Syllabus

Physics, Semester A

Course Overview

Physics is one of the three main fields of science, along with biology and chemistry. If asked what biology and chemistry deal with, most of us can come up with a one-word answer: life and chemicals respectively. Physics though, often seems like a grab bag of topics, including motion, magnets, machines, light, sound, and electrical circuits.
The common thread running through all these things is that they each illustrate some very basic mathematical laws in our physical world. In brief, physics is the scientific study of matter, energy, and their most fundamental physical interactions, including attractions, repulsions, and collisions.
In Physics A, you will learn about the "basics" of physics: how to describe and analyze motion, how forces interact with matter, and how to further describe these interactions with the aid of the concepts of energy and momentum. Finally, you'll explore one more specialized topic, thermodynamics, the physics of heat.

Course Goals

By the end of this course, you will be able to do the following:

- Accurately describe and analyze motion along a linear path in mathematical terms, including distance, velocity, and acceleration.
- Mathematically describe and analyze motion along a curved path, using vectors as a mathematical tool in this process.
- Explore and apply the laws of dynamics, relating forces and motion.
- Use the concepts of energy, work, and momentum to analyze complex physical situations, including situations in which two or more bodies interact with each other.
- Observe, analyze, and predict effects of periodic motion, including such everyday motions as a child swinging back and forth on a swing, an object bobbing up and down on a spring, or a planet traveling in an orbit around a star.
- Explore and understand the relationship between temperature, heat, and energy, and understand the ways in which heat can be transferred from one body to another.

Math and Science Skills

Successful completion of Algebra 1 and high school Geometry provide the prerequisite mathematical skills for Physics A.
In addition, you should have a good working understanding of inquiry science methods, including:

- Experimental design, including the importance of experimental controls.
- Basic data analysis skills, including the ability to interpret mathematical patterns from data tables and graphs.
- The ability to use experimental results and/or real data sets to propose general rules.

General Skills

To participate in this course, you should be able to do the following:

- Complete basic operations with word processing software, such as Microsoft Word or Google Docs.
- Perform online research using various search engines and library databases.
- Communicate through email and participate in discussion boards.

For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Plato Student Orientation document, found at the beginning of this course.

Credit Value

Physics A is a 0.5-credit course.

Course Materials

- Computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Physics Test and Study Reference found at the end of this syllabus, which provides a table of physics formulas used in the course.
- Notebook

Course Pacing Guide

This course description and pacing guide is intended to help you keep on schedule with your work. Note that your course instructor may modify the schedule to meet the specific needs of your class.

Unit 1: Kinematics

Summary
In this unit, you will learn what physics is and how it relates to other major sciences. You will also begin your study of physics in this unit by exploring kinematics—the mathematical description of motion. You will accurately describe and analyze linear motion.

Day	**Activity**/*Objective*	Type
1 day: 1	**Syllabus and Plato Student Orientation** *Review the Plato Student Orientation and Course Syllabus at the beginning of this course.*	Course Orientation
2 days: 2–3	**Introduction to Physics** *Learner will define physics, consider how it relates to other sciences, and examine how scientists have contributed to our understanding of the physical world.*	Lesson
2 days: 4–5	**Describing Motion** *Learner will identify kinematic quantities that are used to describe motion, distinguishing between scalar and vector quantities.*	Lesson
2 days: 6–7	**Mathematics for Physical Sciences** *Learner will understand basic mathematical concepts important to the physical sciences and successfully carry out mathematical operations.*	Lesson
2 days: 8–9	**Graphs and Relationships** *Learner will plot graphs and recognize relationships in data.*	Lesson
2 days: 10–11	**Measures of Motion** *Learner will define distance, displacement, speed, velocity, and acceleration and understand how they are related.*	Lesson
2 days:	**Equations of Motion**	Lesson

12–13	*Learner will solve problems for objects with constant acceleration, relating displacement, velocity, acceleration, and time.*	
2 days: 14–15	**Graphing Motion** *Learner will analyze, interpret, and construct graphs that track displacement, velocity, and acceleration over time.*	Lesson
2 days: 16–17	**Unit Activity and Discussion—Unit 1**	Unit Activity Discussion
1 day: 18	**Posttest—Unit 1**	Assessment

Unit 2: Kinematics 2

Summary
In this unit, you will mathematically describe and analyze motion along a curved path. You will use vectors as a mathematical tool in this process.

Day	**Activity**/*Objective*	**Type**
2 days: 19–20	**Vectors in Two Dimensions** *Learner will perform vector analysis in one or two dimensions.*	Lesson
2 days: 21–22	**Describing Motion in Two Dimensions** *Learner will describe the motion of a particle in two dimensions, given functions for its motion in the x and y directions over time.*	Lesson
2 days: 23–24	**Equations of Motion in Two Dimensions** *Learner will apply basic kinematic equations and relationships to objects moving in two dimensions.*	Lesson
2 days: 25–26	**Projectile Motion from a Horizontal Launch** *Learner will analyze the motion of projectiles launched horizontally in a uniform gravitational field when friction is negligible.*	Lesson
2 days: 27–28	**General Projectile Motion** *Learner will analyze the motion of a projectile launched at some angle above the horizon when friction is negligible.*	Lesson
2 days: 29–30	**Unit Activity and Discussion—Unit 2**	Unit Activity Discussion

1 day: 31	**Posttest—Unit 2**	Assessment

Unit 3: Dynamics

Summary
In this unit, you will explore the field of dynamics, investigating the relationship between forces and motion.

Day	**Activity**/*Objective*	Type
2 days: 32–33	**Newton's Laws** *Learner will understand the basic terms, concepts, and laws that relate force and motion.*	Lesson
2 days: 34–35	**Using Newton's First Law** *Learner will examine the concepts of mass, inertia, and equilibrium.*	Lesson
2 days: 36–37	**Using Newton's Second Law** *Learner will solve problems that involve application of Newton's second law of motion in one dimension.*	Lesson
2 days: 38–39	**Using Newton's Third Law** *Learner will determine the value of normal and tension forces by applying Newton's third law of motion.*	Lesson
2 days: 40–41	**Universal Gravitation** *Learner will describe the universal nature of gravity and solve two-body gravity problems.*	Lesson
2 days: 42–43	**Forces Acting in Two Dimensions** *Learner will identify dynamics used to analyze two-dimensional situations.*	Lesson
2 days: 44–45	**Unit Activity and Discussion—Unit 3**	Unit Activity Discussion
1 day: 46	**Posttest—Unit 3**	Assessment

Unit 4: Energy and Momentum

Summary
In this unit, you will learn about and use the concepts of energy, work, and momentum to analyze complex physical situations, including situations in which two or more bodies interact with each other.

Day	**Activity**/*Objective*	Type
2 days: 47–48	**Work** *Learner will solve problems that relate work, force, and displacement*	Lesson
2 days: 49–50	**Kinetic and Potential Energy** *Learner will solve problems involving kinetic energy and potential energy.*	Lesson
2 days: 51–52	**Relating Work and Energy** *Learner will analyze the relationship between work and energy, including the law of conservation of energy.*	Lesson
2 days: 53–54	**Power and Efficiency** *Learner will solve problems involving power and efficiency.*	Lesson
2 days: 55–56	**Momentum** *Learner will define momentum and relate it to energy.*	Lesson
2 days: 57–58	**Impulse** *Learner will define impulse and relate it to an object's change in momentum.*	Lesson
2 days: 59–60	**Conservation of Momentum** *Learner will solve problems involving elastic and inelastic collisions in one dimension using conservation of momentum and energy.*	Lesson
2 days: 61–62	**Collisions in Two Dimensions** *Learner will solve problems involving elastic and inelastic collisions in two dimensions using conservation of momentum and energy.*	Lesson
2 days: 63–64	**Unit Activity and Discussion—Unit 4**	Unit Activity Discussion
1 day: 65	**Posttest—Unit 4**	Assessment

Unit 5: Periodic Motion

Summary
In this unit, you will observe, analyze, and predict periodic (regularly repeating) motion. This includes such everyday motions as a child swinging back and forth on a swing, an object bobbing up and down on a spring, or a planet traveling along in an orbit around a star.

Day	**Activity**/*Objective*	Type
2 days: 66–67	**Periodic Motion** *Learner will define and describe periodic motion and solve problems related to it.*	Lesson
2 days: 68–69	**Mass on a Spring** *Learner will apply knowledge of simple harmonic motion to the case of mass on a spring.*	Lesson
2 days: 70–71	**Pendulum Motion** *Learner will analyze the motion of a pendulum.*	Lesson
2 days: 72–73	**Circular Motion** *Learner will describe the nature of circular motion and the net force associated with it.*	Lesson
2 days: 74–75	**Unit Activity and Discussion—Unit 5**	Unit Activity Discussion
1 day: 76	**Posttest—Unit 5**	Assessment

Unit 6: Thermodynamics

Summary
In this unit, you will explore the relationship between temperature, heat, and energy, understand the ways in which heat can be transferred from one body to another, and learn how we can use differences in heat energy to do work.

Day	**Activity**/*Objective*	Type

2 days: 77–78	**Temperature, Energy, and Heat** *Learner will define temperature, thermal energy, conduction, convection, and radiation.*	Lesson
2 days: 79–80	**Specific Heat and Latent Heat** *Learner will define specific heat and latent heat and calculate heat transfer when systems reach thermal equilibrium..*	Lesson
2 days: 81–82	**The First Law of Thermodynamics** *Learner will identify the first law of thermodynamics as a conservation of energy law.*	Lesson
2 days: 83–84	**The Second Law of Thermodynamics** *Learner will identify the second law of thermodynamic and relate it to heat engines and entropy.*	Lesson
2 days: 85–86	**Heat and the Earth** *Learner will explain heat in terms of its global effect on the earth.*	Lesson
3 days: 87–88	**Unit Activity and Discussion—Unit 6**	Unit Activity Discussion
1 day: 89	**Posttest—Unit 6**	Assessment
1 day: 90	**End of Semester Test**	Assessment

Physics Test and Study Reference

Newtonian Mechanics

(Note: All vectors are expressed in terms of *x*-components only.)

Kinematics

$$v_x = \frac{\Delta x}{\Delta t} \quad \text{and} \quad a_x = \frac{\Delta v_x}{\Delta t}$$

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

$$v_x = v_{x0} + a_x t$$

$$v_x^{\ 2} = v_{x0}^{\ 2} + 2a_x x$$

Dynamics and Periodic Motion

$$\sum F = ma \quad \text{or} \quad F_x = ma_x$$

$$F_f = \mu_s F_N \quad \text{and} \quad F_f = \mu_k F_N$$

Mathematical Formulas

Interpolation

$$y - y_0 = \left[\frac{(y_1 - y_0)}{(x_1 - x_0)}\right] \times (x - x_0)$$

Trigonometry

$$\sin\theta = \frac{opposite}{hypotenuse} = \frac{a}{c}$$

$$\cos\theta = \frac{adjacent}{hypotenuse} = \frac{b}{c}$$

$$\tan\theta = \frac{opposite}{adjacent} = \frac{a}{b}$$

$F_g = mg$ or $F_g = G\frac{m_1 m_2}{r^2}$

$F_c = \frac{mv^2}{r}$

$F = -kx$ $T = 2\pi\sqrt{\frac{m}{k}}$

$T = 2\pi\sqrt{\frac{L}{g}}$

Energy and Momentum

$W = Fd\cdot\cos\theta$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$P = \frac{W}{\Delta t} = \frac{Fd}{t}$

$e = \frac{W_o}{W_i}$

$MA = \frac{F_r}{F_e}$ and $IMA = \frac{d_e}{d_r}$

$p_x = mv_x$

$impulse = F_x\Delta t = \Delta p_x = p_f - p_i$

$\arctan\left(\frac{a}{b}\right) = \theta$

Thermodynamics

$C^\circ = (F^\circ - 32)\times\left(\frac{5}{9}\right)$ and

$K = C^\circ + 273$

$Q = mC(T_f - T_i)$

$W = P(V_f - V_i)$

$\Delta U = Q - W$

$W = Q_H - Q_C$

$e_C = \frac{T_H - T_C}{T_H}$

$\Delta S = \frac{\Delta Q}{T}$

$S = k\cdot\ln W$

Waves and Optics

$v = f\lambda$

$T = \frac{1}{f}$

$n = \frac{c}{v}$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_c = \frac{n_2}{n_1}$

$v = 331 + (0.6\cdot T)$

Quantum and Nuclear Physics

$E = hf$

$E = mc^2$

Electricity and Magnetism

Static Electricity

$F = k\frac{q_1 q_2}{r^2}$

$E = \frac{F}{q}$

$E = k\frac{Q}{r^2}$

$\Delta V = \frac{W}{q}$

Circuits

$V = IR$

$R = \frac{\rho L}{A}$

$P = VI$

$$P = I^2 R$$

$$P = \frac{V^2}{R}$$

Magnetism

$$F = qvB$$

$$F = qvB \sin\theta$$