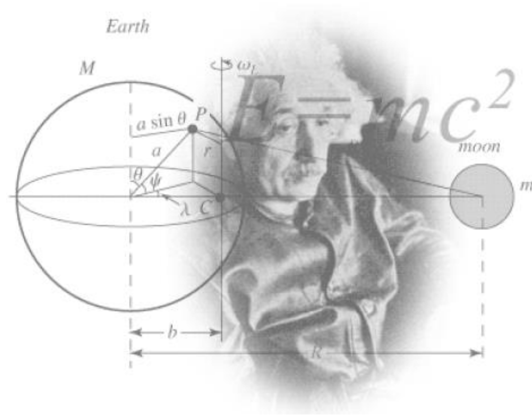
AP Physics 1 Summer Assignment



Welcome to AP Physics 1! It is a college level physics course that is fun, interesting and challenging on a level you've not yet experienced. This summer assignment will review all of the prerequisite knowledge expected of you. There are 7 parts to this assignment. It is quantity not the difficulty of the problems that has the potential to overwhelm, so do it over an extended period of time. By taking the time to review and understand all parts of this assignment, you will help yourself acclimate to the rigor and pacing of AP Physics 1. Use the book if you need to, but really this is all stuff you already know how to do (basic math skills). It is VERY important that this assignment be completed ***individually***. It will be a total waste of your time to copy the assignment from a friend. The summer assignment will be due the first day of class. Good luck! ☺

Part 1: Scientific Notation and Dimensional Analysis

Many numbers in physics will be provided in scientific notation. You need to be able read and simplify scientific notation. (**This section is to be completed without calculators…all work should be done by hand.)** Get used to no calculator! All multiple choice portions of tests will be completed without a calculator.

Express the following the numbers in scientific notation. Keep the same unit as provided. ALL answers in physics need their appropriate unit to be correct.

1. 7,640,000 kg

2. 8327.2 s

3. 0.000000003 m

4. 0.0093 km/s

Often times multiple numbers in a problem contain scientific notation and will need to be reduced by hand. Before you practice, remember the rules for exponents.

When numbers are multiplied together, you ____________ the exponents and __________ the bases.

When numbers are divided, you ______________ the exponents and ____________ the bases.

When an exponent is raised to another exponent, you _____________ the exponents and ___________ the base.

Using the three rules from above, simplify the following numbers in proper scientific notation:

5. $(3x10^{6})\cdot(2x10^{4})$ =

6. $(1.2x10^{4}) / (6x10^{-2})$ =

7. $(4x10^{8})\cdot(5x10^{-3})$ =

8. $(7x10^{3})^{2}$ =

9. $(8x10^{3}) / (2x10^{5})$ =

10. $(2x10^{-3})^{3}$ =

Fill in the power and the symbol for the following unit prefixes. Look them up as necessary. These should be **memorized** for next year. Kilo- has been completed as an example.

Prefix	Power	Symbol
Giga-		
Mega-		
Kilo-	10^3	k
Centi-		
Milli-		
Micro-		
Nano-		
Pico-		

Not only is it important to know what the prefixes mean, it is also vital that you can convert between metric units. If there is no prefix in front of a unit, it is the base unit which has 10^0 for its power, or just simply "1". Remember if there is an exponent on the unit, the conversion should be raised to the same exponent as well.

Convert the following numbers into the specified unit. Use scientific notation when appropriate.

1. 24 g = _______ kg
2. 94.1 MHz = _______ Hz
3. 6 Gb = ________ kb
4. 640 nm = ________ m
5. 3.2 m^2 = ________ cm^2
6. 40 mm^3 = _______ m^3
7. 1 g/cm^3 = _______ kg/m^3
8. 20 m/s = _______ km/hr

For the remaining scientific notation problems you may use your calculator. It is important that you know how to use your calculator for scientific notation. The easiest method is to use the "EE" button. An example is included below to show you how to use the "EE" button.

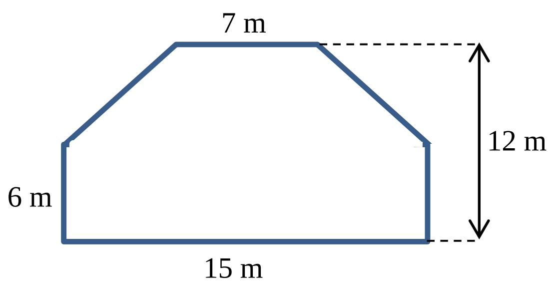
Ex: $7.8 \text{x} 10^{-6}$ would be entered as 7.8"EE"-6

9. $(3.67 \text{x} 10^{3})(8.91 \text{x} 10^{-6})$ =
10. $(5.32 \text{x} 10^{-2})(4.87 \text{x} 10^{-4})$ =
11. $(9.2 \text{x} 10^{6})$ / $(3.6 \text{x} 10^{12})$ =
12. $(6.12 \text{x} 10^{-3})^3$

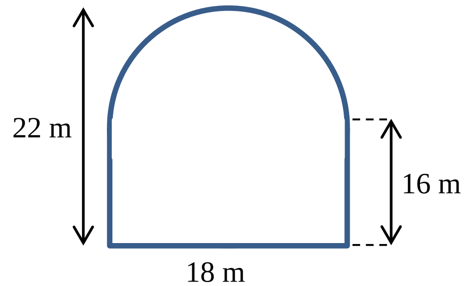
Part 2: Geometry

Calculate the area of the following shapes. It may be necessary to break up the figure into common shapes.

1.



2.

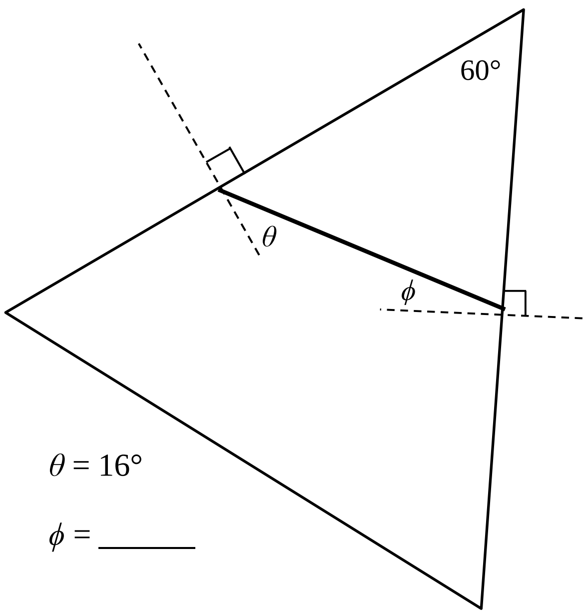


Area = __________

Area = __________

Calculate the unknown angle values for questions 3-6.

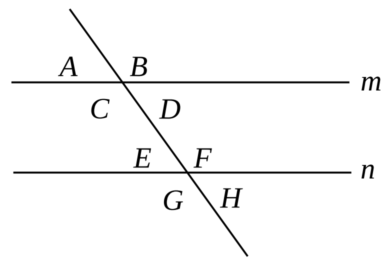
3.



θ = 16°

ϕ = ________

4.

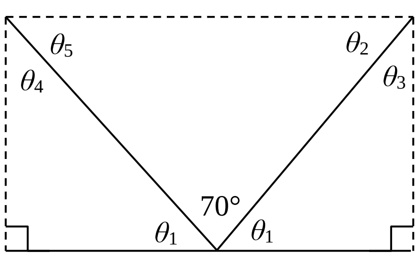


Lines *m* and *n* are parallel.

A = 75° *B* = ______ *C* = ______ *D* = ______

E = ______ *F* = ______ *G* = ______ *H* = ______

5.



θ_1 = ______

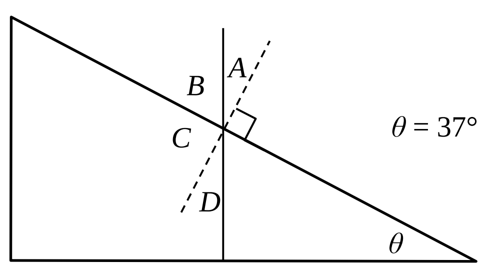
θ_2 = ______

θ_3 = ______

θ_4 = ______

θ_5 = ______

6.



A = ______ *B* = ______

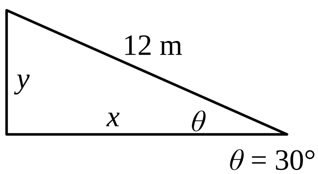
C = ______ *D* = ______

Part 4: Trigonometry

Write the formulas for each one of the following trigonometric functions. Remember SOHCAHTOA!

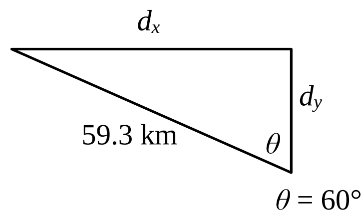
$\sin\theta =$ 		$\cos\theta =$ 		$\tan\theta =$

Calculate the following unknowns using trigonometry. Use a calculator, but show all of your work. Please include appropriate units with all answers. (Watch the unit prefixes!)

1.


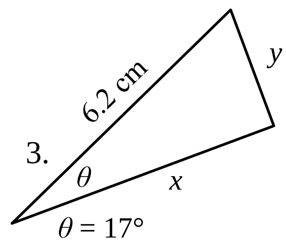
$y =$ ________

$x =$ ________

2.


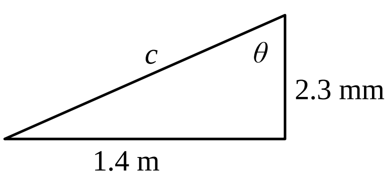
$d_x =$ _______

$d_y =$ _______

3.


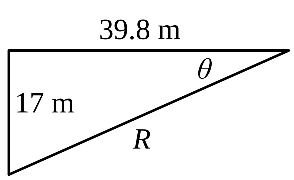
$x =$ ______

$y =$ ______

4.


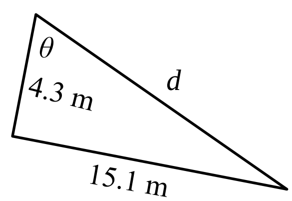
$c =$ _______

$\theta =$ _______

5.


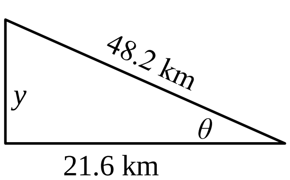
$R =$ _______

$\theta =$ _______

6.


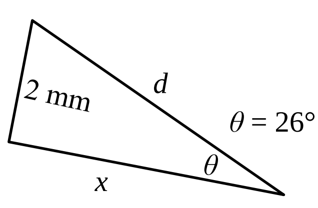
$d =$ _______

$\theta =$ _______

7.


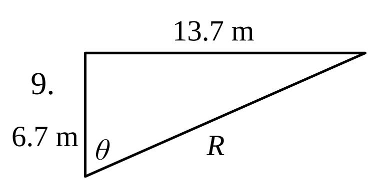
$y =$ _______

$\theta =$ _______

8.


$x =$ _______

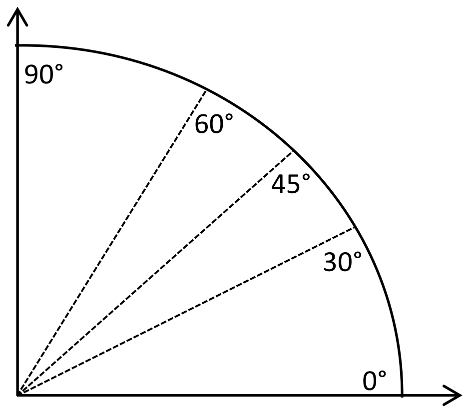
$d =$ _______

9.


$R =$ _______

$\theta =$ _______

You will need to be familiar with trigonometric values for a few common angles. Memorizing this diagram in degrees or the chart below will be very beneficial for next year. How the diagram works is the cosine of the angle is the x-coordinate and the sine of the angle is the y-coordinate for the ordered pair. Write the ordered pair (in fraction form) for each of the angles shown in the table below



θ	$\cos\theta$	$\sin\theta$
0°		
30°		
45°		
60°		
90°		

Refer to your completed chart to answer the following questions.

10. At what angle is sine at a maximum?

11. At what angle is sine at a minimum?

12. At what angle is cosine at a minimum?

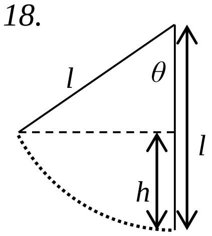
13. At what angle is cosine at a maximum?

14. At what angle are the sine and cosine equivalent?

15. As the angle increases in the first quadrant, what happens to the cosine of the angle?

16. As the angle increases in the first quadrant, what happens to the sine of the angle?

Use the figure below to answer problems 17 and 18.



17. Find an expression for h in terms of l and θ.

18. What is the value of h if l = 6 m and θ = 40°?

Part 5: Algebra

Solve the following (almost all of these are extremely **easy** – it is *important* for you to work *independently*). Units on the numbers are included because they are essential to the concepts, however they do not have any *effect* on the actual numbers you are putting into the equations. In other words, the units do not change how you do the algebra. Show every step for every problem, including writing the original equation, all algebraic manipulations, and substitution! You should practice doing all algebra *before* substituting numbers in for variables.

Section I: *For problems 1-5, use the three equations below:*

$$v_f = v_0 + at$$

$$x_f = x_0 + v_0 t + \frac{1}{2}at^2$$

$$v_f^2 = v_0^2 + 2a(x_f - x_0)$$

1. Using equation (1) solve for t given that v_0 = 5 m/s, v_f = 25 m/s, and a = 10 m/s^2.

2. Given v_0 = 0 m/s, x_0 = 0 m and t = 10 s, use all three equations together to find x_f.

3. a = 10 m/s^2, x_0 = 0 m, x_f = 120 m, and v_0 = 20 m/s. Use the second equation to find t.

4. v_f = - v_0 and a = 2 m/s^2. Use the first equation to find t / 2.

5. How does each equation simplify when a = 0 m/s^2 and x_0 = 0 m?

Section II: *For problems 6 – 11, use the four equations below.*

$$\Sigma F = ma$$
$$f_k = \mu_k N$$

$$f_s \leq \mu_s N$$

$$F_s = -kx$$

6. If ΣF = 10 N and a = 1 m/s^2, find m using the first equation.

7. Given $\Sigma F = f_k$, m = 250 kg, μ_k= 0.2, and N = 10m, find a.

8. $\Sigma F = T - 10m$, but a = 0 m/s^2. Use the first equation to find m in terms of T.

9. Given the following values, determine if the third equation is valid. $\Sigma F = f_s$, m = 90 kg, and a = 2 m/s^2. Also, μ_s= 0.1, and N = 5 N.

10. Use the first equation in Section I, the first equation in Section II and the givens below, find ΣF. m = 12 kg, v_0 = 15 m/s, v_f = 5 m/s, and t = 12 s.

11. Use the last equation to solve for F_s if k = 900 N/m and x = 0.15 m.

Section III: *For problems 12, 13, and 14 use the two equations below.*

$$a = \frac{v^2}{r}$$

$$\tau = rFsin\theta$$

12. Given that v is 5 m/s and r is 2 meters, find a.

13. Originally, a = 12 m/s^2, then r is doubled. Find the new value for a.

14. Use the second equation to find θ when τ = 4 Nm, r = 2 m, and F = 10 N.

Section IV*: For problems 15 – 22, use the equations below.*

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

$$\Delta U_g = mgh$$

$$W = F(\Delta x)cos\theta$$

$$U_s = \frac{1}{2}kx^2$$

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

$$P = Fv_{avg}cos\theta$$

15. Use the first equation to solve for K if m = 12 kg and v = 2 m/s.

16. If ΔU_g = 10 J, m = 10 kg, and g = 9.8 m/s^2, find h using the second equation.

17. $K = \Delta U_g$, g = 9.8 m/s^2, and h = 10 m. Find v.

18. The third equation can be used to find W if you know that F is 10 N, Δx is 12 m, and θ is 180°.

19. Use the value for W you found in the previous question to find P if t = 2 s. Which equation do you need for this?

20. Given U_s = 12 joules, and x = 0.5 m, find k using the fourth equation.

21. For the same value of x as given in problem 20 and the k value you just found, use the last equation in Section II to find F_s.

22. For P = 2100 W, F = 30 N, and $\theta = 0°$, find v_{avg} using the last equation in this section.

Section V: *For problems 23 – 25, use the equations below.*

$$p = mv$$

$$F\Delta t = \Delta p$$

$$\Delta p = m\Delta v$$

23. p is 12 kgm/s and m is 25 kg. Find v using the first equation.

24. "Δ" means "final state minus initial state". So, Δv means $v_f - v_i$ and Δp means $p_f - p_i$. Find v_f using the third equation if p_f = 50 kgm/s, m = 12 kg, and v_i and p_i are both zero.

25. Use the second and third equation together to find v_i if v_f = 0 m/s, m = 95 kg, F = 6000 N, and Δt = 0.2 s.

Section VI*: For problems 26 – 28 use the three equations below.*

$$T_s = 2\pi\sqrt{\frac{m}{k}}$$

$$T_p = 2\pi\sqrt{\frac{l}{g}}$$

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

26. T_p is 1 second and g is 9.8 m/s^2. Find l using the second equation.

27. m = 8 kg and T_s = 0.75 s. Solve for k.

28. Given that $T_p = T$, g = 9.8 m/s^2, and that l = 2 m, find f (the units for f are Hertz).

Section VII*: For problems 29 – 32, use the equations below.*

$$F_g = -\frac{GMm}{r^2}$$

$$U_g = -\frac{GMm}{r}$$

29. Find F_g if $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, $M = 2.6 \times 10^{23}$ kg, m = 1200 kg, and r = 2000 m.

30. What is r if U_g = -7200 J, $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, $M = 2.6 \times 10^{23}$ kg, and m = 1200 kg?

31. Use the first equation in Section IV for this problem. $K = -U_g$, $G = 6.67 \times 10^{-11}$ m^3 kg^{-1} s^{-2}, and $M = 3.2 \times 10^{23}$ kg. Find v in terms of r.

32. Using the first equation above, describe how F_g changes if r doubles.

Section VIII: *For problems 33– 35, use the equations below.*

$$F = \frac{kqQ}{r^2}$$

$$E = \frac{kQ}{r^2} = \frac{F}{q}$$

$$U_E = \frac{kQq}{r} = qV$$

$$E = -\frac{V}{d}$$

$$V = \frac{kq}{r}$$

33. k is a constant and is always equal to 9.0×10^9 Nm^2/C^2. If $q = 1.2 \times 10^{-13}$ coulombs, $Q = -q$, and $F = -10$ Newtons then find r using the first equation.

34. Another way of writing k is $\frac{1}{4\pi\epsilon_0}$. Using $k = 9.0 \times 10^9$ Nm^2/C^2, solve for ϵ_0.

35. If I have a U_E of 12 joules and I double Q and q then what is my new value of U_E?

Section IX: *For problems 36 – 41 use the equations below.*

$$V = IR$$

$$I = \frac{\Delta Q}{t}$$

$$P = IV$$

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

$$R_S = (R_1 + R_2 + R_3 + \cdots + R_i) = \Sigma R_i$$

$$\frac{1}{R_P} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_i}\right) = \sum_i \frac{1}{R_i}$$

36. Given V = 220 volts, and I = 0.2 amps, find R (the units are ohms, Ω).

37. If ΔQ = 0.2 C, t = 1s, and R = 100 Ω, find V using the first two equations.

38. R = 60 Ω and I = 0.1 A. Use these values to find P using the first and third equations.

39. Let $R_S = R$. If R_1 = 50 Ω and R_2 = 25 Ω and I = 0.15 A, find V.

40. Let $R_P = R$. If R_1 = 50 Ω and R_2 = 25 Ω and I = 0.15 A, find V.

41. Given R = 110 Ω, l = 1.0 m, and $A = 22\times 10^{-6}\ m^2$, find ρ.

GOOD JOB! That wasn't so bad was it? *Trust me*… the blood, sweat, and tears it took to get through all of those problems will make everything later on a lot easier. Think about it as an investment with a guaranteed return.

Part 6: Scalars and Vectors

Hooray for the Internet! Watch the following two videos:

http://www.khanacademy.org/science/physics/v/introduction-to-vectors-and-scalars

http://www.khanacademy.org/science/physics/v/visualizing-vectors-in-2-dimensions

For each video, summarize the content Mr. Khan is presenting in three sentences. Then, write at least one question per video on something you didn't understand or on a possible extension of the elementary concepts he presents here.

If you have issues paying attention or if your Facebook is open as you are trying to focus on these videos, you might have to watch them more than once. Trust me, these concepts are some of the *building blocks* of Physics. Get this down and you are on the fast track to success.

Part 7: Conceptual Preview

QUESTIONS FOR YOU TO THINK ABOUT and *then* RESEARCH…

Do your best to answer the following questions after examining the provided videos and links. These concepts are important ideas we will discuss throughout the year.

Kinematics

1. A gun is fired parallel to the ground. At the same instant, a bullet of equal size and mass next to the muzzle is released and drops to the ground. Which hits the ground first and why?
   http://www.youtube.com/watch?v=oBdalzRJR5g
   http://phet.colorado.edu/en/simulation/projectile-motion

Newton's Laws

2. Why can you exert a greater force on the pedals of a bicycle if you pull up on the handlebars?
http://ed.ted.com/lessons/joshua-manley-newton-s-3-laws-with-a-bicycle
http://phet.colorado.edu/en/simulation/ramp-forces-and-motion

Work and Energy

3. Consider a fly that is hovering on the inside of your car as you are traveling down the Interstate. Does it have more or less kinetic energy than the car?
http://ed.ted.com/lessons/how-does-work-work-peter-bohacek
http://phet.colorado.edu/en/simulation/energy-skate-park

Momentum and Impulse

4. Describe why a watermelon will be obliterated when you drop it in a parking lot but will remain intact when dropped from the same height into a pool.
http://www.youtube.com/watch?v=Hx9TwM4Pmhc
http://phet.colorado.edu/en/simulation/collision-lab

Circular Motion and Gravitation

5. Either for fun or for physics (sometimes you can't tell these apart…) you are swinging a rock attached to a string over your head. Suddenly the string breaks. Describe the new motion of the rock by drawing a picture.
http://www.youtube.com/watch?v=zN6kCa6xi9k
http://phet.colorado.edu/en/simulation/balancing-act

Waves and Sound

6. If you blow across the top of a Coke bottle, a specific note is produced. Add a little water to the bottle and the pitch changes. Add more water and it changes even more… why?
   http://www.youtube.com/watch?v=qyi5SvPlMXc&list=PLED25F943F8D6081C&index=73
   http://phet.colorado.edu/en/simulation/wave-on-a-string

Electricity

7. Why can birds sit on high powered electrical wires and not be electrocuted?
   http://ed.ted.com/lessons/electric-vocabulary
   http://phet.colorado.edu/en/simulation/balloons

   http://phet.colorado.edu/en/simulation/electric-hockey

To make physics easier, familiarize yourself with some of the bizarre, counterintuitive concepts that we'll be studying this year! A little investment now will have huge payoffs later on!

Congratulations! You're finished

This course is a wonderful opportunity to grow as a critical thinker, problem solver and great communicator. Don't believe the rumors- it is not impossibly hard. It ***does*** *require hard work, but so does anything that is worthwhile. You would never expect to win a race if you didn't train. Similarly, you can't expect to do well if you don't train academically. AP Physics is immensely rewarding and exciting, but you do have to take notes, study, and read the book (gasp!). I guarantee that if you do what is asked of you that you will look back to this class with huge sense of satisfaction! I know I can't wait to get started…*

Let's learn some ***SCIENCE****!!!*