dynamics, Equilibrium
6	7, 8	Work and Energy
7	9	Linear Momentum
8	7-9	Conservation Laws
<b>*****Parents</b>	<b>Weekend</b>	<b>*****</b>
9	12	Gravity & Circular Motion
10	10, 11	Torque, Angular Momentum, Rotational Dynamics
11	15	Fluids Mechanics

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## Trimester 2

<b>Week (#)</b>	<b>Chapters</b>	<b>Topics</b>
1	16-18	Gas Laws, Heat
2	17,18	Heat & Thermodynamics
3	18	Thermodynamics
4	13,14	Vibrations & Waves
5	14, 28	Sound & Physical Optics
6	26	Geometrical Optics
7	19	Electrical Field & Force
8	20	Electrical Field & Force
9	1-20	<b>Mid-Year Exam</b>
10	21	Electrical Circuits
11	22	Magnetic Field and Force
12	23	Electromagnetic Induction

## Trimester 3

<b>Week (#)</b>	<b>Chapters</b>	<b>Topics</b>
1	30	Quantum Physics
2	31, 32	Atomic and Nuclear Physics
3	Comprehensive Review (CR) Begins	
4	CR	
5	CR	
6	CR	
7	CR	
8	CR	
9	CR (AP Exams)	
10	AP Exams	
11	Physics for Fun	
<b>12</b>	<b>Final Test</b>	

## **Tentative Outline of Topics**

### **1. Motion**

#### **A. Units & Measurements**

- (a) Metric Units: Fundamental and Derived
- (b) Metric Prefixes
- (c) Significant Digits: Data and Arithmetic
- (d) Mass, Weight, and Density

#### **B. Vectors and Graphing**

- (a) Vectors vs. Scalars
- (b) Vector Addition: Perpendicular Component Method
- (c) Vector Multiplication: Scalar and Vector Product
- (d) Basic Graphing: Scales, Slopes, Direct and Indirect Proportions

#### **C. One- Dimension and Two- Dimensions Kinematics**

- (a) Kinematic Vectors: Displacement, Velocity, Acceleration
- (b) Average vs. Instantaneous Quantities
- (c) Equations of Motion and their Application: Constant Acceleration, Acceleration due to Gravity
- (d) Graphical Analysis of Motion in Time
- (e) Two Dimensional Kinematics: Projectiles

### **2. Forces and Equilibrium**

#### **A. The Laws of Newton**

- (a) The Law of Galileo in contrast to Aristotle
- (b) Force and Acceleration
- (c) Action-Reaction Forces

#### **B. Friction and Normal Forces**

#### **C: Mechanical Equilibrium or Free-Body Diagrams**

- (a) Resultant Force on Point Masses
- (b) The Inclined Plane
- (c) Static vs. Dynamic Equilibrium

### **3. Energy**

#### **A. Work & Energy**

- (a) Work
- (b) Kinetic Energy
- (c) Potential Energy
- (d) Elastic and Gravitational Energy

#### **B. Conservation of Mechanical Energy**

- (a) Energy Transformation for Freely Falling Object

- (b) Energy transformation When an Object Moves Along an Inclined Plane (with/without friction)
- (c) Work-Energy Theorem

#### **4. Momentum:**

- A. Classical and Newtonian Definitions of Linear Momentum
- B. Linear Momentum Conservation & Collisions
- C. Impulse

#### **5. Gravitation and Circular Motion**

##### **A. Gravitation**

- (a) Universal Gravitation: The Inverse-Square Law
- (b) Orbiting Objects as Falling
- (c) Planetary Motion: Laws of Kepler

##### **B. Circular Motion**

- (a) Uniform Circular Motion and Acceleration
- (b) Examples of Centrifugal Force
- (c) Satellite and Planetary Motion, Escape Velocity
- (d) Calculation of Acceleration of Gravity in terms of Universal Gravitational Constant

#### **6. Torque and Rotational Equilibrium**

- (a) Different Units for Rotational Speed
- (b) Rotational Kinematics
- (c) Resultant Torque on Rigid Body
- (d) Rotational Equilibrium
- (e) Angular Momentum and Conservation

#### **7. Fluids**

- A. Hydrostatic Pressure
- B. Buoyancy
- C. Fluid Flow Continuity
- D. Bernoulli's Equation

#### **8. Gas Laws & Thermodynamics**

##### **A. Gas Laws**

- (a) Relation Between Pressure, Volume, and Temperature
- (b) Ideal Gas Laws
- (c) Kinetic-Molecular Theory-Interpretation of Temperature

- B. Heat
  - (a) Mechanical Equivalent of Heat
  - (b) Phase Transformation and Phase Diagrams
  - (c) Heat Transfer Processes: Conduction, Convection, & Radiation
  - (d) Thermal Expansion
- C. Thermodynamics
  - (a) First Law
  - (b) Types of Thermodynamic Processes
    - i. Adiabatic
    - ii. Isothermal
    - iii. Isochoric
  - (c) Pressure -Volume Work of a Gas
  - (d) Second Law of Thermodynamics: Entropy
    - i. Entropy: Disorder
    - ii Heat Pumps and Refrigerator
    - iii Efficiency of Carnot Engine
    - iv Actual Efficiency of a heat Engine

## 9. Waves and Oscillations

- A. Simple Harmonic Motion (SHM)
  - (a) Hooke's Law
  - (b) Comparison of SHM with Uniform Circular Motion
  - (c) SHM: Period of oscillation
  - (d) Time-dependent Position, Velocity, and Acceleration of an Oscillator
  - (e) Elastic Potential Energy and Energy Conservation
  - (f) The Simple Pendulum
  - (g) Resonance: The Swing
- B. Waves
  - (a) Longitudinal and Transverse waves
  - (b) Relationship between wavelength, frequency, and speed
  - (c) Sound Wave: Medium-dependent Speed
  - (d) Intensity, Pitch, Loudness & Doppler Effect
  - (d) Standing Waves & Musical Instruments

## 10. Light

- A. What is Light?
  - (a) Light as Electromagnetic Wave
  - (b) The Electromagnetic Spectrum
- B. Physical Optics
  - (a) Diffraction Through Slits
  - (b) Interference
  - (c) Thin Films
  - (d) Polarization

## C. Geometrical Optics

- (a) Plane Mirrors
- (b) Concave & Convex Mirrors
- (c) Laws of Reflection & Refraction
- (d) Total Internal Reflection, Critical Angle
- (e) Dispersion and Rainbow
- (f) Lenses
  - i. Concave Lens
  - ii. Convex Lens
  - iii. Image Formation in Lenses and Mirrors

## 11. Electromagnetism

### A. Electrostatics

- (a) Electric Charge
- (b) Electrostatic Forces (Coulomb's Law)
- (c) Electric Lines of Force
- (d) Conductors & Insulators
- (e) Induced Charge
- (f) Parallel Plate Capacitor

### B. Electric Fields & Potential

- (a) Electric fields & Electrical Work
- (b) Electric Potential Energy
- (c) Equi-potential surfaces Grounded Conductors
- (d) Particle Dynamics Within a Capacitor
  - (i) Cathode Ray Tube
  - (ii) Milikan Oil Drop Experiment

### C. Direct Circuits

- (a) Mechanical Analogy of a Circuit: EMF, Current, Resistance
- (b) Current, Electrical Work, and Electric Power
- (c) Ohm's Law
- (d) Heat Dissipated in a Resistor: Calorimetry Connection
- (e) Energy Stored in a Capacitor
- (f) Resistors and Capacitors in Series and Parallel
- (g) Kirchhoff's Two Laws
- (h) Home Consideration,
  - i. Parallel Circuits and Circuit Breakers
  - ii. Multi-loop Circuits
  - iii. Connecting Ammeters, Voltmeters, and Cells

### D. Magnetism

- (a) Sources of Magnetic Field Lines: Moving Charges
- (b) Field Lines about Bar Magnets, Horseshoe Magnets and the Earth
- (c) Field lines about a Wire and a Coil: Biot-Savart Law
- (d) Electromagnets
- (e) Atomic Theory of Magnetism: Electron Spins and Domains
- (f) Magnetic Forces
  - i. Point Charges: Lorentz Law
  - ii. Forces between Parallel Wires

- (g) Magnetic Torque on a Current Loop
- (h) Magnetic Devices
  - i. Electromagnetic Motor
  - ii. Mass Spectrometer
- (i) Electromagnetic Induction
  - i Generation of Electromotive Force
  - ii Faraday's Law
  - iii Electric Generator & Motor
  - iv Transformers

## 12. Atomic & Nuclear Structure

### A. Atomic Theory & Quantum Mechanics

- (a) Radioactivity: alpha, beta, and gamma radiation
- (b) Cathode Ray Tubes and The Raisin Cake Model of the At
- (c) Rutherford: The Gold Foil Experiment
- (d) Bohr: Postulates of Atomic Structure
  - i. Electrons are confined to certain quantized orbits
  - ii. Contrary to Maxwell, electrons do not emit energy while in stationary orbits
  - iii These orbits are of quantized angular momentum
- (e) Bohr: Conclusions
  - i. Interpretation of Line Spectra (qualitative)
  - ii. Derivation of Quantized Electron Energy Values
  - iii. Agreement with Line Spectra (quantitative)

### B. Quantum Theory: Physical Laws at Atomic Scale

- (a) Experimental Evidence suggesting the need for a new theory
  - i. Line Spectra
  - ii The Photoelectric Effect
- (b) Early Theoretical Work
  - i. Einstein and Planck: Quantization of EMR
  - ii. de Broglie: Photon Momentum, Matter Waves, & Wave- Particle Duality
  - iii Heisenberg: The Uncertainty Principle
- (c) Current Quantum-Mechanical Model of The Atom
- (d) Electronic Energy Level Diagrams

### C. Nuclear Reactions

- (a) Balancing Nuclear Reactions
- (b) Alpha, Beta, & Gamma Decay
- (c) First-Order Decay Processes: Half-Lives and Decay Sequences
- (d) Power Sources: Fission & Fusion

## List Of Labs:

- Lab # 1: P-06 Acceleration due to Gravity
- Lab # 2: P-04 Constant Acceleration Down an Incline
- Lab # 3: P-11 Newton's Second Law
- Lab # 4: P-13 Atwood's Machine
- Lab # 5: P-17 Conservation of Momentum
- Lab # 6: P-38 Heat Transfer
- Lab # 7: P-19 Simple Harmonic Motion
- Lab # 8: P-32 Sound Waves
- Lab # 9: P-55 Light Intensity vs. Position
- Lab # 10: Optical Bench
- Lab # 11: P-40: Ohm's Law
- Lab # 12: Kirchhoff's Laws with Multimeters and Circuit Boards
- Lab # 13: P-43 RC Circuit
- Lab # 14: P-51 Magnetic Field
- Lab # 15 : P-41 Magnetic Induction

## Other Suggested Experiments

- Determine Density
- Determine g.
- Coefficient of Friction
- Centripetal Force
- Conservation of Energy
- Specific Heat
- Period of a Pendulum
- Resistor Addition