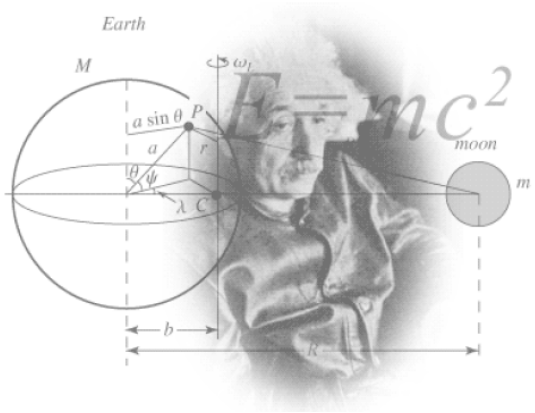
AP Physics 1 Summer Assignment



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 6 parts to this assignment. It is the quantity not the difficulty of the problems that has the potential to overwhelm, so do it over an extended period of time. it should not take you any longer than a summer reading book assignment. 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 internet 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 is a total waste of your time to copy the assignment from a friend, not to mention you need to know this for class. The summer assignment will be due at the beginning of the second week of class. Good luck! ☺

Part 1: Scientific Notation and Unit Conversions

Many numbers in physics will be provided in scientific notation. You need to be able read and simplify scientific notation.

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. Before you practice, remember the rules for exponents. Attempt the following by hand, but you are always allowed to use your calculator to check.

- When numbers are multiplied together, you *add* the exponents and *multiply* the bases.
- When numbers are divided, you *subtract* the exponents and *divide* the bases.
- When an exponent is raised to another exponent, you *multiply* the exponent.

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

5. $(3\text{x}10^{6})\cdot(2\text{x}10^{4})$ =

6. $(1.2\text{x}10^{4}) / (6\text{x}10^{-2})$ =

7. $(4\text{x}10^{8})\cdot(5\text{x}10^{-3})$ =

8. $(7\text{x}10^{3})^{2}$ =

9. $(8\text{x}10^{3}) / (2\text{x}10^{5})$ =

10. $(2\text{x}10^{-3})^{3}$ =

Fill in the power and the symbol for the following unit prefixes. Look them up as necessary. 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 = 24/1000 = 0.024 = 2.4 x 10^{-3} kg
2. 94.1 MHz = _____ Hz
3. 6 Gb = _____ kb
4. 640 nm = _____ m
5. 3.2 m^2 = 3.2x$(100)^2$ = 32000 = 3.2 x10^4 cm^2
6. 40 mm^3 = _____ m^3
7. 1 g/cm^3 = _____ kg/m^3
8. 20 m/s = _____ km/hr

It is important you know how to use your calculator for scientific notation as well. The easiest method is to use the "EE" button. An example is included below to show you how to use the "EE" button.

Ex: 7.8x10^{-6} would be entered as 7.8"EE"-6

9. (3.67x10^3)(8.91x10^{-6}) =
10. (5.32x10^{-2})(4.87x10^{-4}) =
11. (9.2x10^6) / (3.6x10^{12}) =
12. (6.12x10^{-3})^3 =

Part 2: Significant Figures

Although significant figures will not be assessed on your tests or AP exam, they are very important for proper data measurement and analysis for labs. Additionally, you will have an online homework system, Mastering Physics, which requires you to put answers in using significant figures.

Observed values of experimental quantities have inherent uncertainties created by either the limitations of the instrument or the skill of the person using it. The number of significant figures in a physical quantity is equal to the number of digits in it that are known with certainty.

Rules for determining the number of significant figures in uncertain numbers

a. A digit is significant
   i. If it is a non-zero number.
   ii. If it is the last digit in a number that includes a decimal point.
   iii. If it is between two significant numbers.
b. To determine the number of significant figures in a number expressed in scientific notation consider only the coefficient (the part of the number that precedes " x 10 $^{\text{exponent}}$")

Examples:

a. 606 kg — 3 significant figures (the zero is significant as it is between two nonzero numbers)
b. 26.200 m — 5 significant figures (the last zero is significant as it is the last digit with a decimal)
c. 1.09×10^{15} g — 3 significant figures (only considering 1.09, the zero is significant it is between)
d. 300. m/s — 3 significant figures (the last zero is the last digit with a decimal)

Practice:

a. 790 m/s
b. 45.002 m
c. 25000 g
d. 2500×10^{3} kg

Multiplication/Division with Significant Figures

The number of significant figures after multiplication or division is equal to the number of significant figures in the least accurately known quantity. Before "dropping" figures from a calculation that are insignificant, look to see if the insignificant digits would cause the remaining significant figures to be rounded up. For the purposes of determining significant figures, ignore numbers such as pie and conversion factors. These are considered exact and will NOT change the overall precision of the other numbers in the problem.

Examples:

a. $3.0010 \times 21 =$ $63.021 = 63$
b. $45.00 / 2230 =$ $0.02017937\ldots = 0.0202 = 2.02 \times 10^{-2}$

Practice:

a. $(2.034 \times 10^{-21}) \times (500 \times 10^{5}) =$
b. $3.0 \times \pi =$

Addition/Subtraction with Significant Figures

The number of decimal places after addition or subtraction is equal to the smallest number of decimal places in any of the individual terms. This is very different from the rule for multiplication/division because it focuses on the accuracy of the last significant figure as opposed to just the total number of significant digits in each number.

The best way to complete an addition or subtraction significant figure problem is as follows:

a. Rewrite the numbers vertically and align the decimal point in each number
b. Add or subtract the numbers as normal
c. Find the number in the calculation that had its last significant digit farthest to the left.
d. Your answer cannot have significant figures to the right of that position.
e. Don't forget to round up or down when you drop off the extra non-significant digits.

Special things to consider BEFORE starting a significant figure addition or subtraction problem:

a. All numbers must have the same unit. If not, do a unit conversion first.
b. If numbers are in scientific notation, you must change them to the same exponent before applying the rules for addition and subtraction with significant figures.

Examples:

a. 432.2 g + 24.06 g =

$$\begin{array}{r} 432.2 \\ +\ 24.06 \\ \hline 456.26 \end{array}$$

456.3 g

b. 12 m + 30 cm = 30 cm/100 = .3 m

$$\begin{array}{r} 12. \\ +\ .3 \\ \hline 12.3 \end{array}$$

12 m

c. 1.02×10^5 m + $.02 \times 10^7$ m = $.02 \times 10^7 = 2 \times 10^5$

$$\begin{array}{r} 1.02 \times 10^5 \\ +\ 2.\ \ \times 10^5 \\ \hline 3.02 \times 10^5 \end{array}$$

3×10^5 m

Practice:

a. 324.54 km - 25.6 km =

b. 28.9 L +300.25 L + 2.945 L =

c. 3.004×10^{-6} cm $+5.4 \times 10^{-7}$ cm =

Additional Considerations

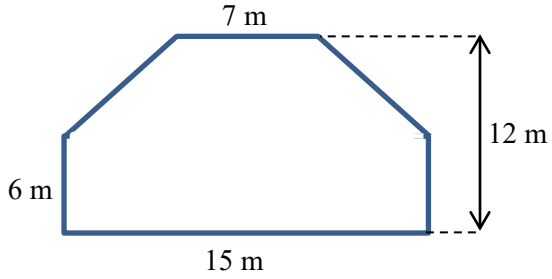
The number of significant figures in a given quantity may be ambiguous due to the presence of zeros at the beginning or end of the number. To remove this type of ambiguity, we can write the number in scientific notation — that is, as a number with the correct number of significant figures times an appropriate power of ten.

Round-off error occurs when numerical results are rounded off at different times during a calculation. To minimize round-off error, it's a good idea to keep an extra digit throughout your calculations whenever possible, rounding off only the final result. But while this practice can help to reduce the likelihood of round-off error, there is no way to avoid it in every situation.

Part 3: Geometry

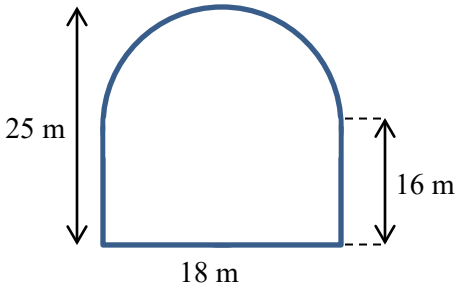
Calculate the area of the following shapes. It may be necessary to break up the figure into common shapes.

1.



Area = _____

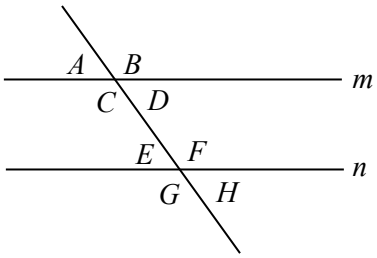
2.



Area = _____

Calculate the unknown angle values for questions 3-5.

3

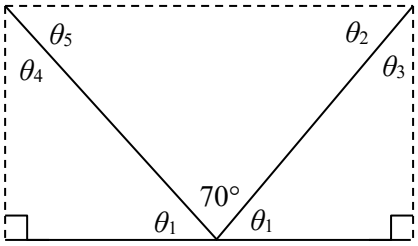


Lines *m* and *n* are parallel.

$A =$ 75° $B =$ _____ $C =$ _____ $D =$ _____

$E =$ _____ $F =$ _____ $G =$ _____ $H =$ _____

4.



$\theta_1 =$ _____

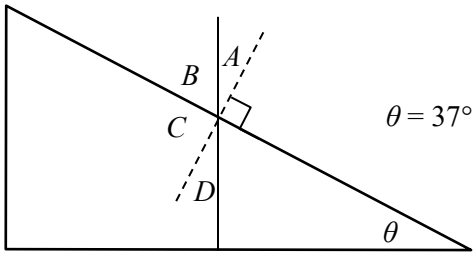
$\theta_2 =$ _____

$\theta_3 =$ _____

$\theta_4 =$ _____

$\theta_5 =$ _____

5.



$A =$ _____ $B =$ _____

$C =$ _____ $D =$ _____

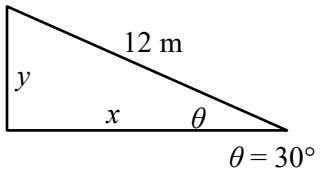
Part 4: Trigonometry

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. Make sure your calculator is in degree mode. Please include appropriate units with all answers. (Watch the unit prefixes!)

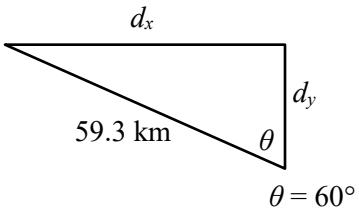
1.



$y =$ _____

$x =$ _____

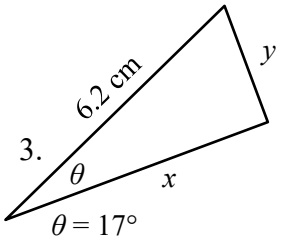
2.



$d_x =$ _____

$d_y =$ _____

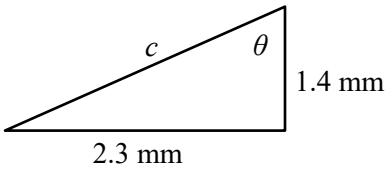
3.



$x =$ _____

$y =$ _____

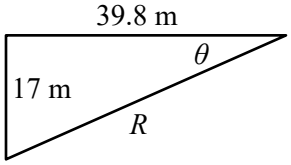
4.



$c =$ _____

$\theta =$ _____

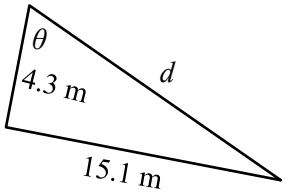
5.



$R =$ _____

$\theta =$ _____

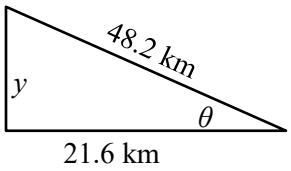
6.



$d =$ _____

$\theta =$ _____

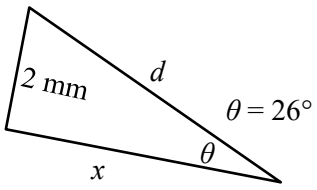
7.



$y =$ _____

$\theta =$ _____

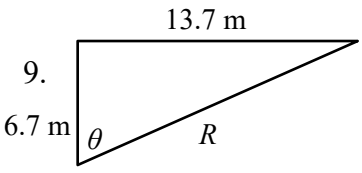
8.



$x =$ _____

$d =$ _____

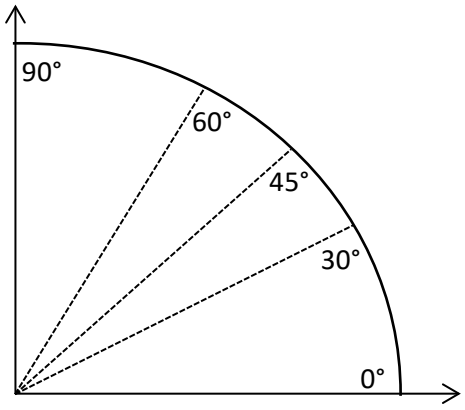
9.



$R =$ _____

$\theta =$ _____

You will need to be familiar with trigonometric values for a few common angles. Memorizing this unit circle diagram in degrees or the chart below will be very beneficial for next year in both physics and pre-calculus. 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. Make sure your calculator is in degree mode. Write the ordered pair (either in fraction or decimal 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 is shown), what happens to the cosine of the angle?

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

Part 5: Algebra

Solve the following. 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. Use an extra sheet if you need more space.

1. Rearrange the following equation to solve for t.

   $v_f = v_0 + at$

2. If $x_0 = 0$ m and $x_f = 0$ m, solve the following equation for the two solutions of t in terms of v_0 and a.

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

3. Rearrange the following equation to solve for v_0.

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

4. Rearrange the equation $\Sigma F = ma$ to solve for m.

5. Given $\Sigma F = f_k$ and $N = 10m$, solve for a using the following two equations in terms of μ_k.

   $\Sigma F = ma$

   $f_k = \mu_k N$

6. $\Sigma F = T - 10m$, but $a = 0$ m/s^2. Use the equation $\Sigma F = ma$ to solve for m in terms of T.

7. Use the following two equations to solve for ΣF in terms of m, v_f, v_0, and t.

   $v_f = v_0 + at$

   $\Sigma F = ma$

8. Use the equation $F_s = -k\Delta x$ to solve for F_s if $k = 900$ N/m and $x_f = 0.35$ m and $x_i = 0.28$ m. Give a numerical answer with appropriate units.

Part 6: Graphing and Functions

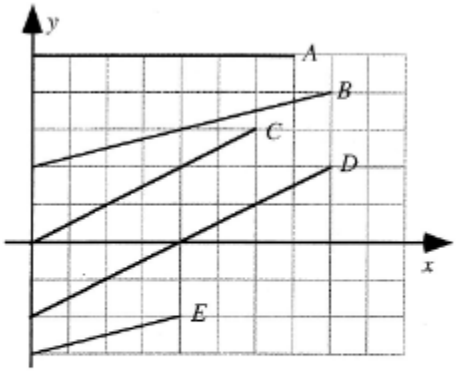
A greater emphasis has been placed on conceptual questions and graphing on the AP exam. Below you will find a few example concept questions that review foundational knowledge of graphs. Ideally you won't need to review, but you may need to review some math to complete these tasks.

Key Graphing Skills to remember:

1. Always label your axes with appropriate units.
2. Sketching a graph calls for an estimated line or curve while plotting a graph requires individual data points AND a line or curve of best fit.
3. Provide a clear legend if multiple data sets are used to make your graph understandable.
4. Never include the origin as a data point unless it is provided as a data point.
5. Never connect the data points individually, but draw a single smooth line or curve of best fit
6. When calculating the slope of the best fit line you must use points from your line. You may only use given data points IF your line of best fit goes directly through them.

Conceptual Review of Graphs

Shown are several lines on a graph.



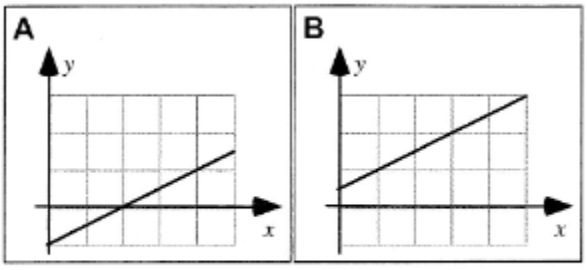
Follow-up Question: Which of the lines A-E represent a proportional function? Explain your reasoning.

Rank the slopes of the lines in this graph.

					OR			
1 Greatest	2	3	4	5 Least		All the same	All zero	Cannot determine

Explain your reasoning.

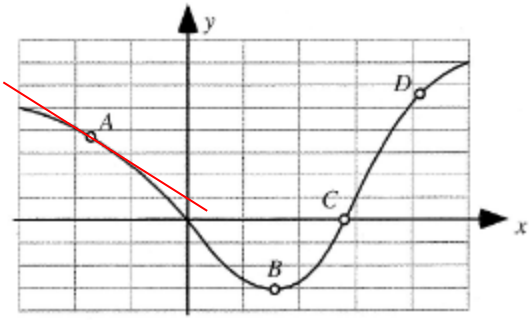
Shown are two graphs.



Is the slope of the graph (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases?* _____

Explain your reasoning.

Four points are labeled on a graph.



Hint: *Draw a tangent line at each point like the one shown at A.*

Rank the slopes of the graph at the labeled points.

				OR			
					☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

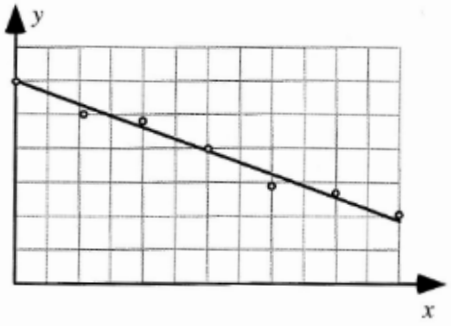
Explain your reasoning.

A1-WWT22: LINE DATA GRAPH—INTERPRETATION

A student makes the following claim about some data that he and his lab partners have collected:

"Our data show that the value of y decreases as x increases. We found that y *is inversely proportional to* x*."*

What, if anything, is wrong with this statement? If something is wrong, identify and explain how to correct all errors. If this statement is correct, explain why.



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

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 1 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****!!!*