**AP Physics 1**

2014-2015

Text: *Physics: Principles with Applications (6th Ed)* – Giancoli, Pearson/Prentice Hall, 2004

Class meets 4 time a week for 50 minutes for a total of 200 minutes per week. 14 + 14 + 2 review weeks = 28 + review. Laboratory work once per week.

AP Physics 1 is an AP-level algebra-based physics course, taught as a first-year college physics class for 11th and 12th graders who have had physics before. The primary purpose of this class is to establish a fundamental grounding in mechanical physics for future engineering, science, pre-medicine, nursing, and physical therapy students. There will also be heavy emphasis on preparation for the AP test. Students should anticipate learning how to plan their own investigations in a laboratory setting and familiarizing themselves with being able to explain reasoning verbally, in addition to manipulating mathematical symbols.

Prerequisites:

* At least one semester of physics completed
* At least a ‘B’ grade in Algrebra II or Pre-calculus
* Current enrollment in ESL 4 or higher

Your grade will be determined by the following weighted average:

*Exams***:** 45%

*Labs:* 20%

*Homework, quizzes, and class participation*: 20%

In-class activities 5%

*Final presentation:* 10%

**Classroom policy**

**Respect:** It is the duty of the teacher to respect the students and their honest curiosity. It is the duty of the students to respect the teacher and his judgment and decisions in running the classroom and the subject material.

**Cell phones:** Cell phones are not allowed to be used in the classroom for **any** reason, except when given explicit instructions by the teacher. Cell phones must be turned off and placed in the ***cell phone basket*** at the front of the classroom while class is in session. If your cell phone rings or vibrates in the basket or you are seen to have a cell phone with you, your phone will be confiscated for a *minimum* of 24 hours. For example, loss of a phone on a Friday will result in losing the phone for the entire weekend.

**Food and drink:** Food and drink are not permitted in the physics classroom. Exception: you are permitted to bring drinks if brought in a reusable sealable container.

**Trash:** Students are expected to dispose of their trash and garbage. If you leave graded assignments in the classroom after class time, those assignments will be changed to 0 credit.

**Class participation:** Students are expected to improve the classroom setting. *Raise your hand* to ask a question. Talking out of turn – including talking while the teacher is talking and talking without raising your hand – ***is NOT permitted***. Each time a student talks out of turn, (s)he loses 1 point from his/her class participation grade.

All relevant questions about the subject (e.g. “Can you explain the last step in that problem?”) are *highly encouraged*. It can take bravery to admit that you do not understand and almost always another student has the same question and is relieved that you asked. Private questions (e.g. “I have a question about the grade on my test”, “Do you have my homework?”) should be saved for after class. Comments about the class (e.g. “This test was too hard.”) should always be discussed in private, out of respect for the classroom environment.

**Absences/missing class:** All work due to *unexcused* absences will be given 0 credit. All work missed due to *excused* absences can be made up. Students are responsible for making sure they get missed assignments and tests. A good idea is to ask the teacher during free time, “What did I miss?” The due dates for missed work will be decided by the teacher; however, do not expect any additional time to prepare for missed tests or quizzes. Be ready on the day you return.

**Supplies:**  Students will need a ***physics folder*** to keep graded physics assignments. Students will need a ***physics*** ***spiral notebook*** where they can take class notes (see: *Tests*). Students will need a ***lab notebook***, to keep their labs in. ***Lab notebooks*** will be given at beginning of the year. Being ready for class also means having something to write with. Pencil or mechanical pencil is highly recommended.

**Cheating**: Cheating (copying another student) in test and quizzes is absolutely prohibited. Cheating will result in a 0 score and disciplinary sanctions for the person cheating. Disciplinary sanctions will also result for the person *who helped the student cheat*.

**Name on paper**: Put your name on your assignments. Assignments with no name on them will be given half credit *if I can find out who they belong to*. If I cannot find out whom an assignment belongs to, 0 credit will be given.

**Homework and Quizzes**

Homework assignments are ***required*** for this class. Homework due dates will be posted to the class website: <http://www.examplewebsite.com>. Students are permitted to work together, but each student must be able to reproduce the work on his/her own. For this reason, homework quizzes will be given. Late homework is accepted up to one day late at 50% credit. Homework will **not** be accepted that is more than 24 hours late. Unless otherwise stated, all homework will be due at the end of the school day at **5pm**. Homework will be graded on a 2-point scale:

|  |  |
| --- | --- |
| 0 points **X** | Did not do, no effort |
| 1 point **√-** | Partially completed. Some effort |
| 2 points **√** | Completed. Showed effort. |

Quizzes will be graded on a 4-point scale:

|  |  |
| --- | --- |
| **1** | Attempted and has name. |
| **2** | Some correct work and understanding |
| **3** | Minor mistake (e.g. units missing) |
| **4** | Perfect |

**Tests**

Every 1 or 2 units, there will be a test. All tests will be open notes! This means you are allowed to use your notes in your spiral notebooks on all regular tests. Take good notes! After each test, you have the option of redoing all missed points for half credit. For example, if you get a 80% on the test, it is possible to redo the missed points and get a 90%. Test redos must be done on the same test using a different color. No redo credit will be given without your original test.

**Final presentation**

Towards the end of the school year, you will be required to choose a physics-related topic that interests you to research. Results will be given in the form of a 15-minute oral presentation to the class. PowerPoint is optional but not required. Presentations will be graded on (in descending order of importance): depth of research, clarity of presentation, style of presentation, and scores of the above elements as given by classmates. More information will be given later in the school year.

**Grades**

Grades will be determined based on a combination of a curve and an absolute scale. A good guide:

|  |  |
| --- | --- |
| A | Excellent understanding of material and details. Top ~15% of the class. |
| B | Good understanding. Above average in class. |
| C | Some understanding. Below average in class. |
| D | Problems with basic concepts. Cannot do simple problems. Bottom ~15% of class. Missing work. |
| F | Very little understanding of basic concepts. Significantly behind the rest of the class. Missing most assignments. |

**Calendar:**

1. Kinematics(4 weeks) Standards 3.A.1, 1.A.1, 4.A.1
	1. Vectors
	2. Vector algebra
	3. Vector components
	4. Coordinate systems
	5. Displacement
	6. Velocity
	7. Acceleration
	8. Motion in one dimension
	9. Motion in two dimensions
		1. Projectile motion
2. Newton’s Laws of Motion (5 weeks) Standards: 1.C.1, 1.C.2, 1.C.3, 2.B.1, 2.B.2, 3.A, 3.B, 3.C, 4.A
	1. Static equilibrium (1st law)
	2. Dynamics of a single object (2nd law)
	3. Systems of two or more objects (3rd law)
3. Work, Energy, Power (4 weeks)1.D, 3.E, 4.C, 5.A, 5.B
	1. Work and the Work-Energy theorem 3.E
		1. Real-world Activity Analysis: Catching a Falling Child from a Window

Prediction: What will happen to the man who catches the child? What will the force on him be? How does this force depend on the height of the window, mass of the child, and distance the arms move?

* 1. Forces and potential energy 2.E.1.1
	2. Conservation of energy
	3. Power
		1. Debate: Who will win a race: a motorcycle, a car, or an airplane?

What the factors in a vehicle that contribute to its victory in race? What are the order of magnitude differences in these factors between these three vehicles? Make an argument for the importance of mass, volume, cross-sectional area, coefficient of drag, power, force, etc…

* + 1. Real-world application: Generating electrical power safely and cleanly

Making basic assumptions about the population growth of the world, estimate future power needs of the world’s population. Determine sources of power available, and evaluate the best choices based on concerns for financial, human, an environmental cost.

1. Linear momentum (3 weeks) 3.D, 4.B, 5.A, 5.D, 5.D.3
	1. Center of mass
	2. Impulse and momentum
	3. Conservation of linear momentum
2. Circular motion and rotation (4 weeks)3.C.1, 3.E.1, 3.F, 4.D, 5.B, 5.E
	1. Uniform circular motion (constant speed)
	2. Torque and rotational statics (Newton’s 1st law for rotation)
	3. Rotational kinematics and dynamics (Newton’s 2nd law for rotation)
	4. Rotational kinetic energy
	5. Angular momentum and conservation
3. Oscillations and gravitation (4 weeks) Standards 1.C.1, 1.C.3, 2.B, 3.B, 3.C, 3.E, 3.F, 3.G.1, 4.D, 5.A, 5.B, 5.E
	1. Simple harmonic motion (dynamics and energy)
		1. Mass on a spring
		2. Pendulum and other oscillations
	2. Newton’s law of gravity
	3. Orbits of planets and satellites
		1. Circular
4. Waves (2 weeks)6.A, 6.B, 6.C, 6.D
	1. Traveling waves
		1. Mechanical Waves
		2. Sound
	2. Wave propagation
	3. Standing waves 6.D.3
	4. Superposition
5. Electric charge and circuits (2 weeks)
	1. Charge and Coulomb’s Law 1.B, 1.E.2, 2.C, 3.C, 4.E,4,5.A, 5.C
		1. Charge is a conserved quantity 5.C
	2. Electric potential 2.E
	3. Circuits:
		1. Ohm’s Law 1.E
		2. Combining resistors
		3. Kirchoff’s laws 5.B.9, 5.C.3
		4. Power dissipated in a circuit
6. AP Exam review
7. Projects and presentations (must show at least two *enduring understandings*. Sample presentation: *Special relativity in The Planet of the Apes. LO 1.D.3.1, L.O.5.A.2.1, EK 5.A.5* Details below.)

**Labs**

An important part of this class involves laboratory work, which involves conducting experiments, collecting data, doing analysis on the data, and submitting all data and analysis in the form of a ***lab report***, due the Monday after lab day. Labs will occupy 25% of class time, which is one day per week. All data and lab reports should be kept in your designated physics ***lab notebooks***, which you’ll be given at the start of the year. Each ***lab report*** should start on a new page in your ***lab notebook*** and should include the following sections:

**1. Abstract**

The abstract should include the title of the lab and a one or two sentence statement summarizing what this lab is about.

**2. Background/theory/hypothesis**

What physical principle is being tested? What predictions does the theory make?

**3. Procedure**

Describe how the experiment was done. If someone else wanted to repeat the experiment to confirm your results, how would they do it? What would they need to know?

**4. Data**

 Actual data recorded.

**5. Analysis and discussion**

Interpret and analyze your data in this section. Make sure all axes are labeled and numbered with proper units!

How do your results compare with the theory in section 2? If you’re are trying to measure something, make sure to include % error ( $\left|\frac{actual-predicted}{predicted}\right|$x100% ). Comment on whether your result is close or far away from the expected result. List any sources of error (e.g. friction due to air, limitations of equipment) that could explain the difference between your result and the expected result. For each possible source of error, which direction would the error bias the result (i.e. would each make the result larger or smaller)? In your own judgment, was your result convincing proof of the physical principle? Was your result too far from what the theory predicted? *Reminder: having a result with a large error is not wrong if you can explain it! Report what the data says, NOT what you want the data to say!*

There is no recommended length for each ***lab report***. Include everything that you think is important and say it in the smallest amount of space that you need.

Tentative\* list of possible labs

|  |  |  |
| --- | --- | --- |
| Lab Number | Name | Subject |
| **1** | **World class runner: Guided-inquiry** | 1D Kinematics |
| 2 | Guided-inquiry: Determining *g* from motion on an inclined plane | 2D Kinematics |
| 3 | Guided-inquiry: Human-powered projectile motion | 2D Kinematics |
| 4 | Open-inquiry: Friction and **μ** | Forces |
| 5 | Open-inquiry: Show that Work = Change in Kinetic energy | Work and energy |
| 6 | Guided-inquiry: Collisions  | Energy and momentum |
| 7 | Open-inquiry: Torque and angular acceleration | Rotational motion |
| 8 | Guided-inquiry: Determining *g* from a simple pendulum | Simple Harmonic Motion |
| 9 | Guided-inquiry: Predicting period of a mass-spring system | Simple Harmonic Motion |
| 10 | Open-inquiry: *g* and the buoyancy force | Fluids |
| 11 | Guided-inquiry: Drawing equipotential lines  | Electricity |
| 12 | Guided-inquiry: Ohm’s Law: Combining resistors | Electricity |
| 13 | Guided-inquiry: Speaker lab: Finding cancellation points | Waves |
| 14 | Guided-inquiry: Doppler effect of a car horn | Waves |

Lab summaries:

1. Guided-inquiry: World-Class Runner: Determine from experiment whether a runner accelerates at a constant rate before reaching a constant velocity, using sidewalk chalk and timers. SPs: 1, 2, 3, 4, 5, 6, 7
2. Guided-inquiry: Determining *g* from motion on an inclined plane: Use Vernier ramps and photogate sensors to determine the acceleration due to gravity on an inclined plane. SPs: 1, 2, 3, 4, 5, 6
3. Guided-inquiry: Human-powered projectile motion: Use trundlewheels and timers to measure x and t. Determine v0x, v0y, θ, v0. SPs: 1, 2, 3, 4, 5, 6
4. Open-inquiry: Friction and **μ**: Use the Dual-Range Force Sensor and a scale to graph the relationship between normal force and frictional force and determine μ SPs: 1, 2, 3, 4, 5, 6
5. Open-inquiry lab: Show that Work = Change in Kinetic energy or that Energy is Conserved. Using the equipment available, find a way to test the hypothesis of the Work-Energy Theorem or the Conservation of Energy SPs: 1, 2, 3, 4, 5, 6
6. Guided-inquiry: Collisions. Using photogates, test the conservation of momentum for Vernier carts. SPs: 1, 2, 3, 5, 6
7. Open-inquiry: Torque and angular acceleration. Using Vernier angular motion sensors, find a way to test whether torque is proportional to angular acceleration, and what the constant of proportionality is. SPs: 1, 2, 3, 4, 5, 6, 7
8. Guided-inquiry: Determining *g* from a simple pendulum. Using Vernier angular motion sensors, measure the period of a simple pendulum. Use this information to find *g*, the acceleration due to gravity. SPs: 1, 2, 3, 5, 6
9. Guided-inquiry: Predicting period of a mass-spring system: Predict the period of a mass-spring system, based on mass and the spring constant. Using the Vernier Dual-Range Force Sensors, measure the period and compare. . SPs: 1, 2, 3, 5, 6
10. Open-inquiry: *g* and the buoyancy force: Using the Dual-Range Force Sensor and a graduated beaker, measure how the buoyancy force varies with the displaced volume of water. Use this information to find *g*, the acceleration due to gravity. SPs: 1, 2, 3, 4, 5, 6
11. Guided-inquiry: Drawing equipotential lines: Using conductive paper and a voltmeter, draw the equipotential lines of various electrode configurations. SPs: 1, 3, 6
12. Guided-inquiry: Ohm’s Law: Combining resistors: Combine resistors in series and parallel in various configurations. See if the new combination resistances are as predicted by series and parallel combination laws. SPs: 1, 2, 3, 5, 6
13. Guided-inquiry: Speaker lab: Finding cancellation points: Using a tone generator, find locations of local minimum from destructive interference. Use this information to determine speed of sound in air. SPs: 1, 2, 3, 4, 5, 6, 7
14. Guided-inquiry: Doppler effect of a car horn: Using data gathered with a spectroscope, determine the speed of a car from its Doppler shift. SPs: 1, 2, 3, 5, 6

**Homework and Quizzes**

Homework is the most essential part of learning. Students are permitted to work together, but each student must be able to reproduce the work on his/her own. For this reason, homework quizzes will be given. Homework credit will partially be based on the corresponding quiz score. Late homework is accepted up to one day late at 50% credit.

**Final presentation**

Towards the end of the school year, you will be required to choose a physics-related topic that interests you to research. Results will be given in the form of a 20-minute oral presentation to the class. PowerPoint is optional but not required. Presentations will be graded on (in descending order of importance): depth of research, clarity of presentation, style of presentation, and scores of the above elements as given by classmates. A list of suggested topics will be given. You may also choose your own topic, but the topic must be connected to physics by at least two of the following enduring understandings:

**Enduring Understanding 1.A:** The internal structure of

a system determines many properties of the system.

**Enduring Understanding 1.B:** Electric charge is

a property of an object or system that affects its

interactions with other objects or systems containing

charge.

**Enduring Understanding 1.C:** Objects and systems

have properties of inertial mass and gravitational mass

that are experimentally verified to be the same and that

satisfy conservation principles.

**Enduring Understanding 1.D:** Classical mechanics

cannot describe all properties of objects.

**Enduring Understanding 1.E:** Materials have many

macroscopic properties that result from the arrangement

and interactions of the atoms and molecules that make

up the material.

**Enduring Understanding 2.A:** A field associates a

value of some physical quantity with every point in

space. Field models are useful for describing interactions

that occur at a distance (long–range forces) as well as a

variety of other physical phenomena

**Enduring Understanding 2.B:** A gravitational field is

caused by an object with mass.

**Enduring Understanding 3.A**: All forces share

certain common characteristics when considered

by observers in inertial reference frames.

**Enduring Understanding 3.B:** Classically, the

acceleration of an object interacting with other objects

can be predicted by usinga=Sum(F)/m

**Enduring Understanding 3.C:** At the macroscopic level,

forces can be categorized as either long–range (action–

at–a–distance) forces or contact forces.

**Enduring Understanding 3.D:** A force exerted on an

object can change the momentum of the object.

**Enduring Understanding 3.E:** A force exerted on an

object can change the kinetic energy of the object.

**Enduring Understanding 3.F:** A force exerted on an

object can cause a torque on that object.

**Enduring Understanding 3.G:** Certain types of forces

are considered fundamental

**Enduring Understanding 4.A:** The acceleration of the

center of mass of a system is related to the net force

exerted on the system, where a=Sum(F)/m

**Enduring Understanding 4.B:** Interactions with

other objects or systems can change the total linear

momentum of a system.

**Enduring Understanding 4.C:** Interactions with other

objects or systems can change the total energy of a

system.

**Enduring Understanding 4.D:** A net torque exerted

on a system by other objects or systems will change the

angular momentum of the system.

**Enduring Understanding 5.A:** Certain quantities

are conserved, in the sense that the changes of those

quantities in a given system are always equal to the

transfer of that quantity to or from the system by all

possible interactions with other systems.

**Enduring Understanding 5.B:** The energy of a system

is conserved.

**Enduring Understanding 5.C:** The electric charge of a

system is conserved.

**Enduring Understanding 5.D:** The linear momentum of

a system is conserved.

**Enduring Understanding 5.E:** The angular momentum

of a system is conserved.

**Enduring Understanding 5.F:** Classically, the mass of a

system is conserved.

**Enduring Understanding 5.G:** Nucleon number is

conserved.

**Enduring Understanding 6.A:** A wave is a traveling

disturbance that transfers energy and momentum.

**Enduring Understanding 6.B:** A periodic wave is one

that repeats as a function of both time and position

and can be described by its amplitude, frequency,

wavelength, speed, and energy.

**Enduring Understanding 6.C:** Only waves exhibit

interference and diffraction

**Enduring Understanding 6.D:** Interference and

superposition lead to standing waves and beats.