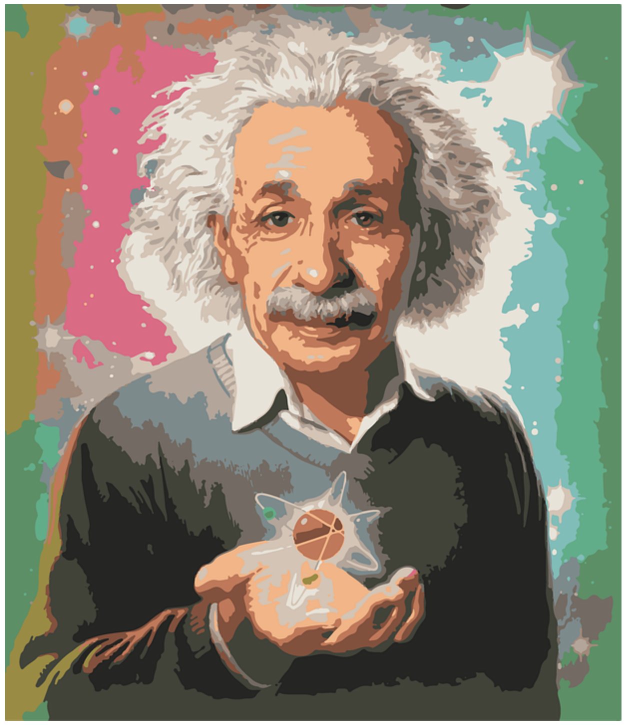
Name:___________________ Date: __________

AP Physics 1: Summer Packet



"Education is not the learning of facts, but the training of the mind to think." – Albert Einstein

The following assignments comes from material that you should have previously learned from your past math classes. These topics will be essential for your success in Physics and you will be lost without a solid foundation of the following topics. If for any reason you are struggling with the material it is your responsibility to gain a better understanding of it through: Khan academy, YouTube, Tutor, or Textbook.

Physics is unlike any subject you have taken before and it will constantly test not what you memorized, but your ability to apply the knowledge you gained.

Website and Channels that can help you relearn the material:
https://www.aplusphysics.com/courses/ap-1/AP1_Physics.html#ap1
https://www.khanacademy.org/science/ap-college-physics-1
https://www.physicsclassroom.com/

AP® Physics 1: Algebra-Based

About the Advanced Placement Program® (AP®)

The Advanced Placement Program® has enabled millions of students to take college-level courses and earn college credit, advanced placement, or both, while still in high school. AP Exams are given each year in May. Students who earn a qualifying score on an AP Exam are typically eligible, in college, to receive credit, placement into advanced courses, or both. Every aspect of AP course and exam development is the result of collaboration between AP teachers and college faculty. They work together to develop AP courses and exams, set scoring standards, and score the exams. College faculty review every AP teacher's course syllabus

AP Physics Program

The AP Program offers four physics courses:

AP Physics 1: Algebra-Based is a full-year course that is the equivalent of a first-semester introductory college course in algebra-based physics.

AP Physics 2: Algebra-Based is a full-year course, equivalent to a second-semester introductory college course in physics.

AP Physics C: Mechanics is a half-year course equivalent to a semester-long, introductory calculus-based college course.

AP Physics C: Electricity and Magnetism, a half-year course following Physics C: Mechanics, is equivalent to a semester-long, introductory calculus-based college course.

AP Physics 1 Course Overview

AP Physics 1 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque and rotational motion.

PREREQUISITES

Students should have completed Geometry and be concurrently taking Algebra II or an equivalent course. Although the Physics 1 course includes basic use of trigonometric functions, this understanding can be gained either in the concurrent math course or in the AP Physics 1 course itself.

LABORATORY REQUIREMENT

This course requires that 25% of instructional time be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to demonstrate the foundational physics principles and apply the science practices. Colleges may require students to present their laboratory materials from AP science courses before granting college credit for laboratory work, so students are encouraged to retain their notebooks, reports, and other materials.

AP Physics 1 Course Content

The course content is organized into seven commonly taught units, which have been arranged in the following suggested, logical sequence:

- **Unit 1:** Kinematics
- **Unit 2:** Dynamics
- **Unit 3:** Circular Motion and Gravitation
- **Unit 4:** Energy
- **Unit 5:** Momentum
- **Unit 6:** Simple Harmonic Motion
- **Unit 7:** Torque and Rotational Motion

Each unit is broken down into teachable segments called topics. In addition, the following big ideas serve as the foundation of the course, enabling students to create meaningful connections among concepts and develop deeper conceptual understanding:

- **Systems:** Objects and systems have properties such as mass and charge.
- **Fields:** Fields existing in space can be used to explain interactions.
- **Force Interactions:** The interactions of an object with other objects can be described by forces.
- **Change:** Interactions between systems can result in changes in those systems.
- **Conservation:** Changes that occur as a result of interactions are constrained by conservation laws.

AP Physics 1 Science Practices

The following science practices describe what skills students should develop during the course:

- **Modeling:** Use representations and models to communicate scientific phenomena and solve scientific problems.
- **Mathematical Routines:** Use mathematics appropriately.
- **Scientific Questioning:** Engage in scientific questioning to extend thinking or guide investigations.
- **Experimental Methods:** Plan and implement data collection strategies in relation to a particular scientific question.
- **Data Analysis:** Perform data analysis and evaluation of evidence.
- **Argumentation:** Work with scientific explanations and theories.
- **Making Connections:** Connect and relate knowledge across various scales, concepts, and representations in and across domains.

AP Physics 1 Exam Structure

AP PHYSICS 1 EXAM: 3 HOURS

Assessment Overview

The AP Physics 1 Exam assesses student application of the science practices and understanding of the learning objectives outlined in the course framework. The exam is 3 hours long and includes 50 multiple-choice questions and 5 free-response questions. The 5 free-response questions may appear in any order. A four-function, scientific, or graphing calculator is allowed on both sections of the exam.

Format of Assessment

Section I: Multiple-choice | 50 Questions | 90 Minutes | 50% of Exam Score

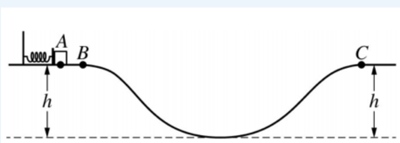
- 45 single-select multiple-choice questions (discrete or in sets).
- 5 multiple-select multiple-choice items (all discrete).

Section II: Free-response | 5 Questions | 90 Minutes | 50% of Exam Score

- Question 1: Experimental Design **(12 points).**
- Question 2: Qualitative/Quantitative Translation **(12 points).**
- Question 3: Paragraph Argument Short Answer **(7 points).**
- Questions 4 and 5: Short Answer **(7 points each).**

Exam Components

Sample Multiple-Choice Question

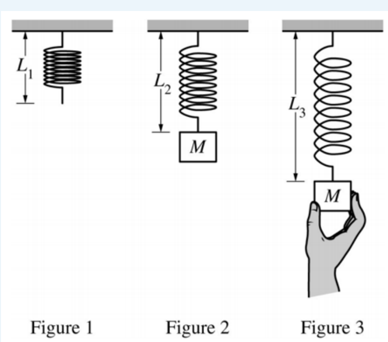


A block is held at rest against a compressed spring at point *A* at the top of a frictionless track of height *h*, as show. The block is released, loses contact with the spring at point *B*, and slides along the track until it passes point *C*, also at height *h*. How do the potential energy *U* of the block-Earth system and the kinetic energy *K* of the block at point *C* compare with those at point *A*?

Potential Energy of Block-Earth System	Kinetic Energy of Block
(A) $U_C = U_A$	$K_C = K_A$
(B) $U_C = U_A$	$K_C > K_A$
(C) $U_C > U_A$	$K_C = K_A$
(D) $U_C > U_A$.	$K_C > K_A$

Correct Answer: B

Sample Free-Response Question: Paragraph Argument Short Answer



A spring with unstretched length L_1 is hung vertically, with the top end fixed in place, as shown in Figure 1. A block of mass *M* is attached to the bottom of the spring, as shown in Figure 2, and the spring has length $L_2 > L_1$ when the block hangs at rest. The block is then pulled downward and held in place so that the spring is stretched to a length $L_3 > L_2$, as shown in Figure 3.

(A) On the dot, which represents the block in Figure 3, draw and label the forces (not components) exerted on the block. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot.

(B) The student releases the block. Consider the time during which the block is moving upward toward its equilibrium position and the spring length is still longer than L_2.

In a clear, coherent paragraph-length response that may also contain diagrams and/or equations, indicate why the total mechanical energy is increasing, decreasing, or constant for each of the systems listed below.

- System 1: The block
- System 2: The block and the spring
- System 3: The block, the spring, and Earth

Use E_1, E_2, and E_3 to denote the total mechanical energy of systems 1, 2, and 3, respectively.

00558-040 (Updated January 2021)

Course at a Glance

Plan

The Course at a Glance provides a useful visual organization of the AP Physics 1 course components, including:

- Sequence of units, along with approximate weighting and suggested pacing. Please note, pacing is based on 45-minute class periods, meeting five days each week for a full academic year.
- Progression of topics within each unit.
- Spiraling of the big ideas and science practices across units.

Teach

PRACTICES

Science practices spiral throughout the course.

- 1 Modeling
- 2 Mathematical Routines
- 3 Scientific Questioning
- 4 Experimental Methods
- 5 Data Analysis
- 6 Argumentation
- 7 Making Connections

+ Indicates 3 or more science pratices for a given topic. The individual topic page will show all the science practices.

BIG IDEAS

Big ideas spiral across topics and units.

- SYS 1-Systems
- FLD 2-Fields
- INT 3-Force Interactions
- CHA 4-Change
- CON 5-Conservation

Assess

Assign the Personal Progress Checks—either as homework or in class—for each unit. Each Personal Progress Check contains formative multiple-choice and free-response questions. The feedback from these checks shows students the areas where they need to focus.

UNIT 1 Kinematics

~19-22 Class Periods | 12-18% AP Exam Weighting

Big Idea	Practices	Topic
INT	+	1.1 Position, Velocity, and Acceleration
CHA	+	1.2 Representations of Motion

Personal Progress Check 1

Multiple-choice: ~15 questions
Free-response: 2 questions

- Experimental Design
- Paragraph Argument Short Answer

UNIT 2 Dynamics

~21-24 Class Periods | 16-20% AP Exam Weighting

Big Idea	Practices	Topic
SYS	1, 7	2.1 Systems
FLD	2, 7	2.2 The Gravitational Field
INT	6	2.3 Contact Forces
SYS	4	2.4 Newton's First Law
INT	+	2.5 Newton's Third Law and Free-Body Diagrams
INT	+	2.6 Newton's Second Law
CHA	+	2.7 Applications of Newton's Second Law

Personal Progress Check 2

Multiple-choice: ~40 questions
Free-response: 2 questions

- Quantitative/Qualitative Translation
- Short Answer

UNIT 3 Circular Motion and Gravitation

~8-10 Class Periods | 6-8% AP Exam Weighting

FLD	3.1 Vector Fields
INT, 7	3.2 Fundamental Forces
INT, 2, 7	3.3 Gravitational and Electric Forces
FLD, 2, 7	3.4 Gravitational Field/ Acceleration Due to Gravity on Different Planets
SYS, 4	3.5 Inertial vs. Gravitational Mass
CHA, 5	3.6 Centripetal Acceleration and Centripetal Force
INT, +	3.7 Free-Body Diagrams for Objects in Uniform Circular Motion
INT, +	3.8 Applications of Circular Motion and Gravitation

Personal Progress Check 3

Multiple-choice: ~40 questions
Free-response: 2 questions
- Experimental Design
- Paragraph Argument Short Answer

UNIT 4 Energy

~22-25 Class Periods | 20-28% AP Exam Weighting

CON, 6, 7	4.1 Open and Closed Systems: Energy
INT, CHA, +	4.2 Work and Mechanical Energy
CON, +	4.3 Conservation of Energy, the Work-Energy Principle, and Power

Personal Progress Check 4

Multiple-choice: ~30 questions
Free-response: 2 questions
- Quantitative/Qualitative Translation
- Short Answer

UNIT 5 Momentum

~14-17 Class Periods | 12-18% AP Exam Weighting

INT, +	5.1 Momentum and Impulse
CHA, +	5.2 Representations of Changes in Momentum
CON, 6, 7	5.3 Open and Closed Systems: Momentum
CON, +	5.4 Conservation of Linear Momentum

Personal Progress Check 5

Multiple-choice: ~35 questions
Free-response: 2 questions
- Experimental Design
- Paragraph Argument Short Answer

UNIT 6 Simple Harmonic Motion

~4-7 Class Periods | 4-6% AP Exam Weighting

INT + **6.1** Period of Simple Harmonic Oscillators

CON + **6.2** Energy of a Simple Harmonic Oscillator

Personal Progress Check 6

Multiple-choice: ~20 questions
Free-response: 2 questions

- Experimental Design
- Short Answer

UNIT 7 Torque and Rotational Motion

~14-19 Class Periods | 12-18% AP Exam Weighting

INT 1 2 **7.1** Rotational Kinematics

INT + **7.2** Torque and Angular Acceleration

CHA + **7.3** Angular Momentum and Torque

CHA + **7.4** Conservation of Angular Momentum

Personal Progress Check 7

Multiple-choice: ~40 questions
Free-response: 2 questions

- Quantitative/Qualitative Translation
- Paragraph Argument Short Answer

The Paragraph-Length Response in AP Physics 1 and 2

A paragraph-length response to a question should consist of a coherent argument that uses the information presented in the question and proceeds in a logical, expository fashion to arrive at a conclusion.

AP Physics students are asked to give a paragraph-length response so that they may demonstrate their ability to communicate their understanding of a physical situation in a reasoned, expository analysis. A student's response should be a coherent, organized, and sequential description of the analysis of a situation. The response should argue from evidence, cite physical principles, and clearly present the student's thinking to the reader. The presentation should not include extraneous information. It should make sense on the first reading.

The style of the exposition is to explain and/or describe, like a paragraph, rather than present a calculation or a purely algebraic derivation, and should be of moderate length, not long and elaborate.

A paragraph-length response will earn points for correct physics principles, as does a response to any other free-response question. However, full credit may not be earned if a paragraph-length response contains any of the following: principles not presented in a logical order, lengthy digressions within an argument, or primarily equations or diagrams with little linking prose.

In AP Physics 1, the argument may include, as needed, diagrams, graphs, equations, and perhaps calculations to support the line of reasoning. The style of such a response may be seen in the example problems in textbooks, which are typically a mix of prose statements, equations, diagrams, etc., that present an orderly analysis of a situation.

In AP Physics 2, the requirement for full credit for a paragraph-length response is more rigorous, i.e., responses are expected to meet the standard of logical reasoning as described for AP Physics 1 but must also be presented primarily in prose form.

To reiterate, the goal is that students should be able to both analyze a situation and construct a coherent, sequenced, well-reasoned exposition that cites evidence and principles of physics and that make sense on the first reading.

AP

The Analysis of Experimental Uncertainty in AP Physics 1 and 2

The following paragraphs describe the expectations for the depth of understanding of experimental uncertainty that will be assessed on the AP Physics 1 and 2 exams and the expectations for laboratory work to be presented to colleges and universities. Greater proficiency in reasoning about experimental uncertainty is expected of students in AP Physics 2.

Exam Expectations for Analysis of Uncertainty: On the AP Physics 1 exam, students will not need to calculate uncertainty but will need to demonstrate understanding of the principles of uncertainty. On the AP Physics 2 exam, students may be expected to calculate uncertainty. In general, multiple-choice questions on both exams will deal primarily with qualitative assessment of uncertainty, while free-response laboratory questions may require some quantitative understanding of uncertainty as described below.

Experiment and data analysis questions on the AP Physics 1 and AP Physics 2 exams will not require students to calculate standard deviations, or carry out the propagation of error or a linear regression. Students will be expected to estimate a line of best fit to data that they plot or to a plot they are given. Students may be expected to discuss which measurement or variable in a procedure contributes most to overall uncertainty in the final result and on conclusions drawn from a given data set. They should recognize that there may be no significant difference between two reported measurements if they differ by less than the smallest difference that can be discerned on the instrument used to make the measurements. They should be able to reason in terms of percentage error and to report results of calculations to an appropriate number of significant digits. Students are also expected to be able to articulate the effects of error and error propagation on conclusions drawn from a given data set, and how results and conclusions would be affected by changing the number of measurements, measurement techniques, or the precision of measurements. Students should be able to review and critique an experimental design or procedure and decide whether the conclusions can be justified based on the procedure and the evidence presented.

Laboratory Expectations for Analysis of Uncertainty: Some colleges and universities expect students to submit a laboratory notebook to receive credit for laboratory courses. Given the emphasis on time spent in the laboratory, students should be introduced to the methods of error analysis including and supported by mean, standard deviation, percentage error, propagation of error, and linear regression, or the calculation of a line of best fit. Colleges will expect students to be familiar with these methods and to have carried out the procedures on at least some of the laboratory experiments they undertake, particularly since the use of computers and calculators have significantly reduced the need for students to perform computations on their own.

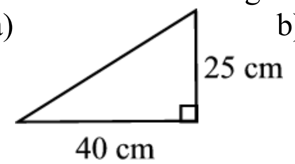
CollegeBoard

Geometry & Trigonometry

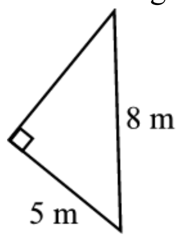
Answer the following questions using Pythagorean theorem, trigonometric functions and inverse trigonometric functions. For full credit, be sure to show your setup and work for each problem.

1. Fill in the missing side of each triangle:

a)

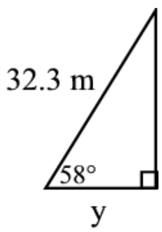


b)

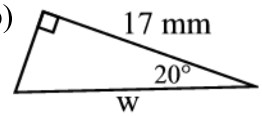


2. Find the marked side of each triangle:

a)

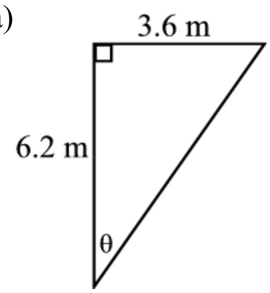


b)

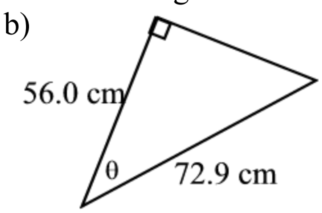


3. Find the value for the marked angle

a)

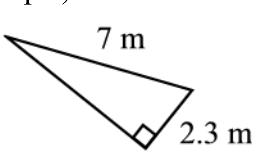


b)



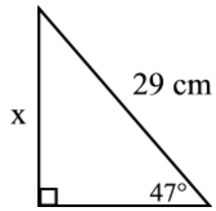
4. Fill in the missing side of each triangle:

a) (3 pts)

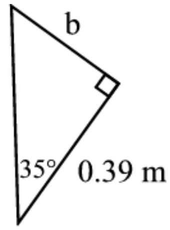


5. Find the marked side of each triangle:

a)

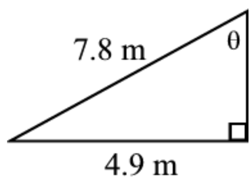


b)

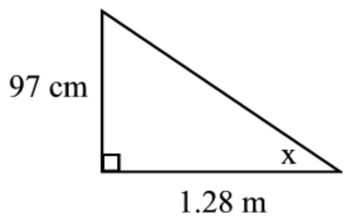


6. Find the value for the marked angle

a)



b)



Dimensional Analysis

7. Although it is widely believed that Germany's Autobahn highway has no speed limit whatsoever, much of the highway has regulated speed limits of 130 km/hr or less, and in some places speed is limited to just 60 km/hr.

a. How many miles per hour is 130 km/hr? (1 mile = 1.61 km)

b. How many miles per hour is 60 km/hr?

8. If you are traveling at 65 miles per hour, how many feet will you be traveling in one second? (There are 5,280 feet in one mile.)

9. The speed of light is 3 x 10^8 meters/second. What is the speed of light in miles/year? (1609 meters = 1 mile)

10. What is 130 meters per second into miles per hour?

11. What is 1100 feet per second into miles per hour?

12. What is 53 yards per hour into inches per week?

13. An Audi R8 V10 can go 196 mi/hr. How fast is this in m/s? (1 mile = 1609 meters) [3 pts]

14. 721 lbs per week into kg per second (1 kg = 2.2 pounds) [3 pts]

Algebra

15. Make ***x*** the subject of the formula in each of the following cases

a) $a + 3x = y + z$

b) $\frac{x}{a} = 1 + \frac{y}{b}$

c) $y = \frac{x+a}{x-a}$

d) $\sqrt{x} - 3 = y$

e) $a + x = y + z$

f) $\frac{x+y}{y} = \frac{y}{a} + \frac{a}{y}$

g) $\frac{y}{x} + a = b$

h) $\sqrt{x+3} = y$

Solve each equation with the quadratic formula.

1) $m^2 - 5m - 14 = 0$

2) $b^2 - 4b + 4 = 0$

3) $2m^2 + 2m - 12 = 0$

4) $2x^2 - 3x - 5 = 0$

5) $x^2 + 4x + 3 = 0$

6) $2x^2 + 3x - 20 = 0$

Video Analysis

Physics will be unlike any subject you have ever taken before. As a teacher, I have discovered that students that develop an interest over the subject and come into the class with lots of physics questions like, “Why is the sky blue?” often do the best in the class. That being said, I’m going to post some YouTube channels. From the following list of sites, watch at least **3** of the videos that compel your interests, and write a paragraph or two about what you learned from each (why did you choose this video, what surprised you, what new ideas or questions does it make you think of, etc). This work will be collected, along with your work from Part 1, on the first day of school. Please write out your video response paragraphs by hand. Of course, feel free to watch more than three!

https://www.youtube.com/user/1veritasium

https://www.youtube.com/user/destinws2

https://www.youtube.com/user/minutephysics