

## **AP Physics (B)**

Primary Text:

Physics for Scientists and Engineers (3<sup>rd</sup> edition)

Douglas Giancoli

Prentice Hall

2000

Supplemental Texts:

Fundamentals of Physics (6<sup>th</sup> edition)

Halliday, Resnick, Walker

John Wiley and Sons

2001

Physics (5<sup>th</sup> edition)

Douglas Giancoli

Prentice Hall

2002

Physics for Scientists and Engineers (4<sup>th</sup> edition)

Paul Tipler

Freeman

1999

TI 89 Titanium calculators are provided for all students. The calculators are used in problem solving as well as in analyzing data collected in labs. Logger Pro software and Vernier sensors are used in many of our labs. (1) Many of the labs begin with the students assigned to explore and collect data from observing physical phenomena. Then they are required to analyze the data with computer software or graphing calculators when possible. Regressions are often found to fit the data. The regression equations and observations are then compared to known formulas and physics properties. (2) Other labs require students to find an unknown quantity by a method they must determine. The necessary lab materials are placed on tables, but the students are required to decide which materials to use and what the procedures will be. (3) Some labs require students to follow detailed procedures and then analyze data according to specified methods. Classes are eighty minutes long on Monday, Wednesday and Friday. On Tuesday and Thursday they last fifty minutes. Labs usually require one eighty minute period to collect data and another fifty minute period to analyze the data and reach conclusions. Twenty five labs are planned for the course with most being open ended. Students will keep all their labs in a lab notebook which will contain all twenty five lab reports when the course is completed. Lab reports will include the objective or hypothesis, all the required materials, the procedure followed, the data collected, the calculations used to analyze the data, all graphs used to analyze the data, and conclusions reached from the experiment. The labs are listed at the end of the syllabus.

Regular classes will be a mix of lecture and problem solving. Free body diagrams and proper problem solving techniques will be emphasized. Students will be required to begin with general formulas and use correct algebraic manipulation to obtain general solutions.

The first semester will cover chapters one through sixteen followed by a review and comprehensive semester exam. The second semester will cover chapters seventeen through forty two followed by a review of the entire course in preparation for the AP exam. Students will work through released AP exams as the final preparation leading up to the actual AP exam in May.

## **Topics in order of study**

### **Semester 1**

Chapter 1 (1 day)  
Measurement, SI system

Chapter 2 (1 week)  
Velocity, acceleration, displacement, one dimensional motion at constant acceleration, falling objects

Chapter 3 (1 week)  
Vectors, two dimensional motion, projectile motion, uniform circular motion

Test 1  
Chapters 1-3

Chapter 4 (1 week)  
Newton's laws of motion, static equilibrium, dynamics of a single particle, systems of two or more objects

Chapter 5 (1 week)  
Newton's laws of motion, friction, uniform circular motion, rotational dynamics

Chapter 6 (1 week)  
Newton's Law of Universal Gravitation, Kepler's laws and the orbits of planets and satellites, Newton's synthesis, gravity near the Earth's surface

Test 2  
Chapters 4-6

Chapter 7 (1 week)

Work done by a constant force, kinetic energy, work-energy principle

Chapter 8 (1 week)

Forces and potential energy, conservation of mechanical energy, power

Chapter 9 (1 week)

Conservation of momentum, collisions, impulse, center of mass

Test 3

Chapters 7-9

Chapter 10 (1 week)

Uniformly accelerated rotational motion, torque, rotational kinetic energy, rotational kinematics

Chapter 11 (1 week)

Torque vector, conservation of angular momentum

Chapter 12 (1 week)

Torque and rotational statics

Test 4

Chapters 10-12

Chapter 13 (1 week)

Hydrostatic pressure in fluids, Pascal's principle, buoyancy, Archimedes' principle, equation of continuity for fluids, Bernoulli's equation

Chapter 14 (1 week)

Oscillations of a mass on a spring, simple harmonic motion, the pendulum

Chapter 15 (1 week)

Characteristics of wave motion, reflection, transmission, interference, traveling waves, standing waves, wave propagation, resonance, refraction, diffraction, superposition

Chapter 16 (1 week)

Characteristics of sound, intensity, vibrating strings, Doppler effect

Test 5

Chapters 13-16

Semester Review (1-2 weeks)

Exam Chapters 1-16

## Semester 2

Chapter 17 (2 days)

Temperature, thermal expansion, ideal gas law,

Chapter 18 (3 days)

Kinetic theory of gases, distribution of molecular speeds

Chapter 19 (3 days)

Heat, calorimetry, first law of thermodynamics, heat transfer, PV diagrams

Chapter 20 (2 days)

Second law of thermodynamics, heat engines, the Carnot engine, entropy

Test 1

Chapters 17-20

Chapter 21 (1 week)

Electrostatics with conductors, electric charge, Coulomb's law, the electric field, motion of a charged particle in an electric field

Chapter 22 (1 day)

Gauss' law, electric flux (optional)

Chapter 23 (1 week)

Electric potential and potential difference, electric fields

Test 2

Chapters 21-23

Chapter 24 (1 week)

Capacitors, capacitance, parallel plate capacitors, capacitors in series and in parallel, energy storage, dielectrics, RC circuits

Chapter 25 (1 week)

The electric battery, electric current, Ohm's law, resistivity, electric power

Chapter 26 (1 week)

DC circuits, resistors in series and in parallel, Kirchhoff's rules, RC circuits, DC ammeters and voltmeters

Test 3

Chapters 24-26

Chapter 27 (1 week)

Magnetic fields, forces on current carrying wire in magnetic fields, force on electric charge moving in a magnetic field, torque on a current loop

Chapter 28 (2 days)

Magnetic field around a conducting wire, force between parallel wires, Ampere's law, Biot-Savart law, electromagnets, solenoids

Chapter 29 (3 days)

Electromagnetic induction, induced EMF, Faraday's law, Lenz's law, EMF in moving conductors, transformers

Test 4

Chapters 27-29

Chapter 30 (1 day)

Mutual inductance, self inductance, LR circuits (optional)

Chapter 31 (1 day)

AC circuits (optional)

Chapter 32 (1 day)

Maxwell's equations, production of electromagnetic waves

Chapter 33 (1 week)

Speed of light, index of refraction, reflection by a plane mirror, images formed by spherical mirrors, Snell's law, dispersion of light, the electromagnetic spectrum, the visible spectrum

Chapter 34 (1 week)

Thin lenses, lens equation, combination of lenses, cameras, the human eye, telescopes, microscopes

Chapter 35 (1 week)

Huygen's principle, interference, diffraction, Young's double slit experiment, interference in thin films, Michelson interferometer

Chapter 36 (1 week)

Diffraction by a single slit, diffraction in a double slit experiment, diffraction gratings, x-rays and x-ray diffraction, polarization

Test 5

Chapters 33-36

Chapter 37 (2 days)

Michelson-Morley experiment, special relativity, mass-energy equivalence

Chapter 38 (1 week)

Atomic energy levels, photon theory of light, photoelectric effect, Compton effect, wave-particle duality, early models of the atom, the Bohr model, atomic spectra, De Broglie's hypothesis

Chapter 39 (1 day)

Heisenberg uncertainty principle, potential wells

Chapter 42 (2 days)

Binding energy and nuclear forces, radioactivity, alpha decay, beta decay, gamma decay, half-life and rate of decay, radioactive dating

Chapter 43 (3 days)

Nuclear reactions, conservation of mass number, conservation of charge, nuclear fission, fusion

Chapter 44 (2 days)

Particles and antiparticles, particle interactions and conservation laws, particle classification, quarks (optional)

Chapter 45 (1 day)

General relativity (optional)

AP Exam Review (2 weeks)

Chapters 1-43

Post Exam Topics

Optional topics listed previously

## **Labs**

Measurement of Length and Mass

Acceleration of a Freely-falling Body

Galileo's Inclined Plane Experiment

Calculating the Coefficient of Friction

Simple Machines

Conservation of Momentum

Equilibrium of a Rigid Body

Density of Mineral Oil

Archimedes Principle

The Simple Pendulum

Simple Harmonic Motion of a Spring

Standing Waves

Waves in a Ripple Tank

Sound Waves

Resonance of Air Columns

Electrostatics

DC Circuits I

DC Circuits II

Charging a Capacitor

RC Circuits

Electromagnets

Mirrors

Converging Lenses

Wavelength of a Laser

Emission Spectrum of Hydrogen

**\*Logger Pro**

Several of the labs will utilize Logger Pro software, a Lab Pro interface and Vernier sensors.

## Examples of Labs

### The Simple Pendulum:

Students are given timers, bobs, string, rods, rod stands, and pendulum clamps. They are told to find the relationship between the length of the pendulum and the period. It is anticipated that they will perform many trials at various lengths and plot their data. They should decide on an appropriate regression and report this equation to me. I then help them compare their regression equation to the known formula for a simple pendulum. Students usually decide on a power regression and the power is usually very close to  $\frac{1}{2}$  as expected. The coefficient is also close to  $\frac{2p}{\sqrt{g}}$ .

### Resonance of Air Columns:

Students are given a resonance apparatus and a group of tuning forks whose frequencies are known only to the teacher. Students are to find the frequencies of the tuning forks by a method relating our study of closed tubes and then compare their values to the actual frequencies. The results are usually very good as we use the formula that takes into consideration the diameter of the tubes.

### Charging a Capacitor:

Students will use a program from the Logger Pro software. They need to connect a Lab Pro to a computer and then connect a voltage probe to the Lab Pro. They will then set up an RC circuit and attach the voltage probe to the terminals of the capacitor. The program will allow students to collect real time data as the capacitor charges. The computer will produce a graph of the voltage across the capacitor versus time. The graph usually looks just like the graphs in the textbooks. We can also use values in the table to see how well the data fits the equation for voltage across a capacitor as it charges. There is usually some variation with the predicted values from the equation and actual values obtained from the experiment.