AP Physics 1 – Summer Assignment 2021

Welcome to AP Physics. Here is your summer assignment, due the first day of class 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 resources to help you – a book, a friend, the internet.

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, and we will be using one in class that school will provide. For students who have not taken Regents Level Physics, you are advised to buy a general review book (Barrons is a good one, but not the only good one) and do some reading.

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.)

The "new AP Physics" – AP Physics 1 – will be 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 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 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 Honors 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 hr = 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?
5.) How many seconds are there in 1 year?
6.) Lake Michigan holds 1.3 x 10^{15} gallons of water. How many liters is this?
7.) Pepsi puts 355 ml of pop in a can. How many drops is this?

   How many cubic meters is this?

8.) 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?
9.) Sixty miles/hour is how many ft/sec?
10.) 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 water/day.
11.) If a person weighs 125 lbs, 8 oz, how many mg does s/he weigh?
12.) If a projectile travels 3.00 x 10^3 feet in one second, how far will it travel in 18 minutes?
13.) If a swimmer swims 85.4 yards in five minutes, how many meters will s/he swim in 70.0 seconds?
14.) Saffron costs $368.00 per ounce. Determine how many grams you can purchase for $15.00.
15.) 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 question completely using correct sentence structure, grammar, and spelling, in your own words*. One word 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 a 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.

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 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 that 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/intorduction-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 pf the student's displacement *not* the same?

Calculation avg velocity or speed

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

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. (This 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

area under a v vs t graph

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 university, a student must run 1.0 miles in 12 min. After running for 10 min, she still has 500 yd to go. If her maximum acceleration is 0.15 m/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

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 in 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

Deriving displacement as a function of time, acceleration and 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 assumptions 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 projectiles 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/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 32m 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.

R

80⁰

b.

70⁰

c.

60⁰

d.

45⁰
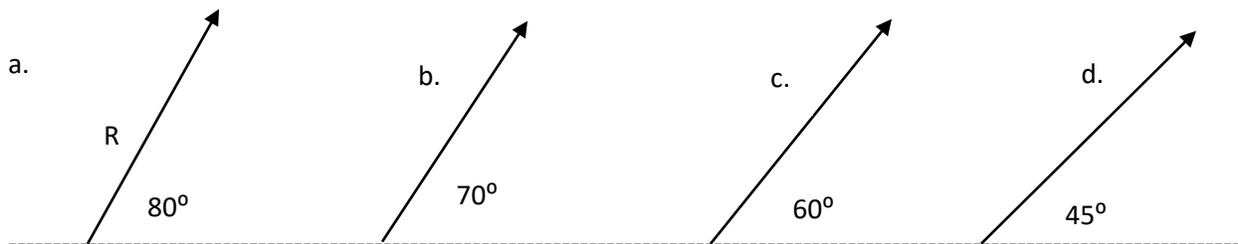
24. As the angle of the vector makes with the horizontal increases, what happens to:
    a) The x component of the vector?
    b) The y component of the vector?

25. If a vector were at an angle of 90⁰ to the horizontal, what would its x and y components be?

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.

10 N

45⁰

15 N
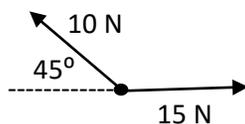
    a. Resolve the 10 N vector into its horizontal and vertical components.
    b. Add/Subtract the horizontal components.
    c. Use the resulting horizontal and vertical components to do two-dimensional vector addition. Find the magnitude and direction of the resultant vector.

27. 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?

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

28. If an object has no unbalanced force acting on it, how would it move?

29. 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?

30. Once a spacecraft is past the solar system, why doesn't it need an engine to travel further into space?

31. What about a body's motion might change when an unbalanced force acts on it?

32. What can change about an object's motion when an 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

33. 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?

34. 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?

35. 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 9.81 m/s^2 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?

36. A person who weighs 600 N (N stands for Newtons --- 600 N is NOT 600 lbs or 600 kg ---- it is equal to 120 lbs --- 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?

37. 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 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

38. 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

39. 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.

40. What types of motion can be exhibited by objects on which no unbalanced forces act?