AP Physics 1 – Summer Assignment 2018

Welcome to AP Physics. Here is your summer assignment - due the first day of class in September. Physics requires strong math skills – particularly in algebra and trigonometry. Many problems in Physics require the application of principles that you have studied in your math courses. This packet reviews mathematical concepts with which you should already be familiar. If you don't remember the concept well (or at all) you need to find some outside resource to help you – a book, a friend, the internet.

The packet will be graded – it will be your first grade in AP Physics – and will also provide a review of some of the material from the past year, or an introduction to that material if you did not take Physics yet. The more effort you put into this assignment, the better prepared you will be for class. This is a long assignment – if you leave it until the last week (or day) of Summer Break, you will be overwhelmed and you will not learn the material. You should be working on it a bit a time the whole summer.

Some things to know about AP Physics 1:

AP Physics is not just plugging in numbers. The course focuses more on concepts. Almost every problem is new and different – including the ones on the actual AP exam. The problems are about applying the concepts to the problem at hand, not being able to follow a prescribed set of steps for a problem.

A review book is helpful – there are many good ones available. For students who have not taken Regents Level Physics, you are advised to buy a general review book (Barrons Physics Review is a good book, but not the only one) and do some reading. If you are looking for a review book to help you with the course during the year there are several good AP Physics 1 review books out there. (The Princeton Review AP Physics 1 Exam, 5 Steps to a 5 AP Physics 1: Algebra - Based by Greg Jacobs are two that come to mind.)

There are a lot of good websites for help with Physics concepts –

prettygoodphysics, thephysicsclassroom, ColoradoPhET, MIT open courses,

Khan Academy, AP central

Look them over during the summer. (You will be using Khan Academy to complete your summer assignment.)

AP Physics 1 – is very heavy on explanation – that is, not just applying math concepts, but explaining, in depth, the concepts that underlie a problem and the reasoning behind your solution. Yes, there is writing in Physics. Einstein wrote papers, Dr. Michio Kaku writes books, and you, too, will write. Review the alphabet. You will find it useful.

Here is the assignment – follow directions:

Part 1: Dimensional Analysis (Show all of your calculations)

Many times in AP Physics you will be required to show all of your calculation steps. You have to show calculations in a logical, orderly manner (neatness counts here – a whole lot, in fact). The idea is that your calculations can be easily followed by another reader, researcher, or – more to the point for you – an AP Exam grader.

It does not matter if you, personally, do not like to show steps. It does not matter if you, personally, are not the neatest person in the world. Calculations, like writing, are a communication – both with another person and with your future self when you look over your work. Poor logic sequence in calculation or leaving out steps necessary for someone to follow the flow of the problem is the same as mixing up tenses and skipping words in writing – it makes what you are trying to say with your calculation incomprehensible. One more time – it matters, no kidding, get used to it.

For the following conversions you will show all of your steps in moving from one unit to another, keeping track of your units as you go to make sure that they work out correctly (in Chemistry you probably called this dimensional analysis). Show your work on loose leaf.

DIMENSIONAL ANALYSIS PROBLEMS

Conversions Factors

DIRECTIONS: Solve each problem using dimensional analysis. Every number must have a unit. Work must be shown. Conversion factors are given below

1 hr = 60 min	1 min = 60 sec	1 ton = 2000 lbs	7 days = 1 week
24 hrs = 1 day	1 kg = 2.2 lbs	1 gal = 3.79 L	264.2 gal = 1 cubic meter
1 mi = 5,280 ft	1 kg = 1000 g	1 lb = 16 oz	20 drops = 1 mL
365 days = 1 yr	52 weeks = 1 yr	2.54 cm = 1 in	1 L = 1000 mL
0.621 mi = 1.00 km	1 yd = 36 inches	1 cc is 1 cm^3	1 mL = 1 cm^3

1.) How many miles will a person run during a 10 kilometer race?

2.) The moon is 250,000 miles away. How many feet is it from earth?

3.) A family pool holds 10,000 gallons of water. How many cubic meters is this?

4.) The average American student is in class 330 minutes/day. How many hours/day is this?
How many seconds is this?

5) Chicago uses 1.2 x 10^9 gallons of water /day. How many gallons per second must be pumped from the lake every second to supply the city?

6) Sixty miles/ hour is how many ft/sec?

7.) Lake Michigan holds 1.3 x 10^{15}gallons of water. If just Chicago removed water from the lake and it never rained again, how many days would the water last? Chicago uses 1.2 x 10^9 gallons of water /day

8). If a projectile travels 3.00 x 10^3feet in one second, how far will it travel in 18 minutes?

9.). A gas station is charging $1.299 per gallon of gas. What would be the price for a liter of gas?

Part 2: Problems

In this section you will be directed to some Khan Academy videos which explain some of the concepts and calculations you will be working with in AP Physics. You need to watch the video and example problems and then work the problems given here. Remember the previous speech about showing all calculations and being neat? Go back and read it again.

Some of these problems require explanation rather than calculation. *When explanation is required you need to answer the questions completely using correct sentence structure, grammar, and spelling, in your own words. Giving a complete answer means justifying your answer.* One word answers are not acceptable. Incomplete answers are not acceptable. You may type your answers or write them out, but they must be on separate paper. Remember – you are an AP Physics student – you need to be able to work independently. If you don't know what a word means (or what it means in terms of Physics – sometimes the common use of the word and the scientific use are not the same) look it up. If your first search for concepts to help you answer a question doesn't work, keep looking. If the video makes use of concepts with which you are unfamiliar, look them up.

For each of the following sections, go to the website associated with the section and then answer the questions given for that section.

It is my very strong suggestion that, as you watch the khan academy videos, you have a pencil, paper and calculator with you and you actually work the problems. (One of the wonderful things about the video is you can pause it while you work.)

It is my equally strong suggestion that you do this assignment a little at a time – if you try to do too much at once, you will not absorb the material. If you leave all of it until the last week of the summer, you are going to be confused and overwhelmed.

Vectors and Scalars

https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/introduction-to-vectors-and-scalars

1. What is the difference between a vector and a scalar? Give two examples of each.

2. A student walks 200 m directly East, then turns and walks 100 m directly North. Why are the measurement of the distance the student traveled and the magnitude of the student's displacement *not* the same?

Calculating avg velocity or speed

https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/calculating-average-velocity-or-speed

instantaneous speed and velocity

https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/instantaneous-speed-and-velocity

3. What is the difference between avg speed/velocity and instantaneous speed/velocity?

4. Give an example of a circumstance in which avg speed is a more useful measurement and one in which instantaneous speed is a more useful measurement. Justify your answer. (That means explain why the measurement is more useful in this case.)
5. How do you find instantaneous velocity from an x vs t (displacement vs time) graph?

Acceleration

https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration_tutorial/v/acceleration

airbus problems

https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration_tutorial/v/airbus-a380-take-off-time

https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration_tutorial/v/airbus-a380-take-off-distance

area under a v vs t graph

https://www.khanacademy.org/science/physics/one-dimensional-motion/acceleration_tutorial/v/why-distance-is-area-under-velocity-time-line

6. The current indoor world record time in the 200-m race is 19.92 sec, held by Frank Fredericks of Namibia (1996)\. While the indoor record time in the one mile race is 228.5 sec, held by Hicham El Guerrouj of Morocco (1997). Find the mean speed in meters per second corresponding to these record times for (a) the 200-m event and (b) the one mile event.
7. A jet plane lands with a speed of 100 m/s and can accelerate at a maximum rate of -5.00 m/s^2 as it comes to rest.
    a. From the instant the plane touches the runway, what is the minimum time needed before it can come to rest?
    b. Can this plane land on a small tropical island airport where the runway is 0.800 km long?
8. A car accelerates uniformly from rest to a speed of 40.0 miles per hour in 12 sec. Find
    a. the distance the car travels during this time and
    b. the constant acceleration of the car.
9. To pass a physical education class at a university, a student must run 1.0 miles in 12 min. After running for 10min, she still has 500 yd to go. If her maximum acceleration is 0.15m/s^2, can she make it? If the answer is no, determine what acceleration she would need to be successful.

Average velocity for constant acceleration

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/average-velocity-for-constant-acceleration

10. What do positive and negative signs tell you about velocity?
11. A man drives a car. He is in a town notorious for giving speeding tickets, so he is very careful to monitor his speed and keep it at the legal 35 m/s through town, but, during his trip through town, he accelerates. Explain.

(You might want to look up clear definitions for velocity and acceleration)

Acceleration of aircraft carrier take off

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/acceleration-of-aircraft-carrier-takeoff

Deriving displacement as a function of time, acceleration and initial velocity

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/deriving-displacement-as-a-function-of-time-acceleration-and-initial-velocity

12. What is the acceleration of a projectile (an object that is dropped or thrown) on Earth?
13. What assumption do we make about g? Why do we make that assumption?

14. What do positive and negative mean for projectile motion? Why is g negative?
15. Write the equation for displacement in terms of initial velocity, acceleration and time.

Plotting projectile displacement acceleration and velocity

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/plotting-projectile-displacement-acceleration-and-velocity

16. What happens to the displacement of a projectile as it rises and falls?
17. What happens to the velocity of a projectile as it rises and falls?
18. What is the velocity of a projectile at the highest point in its path? What is the acceleration of the projectile at this point?
19. What is the acceleration of the projectile as it rises and falls?
20. Assuming the projectile returns to the same height from which it was launched, compare:
    a. Rise time and fall time
    b. Initial velocity (starting up) and final velocity (with which it returns)

Height of projectile

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/projectile-height-given-time

21. Rex Things throws his mother's crystal vase vertically upwards with an initial velocity of 26.2 m/s.
    a. Determine the height to which the vase will rise above its initial height.
    b. With what velocity will the vase return to its initial height?

Impact velocity from a given height

https://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/impact-velocity-from-given-height

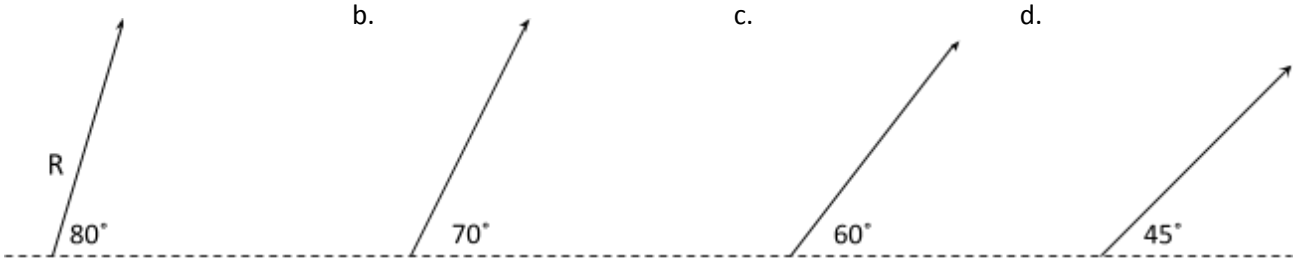
22. A rock is dropped from a cliff 32 m high.
    a. With what velocity will it hit the ground?
    b. How much time will it take for the rock to hit the ground?

Breaking vectors into components:

https://www.khanacademy.org/math/precalculus/vectors-precalc/magnitude-direction/v/mag-dir-vec-sums

23. Break up the following vectors into their vertical and horizontal components i.e. the R_x and R_y. The length of each vector R is 10.0 cm.

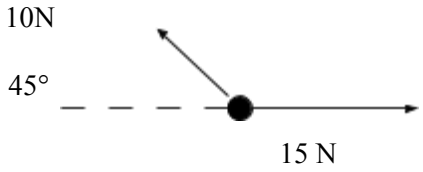
a. b. c. d.



$R_x = 1.74, R_y = 9.85$ $R_x = 3.42, R_y = 9.40$ $R_x = 5.00, R_y = 8.66$ $R_x = 7.07, R_y = 7.07$

24. As the angle the vector makes with the horizontal increases, what happens to
    a. The x component of the vector?
    b. The y component of the vector?
25. If a vector were at an angle of 90 degrees to the horizontal, what would its x and y components be? (prove it)

26. The diagram below depicts all the forces acting on an object. Use both vector resolution and vector addition to find the final resultant force acting on the box. (Follow the directions below the diagram - this is a different method then we used in Physics



Resolve the 10N vector into its horizontal and vertical components. (show work) Resolve the 15 N vector into its horizontal and vertical components.

a. Add/Subtract the horizontal components. (Show work)
b. Use the resulting horizontal and vertical components to do two-dimensional vector addition. Find the magnitude and direction of the resultant vector. (Show work)

27. A student walks 300 m directly East, then turns and walks 500 m directly North.
    a. Calculate the distance the student traveled.
    b. Calculate the students displacement, including direction.

Projectiles Launched at an angle

- Note, this link is to notes which you need to read rather than a video

https://www.khanacademy.org/science/physics/ap-physics-1/two-dimensional-motion/two-dimensional-projectile-mot/a/what-is-2d-projectile-motion

- This link is a video which works through the problem

https://www.khanacademy.org/science/physics/ap-physics-1/two-dimensional-motion/two-dimensional-projectile-mot/v/projectile-at-an-angle

28. A cannon fires a ball at 45 m/s at an angle of 60º to the horizontal. Calculate:
    a. Maximum height of the projectile
    b. Hang time of the projectile
    c. Range of the projectile

Newton's First Law of Motion

https://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-1st-law-of-motion

https://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-first-law-of-motion-concepts

29. If an object has no unbalanced force acting on it, how would it move? (Describe all possibilities)
30. Why, in day to day life, do we observe objects coming to rest even when no other object seems to be exerting a force on them?
31. Once a spacecraft is past the solar system, why doesn't it need an engine to travel further into space?
32. What about a body's motion might change when an unbalanced force acts on it?
33. What can change about an object's motion when no unbalanced force is acting on it?

Newton's Second Law of Motion

https://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-second-law-of-motion

34. You are pushing a friend on a sled. You push with a force of 20 N. Your friend and the sled together have a mass of 60 kg. Ignoring friction, what is the acceleration of your friend on the sled?
35. How much force will a tennis racket need to exert on a tennis ball, with a mass of 0.67 kg, to make it accelerate at a rate of 5,600 m/s^2?
36. Whether you are standing, running or jumping Earth is exerting a gravitational force on you. This gravitational force is called an object's *weight (W)*. Knowing this you can find the weight of an object if you know the mass because the acceleration will be 9.8 m/s2 due to gravity's pull on the object. The equation to use then is: W = mass x acceleration. What is the weight of a 53 kg man?
37. A person who weighs 600 N (N stands for Newtons – 600 N is not 600 pounds or 600 kg – it is about equal to 120 pounds – not a big person) is brought to a planet in a Galaxy Far Far Away where their weight is only 300 N, but they are not any thinner. Why?

38. An astronaut is in outer space working on a space station. He has to move a very large object, which is at rest, to another location on the station. The object is weightless (outer space, remember?) but the astronaut finds that he is not strong enough to start the object moving. Explain.

Newton's Third Law of Motion

https://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-third-law-of-motion

39. Two people stand in the middle of a frozen pond. They simultaneously push each other in opposite directions. Each person exerts the same force on the other person), but they move apart with different accelerations. Explain.

Balanced and Unbalanced Forces

https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces

https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/unbalanced-forces-and-motion

40. A box is at rest on a horizontal surface – a person is pushing the box as hard as they can to the left. Another person is pushing the box as hard as they can to the right. All this force on the box, but it doesn't move. Explain.
41. What types of motion can be exhibited by objects in equilibrium? (Describe all possibilities)

Rotational Motion and Torque

https://www.khanacademy.org/science/physics/torque-angular-momentum/rotational-kinematics/v/angular-motion-variables

42. List and define the rotational variables introduced in the video.
43. An object is traveling counterclockwise around a circular track and is slowing down. What is the direction of the objects rotational acceleration?
44. Convert 70^{o} to radians.

https://www.khanacademy.org/science/physics/torque-angular-momentum/rotational-kinematics/v/relating-angular-and-regular-motion-variables

45. An rock at the end of a string 2m long is swung in a horizontal circle. The string moves through an angle of 450^{o}. What is the arc length traveled by the rock?
46. If the motion described in # 45 takes 3 seconds, calculate:
    a. The linear velocity of the rock
    b. The angular velocity of the rock.
47. Write the equations that relate
    a. angular and linear displacement
    b. angular and linear velocity
    c. angular and linear acceleration

https://www.khanacademy.org/science/physics/torque-angular-momentum/rotational-kinematics/v/relationship-between-angular-velocity-and-speed

48. A turn-table with a radius of 4 m starts from rest and rotates through 10 revolutions with an angular acceleration of 4 rad/s^2
    a. How long did it take to make 10 revolutions?
    b. What is the object's angular velocity after the 10 revolutions.
    c. What is the linear velocity of a bug standing on the edge of the turntable after 10 revolutions.

https://www.khanacademy.org/science/physics/torque-angular-momentum/torque-tutorial/v/introduction-to-torque

49. Define Torque and give the equation. What do positive and negative mean in terms of torque?
50. A force of 60 Newtons is applied to the end of a wrench 12 centimeters long. How much torque is produced?

51. 30 Newton•meters of torque is required to close a door 1.5 meters wide. What force is needed to cause this torque?

https://www.khanacademy.org/science/physics/torque-angular-momentum/torque-tutorial/v/moments

52. Two students sit on a see-saw. Archie is a hulking football player with a mass of 120 kg. Clementine is a dainty cheerleader with a mass of 40 kg. The see-saw is 3.5 m in total length with the fulcrum at the center. If Clementine sits at the end on one side, where must Archie sit relative to the center to keep the see-saw balanced?

53. Where should a third 25.0 gram mass be placed on the mobile drawn below so that the mobile will hang motionless? The mobile is 125 centimeters long and the support is at the 50.0-centimeter mark. The first mass, m_1 is 25.0 centimeters from the left end of the mobile and the third mass, m_3 is at the right end of the mobile (125.0 centimeters).

https://www.khanacademy.org/science/physics/torque-angular-momentum/torque-tutorial/v/ball-hits-rod-angular-momentum-example

54. Does a ball moving in a straight line have angular momentum? Explain