

AP Physics 1 Summer Assignment

Welcome to AP Physics 1! This summer assignment will review all the prerequisite knowledge expected of you. You will find that the challenge of this assignment is in the quantity of the material rather than the complexity. Therefore, you should complete the assignment over an extended period of time. Please complete it individually and take the time to understand all the material. The assignment will be collected upon your return to school in the fall.

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 (*add / subtract*) the exponents and (*multiply / divide*) the bases.

When numbers are divided, you (*add / subtract*) the exponents and (*multiply / divide*) the bases.

When an exponent is raised to another exponent, you (*add / subtract / multiply / divide*) the exponent.

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

5. $(3 \times 10^6) \cdot (2 \times 10^4) =$

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

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

8. $(7 \times 10^3)^2 =$

9. $(8 \times 10^3) / (2 \times 10^5) =$

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

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

5. $3.2 \text{ m}^2 = \text{_____ cm}^2$

2. 94.1 MHz = _____ Hz

6. $40 \text{ mm}^3 = \text{_____ m}^3$

3. 6 Gb = _____ kb

7. $1 \text{ g/cm}^3 = \text{_____ kg/m}^3$

4. 640 nm = _____ m

8. $20 \text{ m/s} = \text{_____ km/hr}$

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: 7.8×10^{-6} would be entered as 7.8"EE"-6

9. $(3.67 \times 10^3)(8.91 \times 10^{-6}) =$

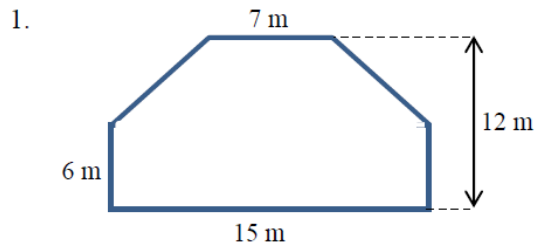
10. $(5.32 \times 10^{-2})(4.87 \times 10^{-4}) =$

11. $(9.2 \times 10^6) / (3.6 \times 10^{12}) =$

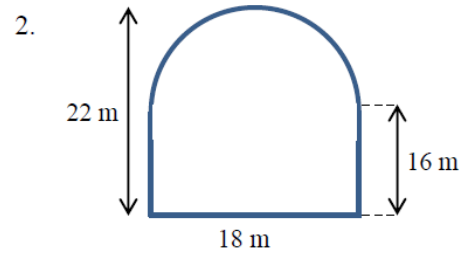
12. $(6.12 \times 10^{-3})^3$

Part 2: Geometry

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

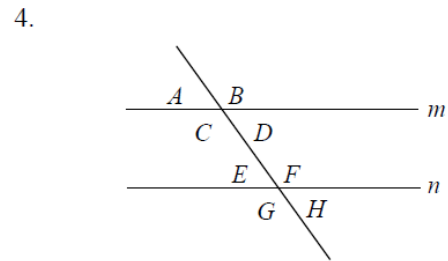
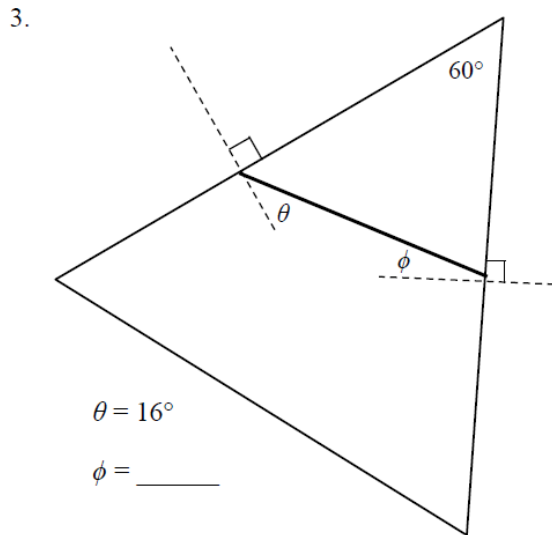


Area = _____



Area = _____

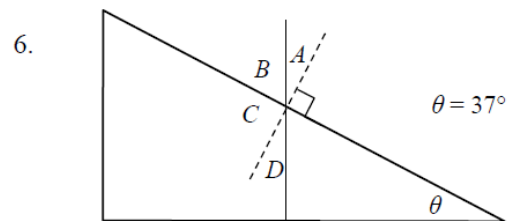
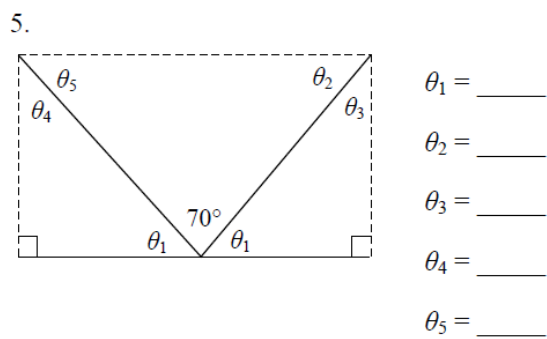
Calculate the unknown angle values for questions 3-6.



Lines m and n are parallel.

$A = 75^\circ$ $B = \underline{\hspace{1cm}}$ $C = \underline{\hspace{1cm}}$ $D = \underline{\hspace{1cm}}$

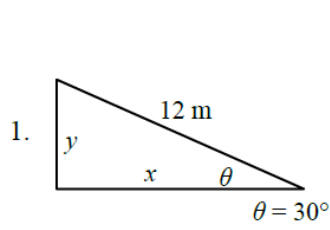
$E = \underline{\hspace{1cm}}$ $F = \underline{\hspace{1cm}}$ $G = \underline{\hspace{1cm}}$ $H = \underline{\hspace{1cm}}$



$A = \underline{\hspace{1cm}}$ $B = \underline{\hspace{1cm}}$

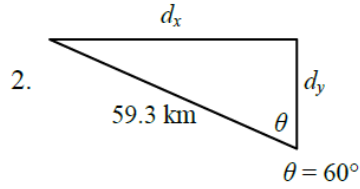
$C = \underline{\hspace{1cm}}$ $D = \underline{\hspace{1cm}}$

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!)



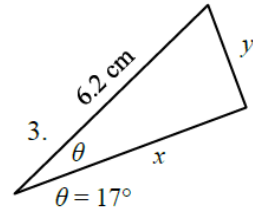
$y = \underline{\hspace{2cm}}$

$x = \underline{\hspace{2cm}}$



$d_x = \underline{\hspace{2cm}}$

$d_y = \underline{\hspace{2cm}}$



$x = \underline{\hspace{2cm}}$

$y = \underline{\hspace{2cm}}$

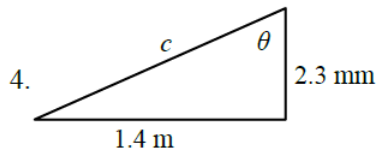
Part 4: Trigonometry

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

$\sin\theta =$

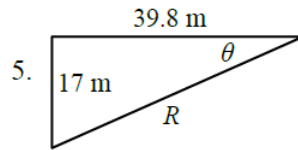
$\cos\theta =$

$\tan\theta =$



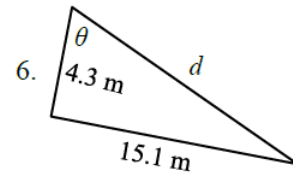
$c = \underline{\hspace{2cm}}$

$\theta = \underline{\hspace{2cm}}$



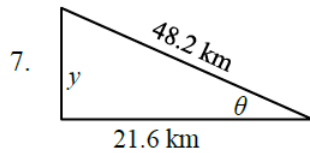
$R = \underline{\hspace{2cm}}$

$\theta = \underline{\hspace{2cm}}$



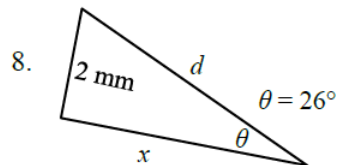
$d = \underline{\hspace{2cm}}$

$\theta = \underline{\hspace{2cm}}$



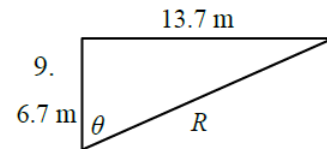
$y = \underline{\hspace{2cm}}$

$\theta = \underline{\hspace{2cm}}$



$x = \underline{\hspace{2cm}}$

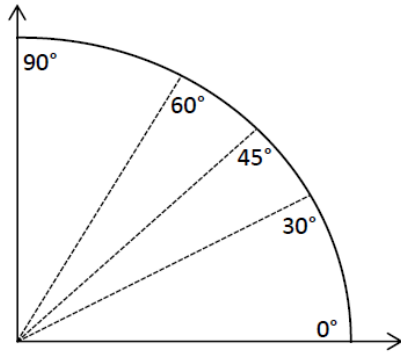
$d = \underline{\hspace{2cm}}$



$R = \underline{\hspace{2cm}}$

$\theta = \underline{\hspace{2cm}}$

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. Write the ordered pair (in fraction form) for each of the angles shown in the table below

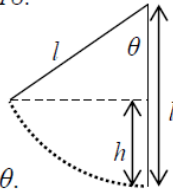


θ	$\cos\theta$	$\sin\theta$
0°		
30°		
45°		
60°		
90°		

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 $\theta = 40^\circ$?

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:

$$v_f = v_0 + at$$

$$x_f = x_0 + v_0t + \frac{1}{2}at^2$$

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

- Using equation (1) solve for t given that $v_0 = 5$ m/s, $v_f = 25$ m/s, and $a = 10$ m/s².
- $a = 10$ m/s², $x_0 = 0$ m, $x_f = 120$ m, and $v_0 = 20$ m/s. Use the second equation to find t .
- $v_f = -v_0$ and $a = 2$ m/s². Use the first equation to find $t/2$.
- How does each equation simplify when $a = 0$ m/s² and $x_0 = 0$ m?

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

$$\Sigma F = ma$$

$$f_k = \mu_k N$$

$$f_s \leq \mu_s N$$

$$F_s = -kx$$

- If $\Sigma F = 10$ N and $a = 1$ m/s², find m using the first equation.
- Given $\Sigma F = f_k$, $m = 250$ kg, $\mu_k = 0.2$, and $N = 10m$, find a .
- $\Sigma F = T - 10m$, but $a = 0$ m/s². Use the first equation to find m in terms of T .
- Given the following values, determine if the third equation is valid. $\Sigma F = f_s$, $m = 90$ kg, and $a = 2$ m/s². Also, $\mu_s = 0.1$, and $N = 5$ N.
- 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.
- Use the last equation to solve for F_s if $k = 900$ N/m and $x = 0.15$ m.

Part 6: Graphing and Functions

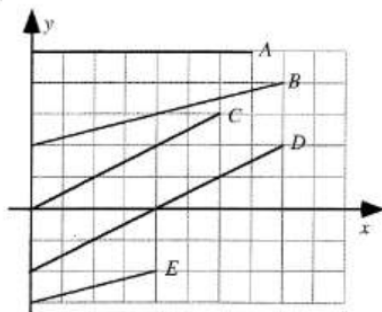
A greater emphasis has been placed on conceptual questions and graphing on the AP exam. Below you will find a few example concept questions that review foundational knowledge of graphs. Ideally you won't need to review, but you may need to review some math to complete these tasks. At the end of this part is a section covering graphical analysis that you probably have not seen before: *linear transformation*. This analysis involves converting any non-linear graph into a linear graph by adjusting the axes plotted. We want a linear graph because we can easily find the slope of the line of best fit of the graph to help justify a mathematical model or equation.

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.

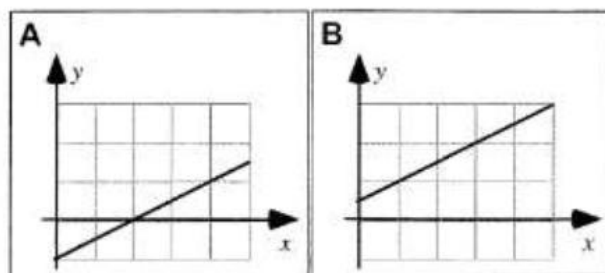


Rank the slopes of the lines in this graph.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	2	3	4	5		All	All	Cannot
Greatest				Least		the same	zero	determine

Explain your reasoning.

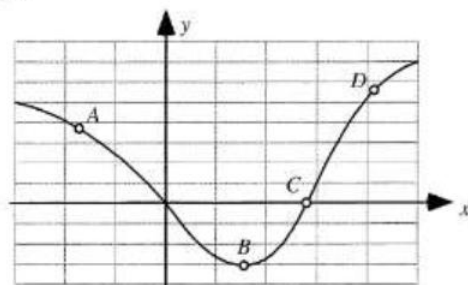
Shown are two graphs.



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.



Rank the slopes of the graph at the labeled points.

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

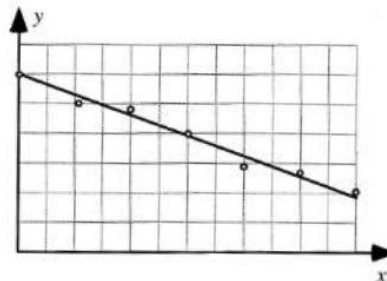
Explain your reasoning.

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.



Linear and Non-Linear Functions

You must understand functions to be able linearize. First let's review what graphs of certain functions looks like. Sketch the shape of each type of y vs. x function below. k is listed as a generic constant of proportionality.

Linear $y = kx$



Inverse $y = k/x$



Inverse Square $y = k/x^2$



Power $y = kx^2$



You will notice that only the linear function is a straight line. We can easily find the slope of our line by measuring the rise and dividing it by the run of the graph or calculating it using two points. The value of the slope should equal the constant k from the equation.

Finding k is a bit more challenging in the last three graphs because the slope isn't constant. This should make sense since your graphs aren't linear. So how do we calculate our constant, k ? We need to transform the non-linear graph into a linear graph in order to calculate a constant slope. We can accomplish this by transforming one or both of the axes for the graph. The hardest part is figuring out which axes to change and how to change them. The easiest way to accomplish this task is to solve your equation for the constant. Note in the examples from the last page there is only one constant, but this process could be done for other equations with multiple constants. Instead of solving for a single constant, put all of the constants on one side of the equation. When you solve for the constant, the other side of the equation should be in fraction form. This fraction gives the rise and run of the linear graph. Whatever is in the numerator is the vertical axis and the denominator is the horizontal axis. If the equation is not in fraction form, you will need to inverse one or more of the variables to make a fraction. First let's solve each equation to figure out what we should graph. Then look below at the example and complete the last one, a sample AP question, on your own.

State what should be graphed in order to produce a linear graph to solve for k .

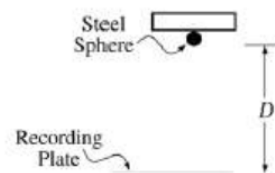
Inverse Graph Vertical Axis: _____ Horizontal Axis: _____

Inverse Square Graph Vertical Axis: _____ Horizontal Axis: _____

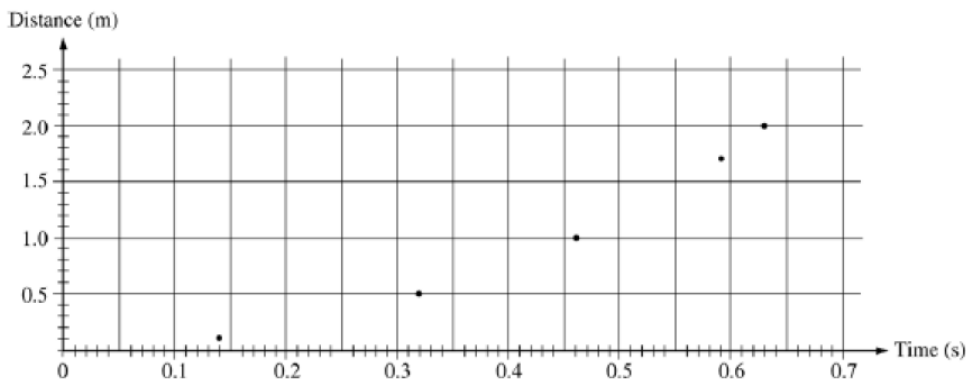
Power (Square) Graph Vertical Axis: _____ Horizontal Axis: _____

Sample AP Graphing Exercise

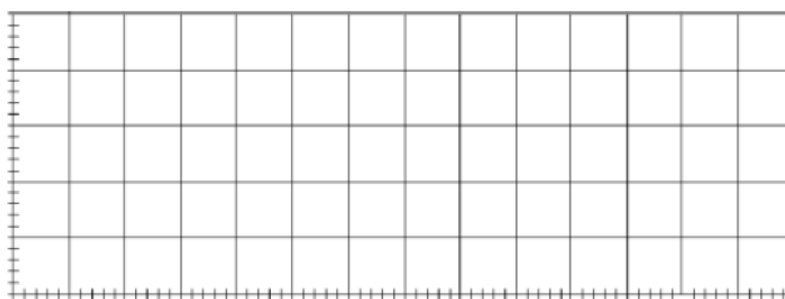
A steel sphere is dropped from rest and the distance of the fall is given by the equation $D = \frac{1}{2}gt^2$. D is the distance fallen and t is the time of the fall. The acceleration due to gravity is the constant known as g . Below is a table showing information on the first two meters of the sphere's descent.



Distance of Fall (m)	0.10	0.50	1.00	1.70	2.00
Time of Fall (s)	0.14	0.32	0.46	0.59	0.63



- Draw a line of best fit for the distance vs. time graph above.
- If only the variables D and t are used, what quantities should the student graph in order to produce a linear relationship between the two quantities?
- On the grid below, plot the data points for the quantities you have identified in part (b), and sketch the straight-line fit to the points. Label your axes and show the scale that you have chosen for the graph.



- Calculate the value of g by using the slope of the graph.