Physics C: Mechanics
2010 - 2011
Brief Description of Course
AP Physics, Mechanics C. This year-long course is designed to prepare students to take the AP Physics, Mechanics C Examination in May. The course meets 5 days a week, with two of the days
being double periods. Therefore, the students meet for a total of seven 42-minute periods each week.
Unit Information
Unit Name or Timeframe:
Chapter 1 -- Units, Physical Quantities, and Vectors (sections 1-7 only)
NOTE: This chapter is assigned as summer reading. The first 7 sections are review from previous science courses. Sections 8, 9 (Vectors) are taught as part of Chapter 3.
Content and/or Skills Taught:
1. Idealized Models: particle models
2. Standards and Units: SI v. Metric System, fundamental units (kg, m, s), unit prefixes
3. Uncertainty and Significant Figures: scientific notation, accuracy v. precision, significant figures
Major Assignments and/or Assessments:
This summer assignment is accompanied by a problem set which is collected and graded by the instructor. The problem sets are returned and reviewed before moving on to the next chapter.
Unit Name or Timeframe:
Chapter 2 -- Motion Along a Straight Line
Content and/or Skills Taught:
1. Displacement, time, and average velocity
2. Instantaneous Velocity
3. Average and instantaneous acceleration
4. Motion with constant acceleration
5. Velocity and position by integration (here calculus is taught -- derivatives and integrals)
Major Assignments and/or Assessments:
1. quizzes, test
2. problem set(s)
3. Labs:
a)Walk This Way (PASCO lab): students use a motion sensor to create varying displacement, velocity,
and acceleration graphs. students are given graphs and attempt to recreate the graph using their motion. students learn how linear and curved graphs are generated based on the student's movement.
Lab write-up required. 2 class periods
b)Fancart Lab (PASCO lab): students use a motion sensor to track the movement of a constantly-accelerating object. they analyze the displacement (quadratic), velocity (oblique), and acceleration (horizontal) graphs, as well as discover the relationships between slopes and areas under
curves (intro to calculus). Lab write-up required. 2 class periods.

Unit Name or Timeframe:
Chapter 3 -- Vectors AND Motion in Two or Three Dimensions
Content and/or Skills Taught:
1. Vectors and vector addition

2. Components of vectors
3. Position and velocity vectors
4. The acceleration vector
5. Freely falling bodies
6. Projectiles
7. Motion in a Circle
8. Relative velocity
9. Navigation using vectors

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs:

a)Picket Fence Lab (PASCO lab): students use a motion sensor to experimentally determine the value
of "g". Lab write-up required. 2 class periods.
b)Bullseye Lab: students predict the landing point of a ball rolling off of the edge of a table. Lab write-up required. 2 class periods.
c)Duck Challenge: students attempt to place a rubber duck at the predicted landing point of a launched
projectile ball. with the exception of a horizontal launch to determine muzzle velocity, students may
not perform practice launches and randomly select the angle of launch. if a "hit" is made, students may
move on to a smaller duck and a different angle. No Lab write-up required. 3 class periods.

Unit Name or Timeframe:

Chapter 4 -- Newton’s Laws of Motion

Content and/or Skills Taught:

1. Force and interactions
2. Newton’s First Law
3. Newton’s Second Law
4. Mass and weight
5. Newton’s Third Law
6. Using Newton’s Laws
7. Free-body diagrams visualized

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: F=ma lab (PASCO lab): by varying either applied force or system mass, students monitor the
changes in acceleration of a cart on a track using a motion sensor. Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 5 -- Applications of Newton’s Laws

Content and/or Skills Taught:

1. Using Newton’s First Law: particles in equilibrium
2. Using Newton’s Second Law: dynamics of particles
3. Frictional forces
4. Dynamics of circular motion

Major Assignments and/or Assessments:

1. quizzes, test

2. problem set(s)
3. Labs:
a)Friction Lab: students determine the coefficients of static and sliding friction for various surface pairings. in addition, they study the effects of surface area and speed on frictional forces. Lab write-up
required. 2 class periods.
b)Force Table Challenge: students put an unbalanced system of three hanging masses on a force table
into equilibrium using a fourth hanging mass. no trial runs allowed -- all work must be performed on
paper. Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 6 -- Work and Kinetic Energy

Content and/or Skills Taught:

1. Work
2. Work and kinetic energy
3. Work and energy with varying forces
4. Power

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: Ramp Challenge: students attempt to get a car to stop as close as possible to the bottom of a
ramp by pulling a sliding block behind it. students may use a choice of block surfaces as well as mass
distributions on the block and car. students must determine friction coefficients experimentally. no
practice runs are allowed. Lab write-up required. 4 class periods.

Unit Name or Timeframe:

Chapter 7 -- Potential Energy and Energy Conservation

Content and/or Skills Taught:

1. Gravitational potential energy
2. Elastic potential energy
3. Conservative and nonconservative forces
4. Force and potential energy
5. Energy diagrams

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: W,K,U Lab (PASCO lab): using a cart and pulley system and a motion sensor, students observe the exchange between work, potential, and kinetic energy as a falling mass pulls a cart down a
track. Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 8 -- Momentum, Impulse, and Collisions

Content and/or Skills Taught:

1. Momentum and impulse
2. Conservation of momentum
3. Inelastic collisions
4. Elastic collisions

5. Center of mass

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs:

a)Cart Bounce Lab (PASCO): a rolling cart "bounces" off of a magnet, generating a force versus time graph. The area under the graph is compared with the change in momentum calculated using a motion sensor for the cart. Lab write-up required. 2 class periods.

b)Explosion Lab: 2 spring-loaded carts of different masses "explode" off of each other. By varying the mass distribution in the carts, students discover the LOCM. Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 9 -- Rotation of Rigid Bodies

Content and/or Skills Taught:

1. Angular velocity and acceleration
2. Rotation with constant angular acceleration
3. Relating angular and linear kinematics
4. Energy in rotational motion
5. Parallel-axis theorem

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs:

a)Moment of Inertia Lab (PASCO)calculates moment of inertia of an irregularly shaped object by adding and subtracting the moments of inertia of its regularly shaped components. theoretical values are compared with experimental. Lab write-up required. 2 class periods.

b)Ramp Race: various objects of different size, shape, and mass are rolled down an incline -- students predict the order of finish, being allowed to measure and mass each object. students learn that only the moment of inertia of the object matters, not its physical characteristics. No Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 10 -- Dynamics of Rotational Motion

Content and/or Skills Taught:

1. Torque
2. Torque and angular acceleration for a rigid body
3. Rigid body rotation about a moving axis
4. Work and power in rotational motion
5. Angular momentum
6. Conservation of angular momentum

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Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: Demonstration: students demonstrate the Law of Conservation of Angular Momentum using

the classic spinning exercise of moving one's arms inward and outward and observing the change in
angular velocity. No Lab write-up required.

Unit Name or Timeframe:

Chapter 11 -- Equilibrium and Elasticity (sections 1-4)

Content and/or Skills Taught:

1. Conditions for equilibrium
2. Center of gravity
3. Solving rigid body equilibrium problems

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Project: Students construct a mobile with everyday objects built around a theme. Students must demonstrate their use of center of gravity as part of their mobile construction. Lab write-up required.

Assigned as a take-home project.

Unit Name or Timeframe:

Chapter 12 -- Gravitation

Content and/or Skills Taught:

1. Newton's Law of Gravitation
2. Weight
3. Gravitational potential energy
4. The motion of satellites
5. The motion of planets

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: Kepler's Laws/Orbit of Mercury Lab: given the data for the orbit of Mercury, students chart
the orbit of Mercury on polar graph paper and demonsrate Kepler's 1st and 2nd law both mathematically and graphically. Lab write-up required. 2 class periods.

Unit Name or Timeframe:

Chapter 13 -- Periodic Motion

Content and/or Skills Taught:

1. The causes of oscillation
2. Simple harmonic motion
3. Energy in simple harmonic motion
4. Applications of simple harmonic motion
5. The simple pendulum
6. The physical pendulum
7. Damped oscillations

Major Assignments and/or Assessments:

1. quizzes, test
2. problem set(s)
3. Labs: Design a Clock Lab: given a spring, students calculate k for the spring and determine how
much mass to hang from the spring to give it a period of 1 second. Lab write-up required. 2 class periods.

Textbooks

Title: Sears and Zemansky's University Physics (10th Edit

Publisher: Addison Wesley Publishing Company
Published Date: 06 December, 1999
Author: Hugh D. Young
Second Author: Roger A. Freedman
Description:

Other Course Materials

Material Type: Software
Description:
1. PASCO scientific equipment and software
-- motion sensors
-- force sensors
-- rotary motion sensors
-- force table
2. DataStudio data analysis software
3. SMART Technologies
-- SMARTBoard
-- SMART software
Material Type: Graphing Calculator
Description:
TI-83 plus graphing calculator
Material Type: Audiovisual Materials
Description:
DVD -- Mechanical Universe Series