AP® PHYSICS C (Mechanics) Syllabus

Instructor: Mrs. Terri Ogden - Grade 12

Room 211 Philipsburg-Osceola High School

Materials

- Textbook: *Principles of Physics, A Calculus-based Text*, 5th Edition, Serway & Jewett, (2011).

  Brooks/ Cole CENGAGE Learning

- Supplemental materials such as additional practice problems, study guides, readings, and lab binders will be provided.
- Students will be assigned a **graphing calculator** and will be responsible to return it at the end of the year in working order.
- Students will be responsible to obtain a 3-ring binder, and writing utensils.

Course Overview

The school day consists of eight 45-minute periods. The AP Physics class will meet *two* consecutive periods each day. The goal is for the course to use guided inquiry and develop critical thinking skills.

The class structure will primarily consist of time to review and discuss assignments, introduction and discussion of new concepts, clarification and problem-solving examples, student collaboration and presentation of practice work. There will be lab experiments and activities, which will constitute at least twenty percent of class time during a grading period.

Students must be prepared to provide evidence of learning by doing the following:

- be actively engaged in discussions regarding concepts, demonstrations, readings, or activities·
- be active participants for small group collaboration when problem-solving or performing guided inquiry activities
- present solutions to various problem-solving activities to the class
- write about the connections they made with the concepts and the activities or demonstrations
- write concise, coherent lab conclusions using their data to validate their answer to an open-ended questions
- Take benchmark quizzes and unit tests

Mathematics is the language of Physics. Concepts are investigated and proven through mathematics.

Course Outline	**PA State Standards**	**Timeline (wks)**
1. Conversions - Becoming familiar with the metric system	3.1.P.A9	1
2. One-dimensional motion - Newton's 1st Law (Inertia) - Acceleration, velocity and displacement - Free fall / acceleration of gravity - Graphing motion	3.2.P.B1 and B6	4
3. Two-dimensional motion - Projectiles - Vectors - Relative Motion	3.2.P.B2 & B6	4
4. Forces - Newton's 2nd Law - Force of gravity, Normal Force, Applied forces - Forces applied at Angles	3.2.P.B1	2
5. Friction - Coefficient of friction - How angles affect normal force and friction	3.2.P.B1	2
6. Torque - Equilibrium	3.2.P.B1. B2	3
7. Conservation of Momentum - Newton's 3rd Law - 1 and 2-dimensional Collisions - Rocket Propulsion	3.2.P.B2 3.2.12.B2 and B6	3
8. Conservation of Energy and Work - Gravitational Potential Energy - Work-Kinetic Energy Theorem - Energy of Springs - Pulleys	3.2.P.B1 3.2.12.B2 and B6	4
9. Rotational Motion - Center of gravity/mass - Centripetal force - Angular acceleration, velocity, displacement	3.2.P.B1 & B2 3.2.12.B1	5
10. Universal Gravitation and Orbits - Force of gravity as centripetal force - Orbits of planets and satellites - Size of the Solar System - Kepler's Laws	3.2.P.B6 3.3.12.B1	2
11. Simple Harmonic Motion - Longitudinal vs. Transverse waves - Frequency, wavelength, wavespeed - Interference of 2 or more waves - Functions of waves	3.2.P.B5 3.2.12.B5	4
12. Sound - Amplitude - Resonance	3.2.P.B5 3.2.12.B5	1

- Doppler Effect		
13. Electricity and Magnetism - Circuits, Voltage, Currency and Resistance - Coils, Batteries, Motors	3.2.P.B4 3.2.12.B4	2
14. Prepare / Review for AP Exam	All above	2

** Note: the following standards are identical and are covered in all units 3.1.P.A9, B6 and C4 3.2.P.A6, and B7, 3.3.P.A8, B3, 3.2.12.A6 and B7, 3.4.12.C2 and D2

Link to Science Standards for Pennsylvania

https://www.pdesas.org/Standard/View

LABRORATORY EXPERIMENTS

The hands-on experiences in this course will include the listed labs which will help to demonstrate and make connections with a concept. Some on-line simulated labs will be required to be done outside of class, depending on time constraints. Labs will be *student-centered, inquiry-based* labs with a given essential question they are to investigate. Students will be given a list of materials, specific objectives and rubric. Students will be required to design the experiment, collect, organize and record data, and write about the connections between the studied content and lab results. Students will maintain a lab notebook. The overall objectives are for students to learn how to isolate variables for testing, to use the scientific method, to learn to read and analyze data, to analyze relationships among properties, to practice technical writing and learn how to substantiate a statement by linking it to their data. Labs and hands-on experiences will constitute at least twenty percent of class time.

General Labs

1. Measurement

Objectives:

- to learn the proper use of the vernier and micrometer calipers and be able to read their scales.

- to understand how the number of significant figures in a measurement is dependent on the precision of the tool used to measure an object.

Velocity and Acceleration

2. Graphing motion 1: Students to use a motion detector to distinguish graphs

Objective: to understand graphs of distance, and velocity

3. Graphing motion 2: Students to run 30 meters with timing for every 5 meters. Calculate and graph personal velocity and acceleration.

Objective: to understand graphs of distance, velocity, and acceleration vs. time

4. Recreating Galileo's acceleration experiment

Objective: to analyze the relationship between acceleration, distance and time and to investigate the value of gravity.

Projectile Motion

5. Horizontal Projectile lab –

Objective: to determine initial velocity, then calculate the range of a horizontal projectile launched from the lab table

6. Upward projectile Lab–

Objective: students determine and test range of a projectile given initial velocity and different angles of a PASCO projectile launcher

7. On-line satellite motion simulation –

Objective: to determine velocity and altitude to keep a satellite in orbit, understand orbital motion and escape speed.

Newton's Laws and Forces

8. Modified Atwood's Machine – part 1

Objective: to analyze the relationship between acceleration, mass and force for varying masses and forces.

9. Addition of Force Vectors

Objective: students to use a force table to add force vectors experimentally, graphically and analytically.

10. Coefficient of Friction,

Objective: Students to determine the coefficient of friction between various surfaces and analyze which variables among surface roughness, normal force and surface area effect the friction force and which effect the coefficient.

11. Terminal Velocity

Objective: Students determine terminal velocity of a coffee filter

Work, Momentum, and Energy

12. Conservation of Momentum

Objective: Students to set up an elastic and an inelastic collision of a dynamics cart system, and using motion detectors, prove that momentum is conserved.

13. Modified Atwood's Machine – part 2

Objective: Students to evaluate whether mechanical energy was conserved in using a modified Atwood's machine with varying masses and forces.

14. Pulley lab

Objective: Students to evaluate work input, work output, machine efficiency, and mechanical advantage.

15. Conservation of Energy: On-line simulation

Objective: students to observe how changing friction, normal force, velocity, and gravity value change kinetic, potential or thermal energy.

16. Coefficient of Restitution

Objective: Students will examine the rebound height of an elastic ball dropped from rest.

16. Hooke's Law Lab:

Objective: Students to determine spring constant of various springs

17. Personal Power

Objective: Students determine power required to lift their own mass in a measured time.

Rotational Motion and Simple Harmonic Motion

18. Circular Motion Lab

Objective: students to calculate centripetal force for a horizontally rotating object and compare it to the measured value

19. Simulated Gravity

Objective: Students research and design a basic rotating space habitat.

20. Simple Harmonic Motion lab

Objective: Students will examine period of a mass-spring system

21. Torque lab1

Objective: students to use translational and rotational equilibrium to determine an unknown mass.

22. Torque lab 2

Objective: Students use stick bridges to validate calculated upward forces when masses are strategically placed on the bridge.

23. Pendulum lab

Objective: students to investigate which variable affects the period of a pendulum, mass, length or angle (amplitude).

24. Kepler's Laws: On-line simulation

Objective: students to use an on-line simulation to analyze Kepler's laws of planetary motion.

Assessment

The overall grading system is point based. The points he or she has earned divided by the total points possible will determine a student's grade. Assignments are generally five points, but can be more depending on difficulty. Test and lab points generally range from 40 to 100 points. There will be a test at the end of every unit and may be quizzes in between. They will consist of multiple-choice questions, short answer, and problem solving. The students will be given many opportunities to practice their problem solving in the AP free-response format that will help to prepare them for the AP exam at the end

of the year. At any time, the students and parents can see their current grade on-line through the school's MMS grading system.

Student Responsibility

Taking an AP course requires an enormous commitment and requires a mature responsibility from students. This course has a considerably large amount of material to cover and it is imperative that students work at least one hour per night or more outside of class. Students must train themselves to do ***close*** reading of material, whether that means taking notes, outlining or another method to help them identify and remember important concepts. Attendance and punctuality are very important. Students will need to have internet access at home and working together on problems is encouraged. I hope you are up to the challenge.

Welcome to the science of energy!