

## 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. 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 acclimatize to the rigor and pacing of AP Physics 1. Use a book or the internet if you need to, but really this is all stuff you already know how to do (basic math skills), or you can email me at [christopher.moyer@huttoisd.net](mailto:christopher.moyer@huttoisd.net) if you are stuck or have a question. I'll get back to you as quickly as I can.



**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 since you will not be prepared for the first day of class. The summer assignment will be due the first day of class and is worth a test grade. If it is not turned in on the first day of class it will be a zero that cannot be recovered. It will be very difficult to pass the first six weeks with a test grade of zero. Good luck! ☺

**READ ALL DIRECTIONS CAREFULLY.  
YOUR GRADE DEPENDS ON HOW WELL DIRECTIONS ARE FOLLOWED.  
ALL ANSWER MUST BE WRITTEN LEGIBLY.**

### *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.)**

*Directions:* 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.

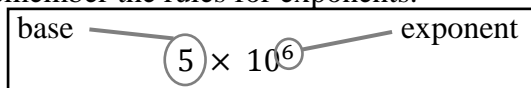
1. 56,840,000 kg

2. 10,854.2 s

3. 0.0000007 m

4. 0.00093  $\frac{\text{km}}{\text{s}}$

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.



Circle the correct answers for each of the following questions (feel free to look them up!):

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.

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

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

11.  $(7 \times 10^5)^4 =$

6.  $(4 \times 10^9) \cdot (5 \times 10^{-4}) =$

12.  $(2 \times 10^{-4})^4 =$

7.  $(6 \times 10^2) \cdot (2 \times 10^4)$

13.  $(6 \times 10^3)^{-2} =$

8.  $(7 \times 10^{-1}) \cdot (9 \times 10^6)$

14.  $(4 \times 10^{-5})^{-3} =$

9.  $\frac{(2 \times 10^3)}{(6 \times 10^6)} =$

15.  $\frac{(5.7 \times 10^{-5})}{(4.6 \times 10^4)} =$

10.  $\frac{(1.2 \times 10^5)}{(6 \times 10^{-3})} =$

16.  $\frac{(8.3 \times 10^{-2})}{(2.7 \times 10^{-4})} =$

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 ( $10^0=1$ ). Remember if there is an exponent on the unit, the conversion should be raised to the same exponent as well.

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

- |                |                                       |  |   |
|----------------|---------------------------------------|--|---|
| 1. 564 g =     | <input type="text" value="_____ kg"/> | 5. 52 m <sup>2</sup> =                 | <input type="text" value="_____ cm&lt;sup&gt;2&lt;/sup&gt;"/>   |
| 2. 101.3 MHz = | <input type="text" value="_____ Hz"/> | 6. 536 mm <sup>3</sup> =               | <input type="text" value="_____ m&lt;sup&gt;3&lt;/sup&gt;"/>    |
| 3. 1.7 Gb =    | <input type="text" value="_____ kb"/> | 7. $20 \frac{\text{g}}{\text{cm}^3}$ = | <input type="text" value="_____ kg/m&lt;sup&gt;3&lt;/sup&gt;"/> |
| 4. 64 nm =     | <input type="text" value="_____ m"/>  | 8. $1 \frac{\text{m}}{\text{s}}$ =     | <input type="text" value="_____ km/hr"/>                        |

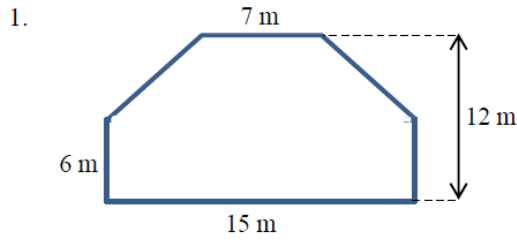
*Directions:* For the remaining scientific notation problems you may use your calculator. It is important that you know how to use your calculator for scientific notation. The easiest method is to use the “EE” button. An example is included below to show you how to use the “EE” button.

Ex:  $7.8 \times 10^{-6}$  would be entered as 7.8“EE”-6, which would read as 7.8E-6 on your calculator screen.

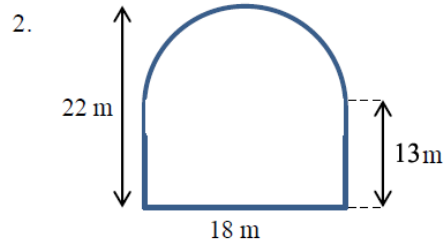
- |   |                      |  |                      |
|---|----------------------|--|----------------------|
| 9. $(8.72 \times 10^4)(4.36 \times 10^{-4}) =$      | <input type="text"/> | 11. $\frac{8.5 \times 10^5}{2.1 \times 10^{10}} =$ | <input type="text"/> |
| 10. $(10.54 \times 10^{-3})(2.11 \times 10^{-5}) =$ | <input type="text"/> | 12. $(4.77 \times 10^{-7})^4$                      | <input type="text"/> |

**Part 2: Geometry**

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

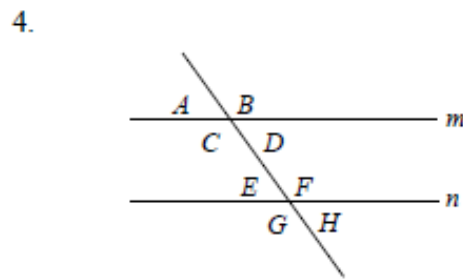
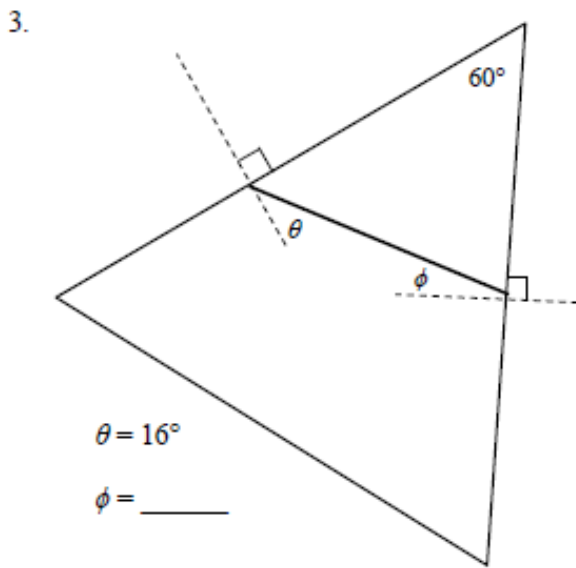


Area = \_\_\_\_\_



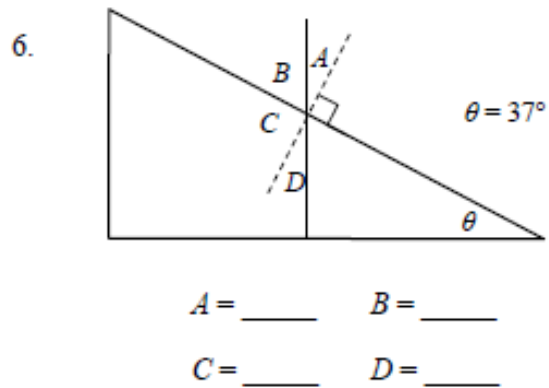
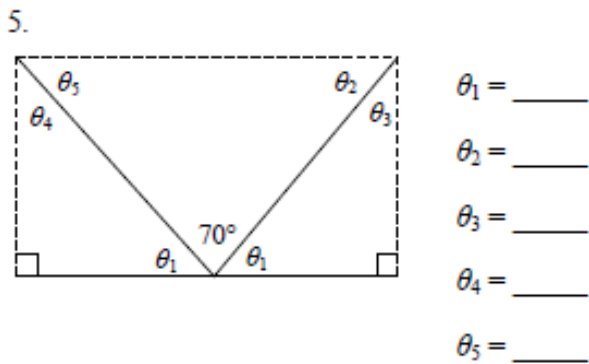
Area = \_\_\_\_\_

Calculate the unknown angle values for questions 3-6.



Lines  $m$  and  $n$  are parallel.

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



**Part 4: Trigonometry**

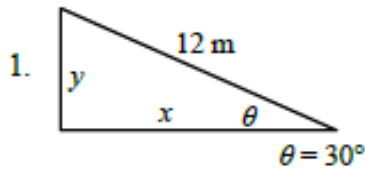
Write the formulas for each one of the following trigonometric functions. Remember SOHCAHTOA!

$\sin\theta =$

$\cos\theta =$

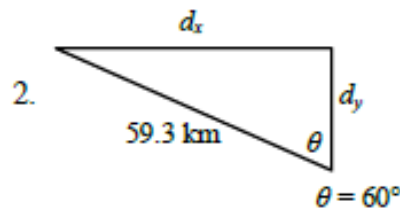
$\tan\theta =$

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!)



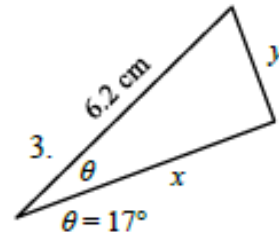
$y =$  \_\_\_\_\_

$x =$  \_\_\_\_\_



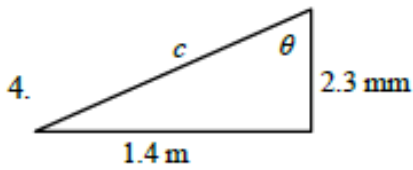
$d_x =$  \_\_\_\_\_

$d_y =$  \_\_\_\_\_



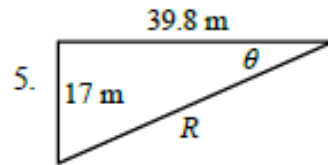
$x =$  \_\_\_\_\_

$y =$  \_\_\_\_\_



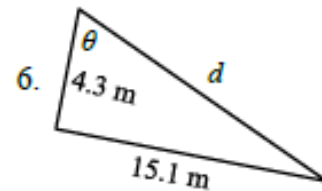
$c =$  \_\_\_\_\_

$\theta =$  \_\_\_\_\_



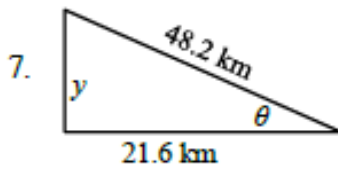
$R =$  \_\_\_\_\_

$\theta =$  \_\_\_\_\_



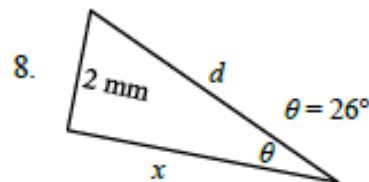
$d =$  \_\_\_\_\_

$\theta =$  \_\_\_\_\_



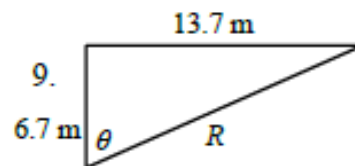
$y =$  \_\_\_\_\_

$\theta =$  \_\_\_\_\_



$x =$  \_\_\_\_\_

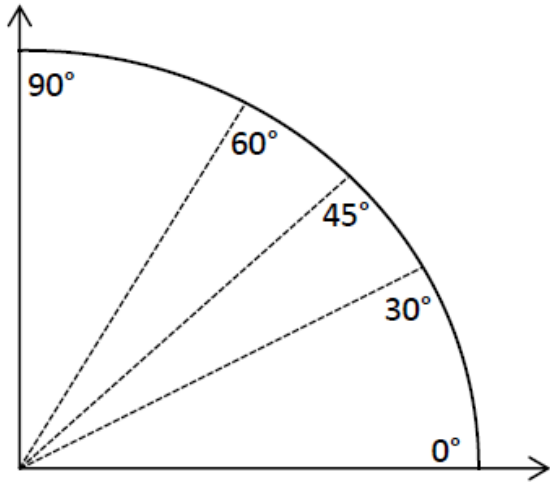
$d =$  \_\_\_\_\_



$R =$  \_\_\_\_\_

$\theta =$  \_\_\_\_\_

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

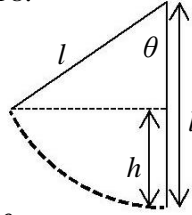


$\theta$	$\cos\theta$	$\sin\theta$
$0^\circ$		
$30^\circ$		
$45^\circ$		
$60^\circ$		
$90^\circ$		

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 maximum?
13. At what angle is cosine at a minimum?
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  $\theta$ .

18. What is the value of  $h$  if  $l = 6$  m and  $\theta = 40^\circ$ ?

**Part 5: Algebra**

Please show your work for this part on separate sheets of paper and put your final answer in the boxes below, there is not enough room on this sheet to show all of your work. Solve the following (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. Don't let the subscripts on the variables confuse you.  $v_f$ , for example is just a single variable.

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

$$(1) \quad v_f = v_0 + at \quad (2) \quad x_f = x_0 + v_0t + \frac{1}{2}at^2 \quad (3) \quad v_f^2 = v_0^2 + 2a(x_f - x_0)$$

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

2.  $a = 10$  m/s<sup>2</sup>,  $x_0 = 0$  m,  $x_f = 120$  m, and  $v_0 = 20$  m/s. Use the second equation to find  $t$ .

3.  $v_f = -v_0$  and  $a = 2$  m/s<sup>2</sup>. Use the first equation to find  $t/2$ .

4. How does each equation simplify when  $a = 0$  m/s<sup>2</sup> and  $x_0 = 0$  m?

**Section II:** For problems 6 – 11, use the four equations below. Don't let the Greek letters confuse you, they're just like any other letter used for variables.

$$\Sigma F = ma$$

$$f_k = \mu_k N$$

$$f_s \leq \mu_s N$$

$$F_s = -kx$$

5. If  $\Sigma F = 10$  N and  $a = 1$  m/s<sup>2</sup>, find  $m$  using the first equation.

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

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

8. Given the following values, determine if the third equation is valid.  $\Sigma F = f_s$ ,  $m = 90$  kg, and  $a = 2$  m/s<sup>2</sup>. Also,  $\mu_s = 0.1$ , and  $N = 5$  N.

9. Use the first equation in Section I, the first equation in Section II and the givens below, find  $\Sigma F$ .  $m = 12$  kg,  $v_0 = 15$  m/s,  $v_f = 5$  m/s, and  $t = 12$  s.

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

**Section III:** For problems 11-13 use the two equations below.

$$a = \frac{v^2}{r} \qquad \tau = rF \sin \theta$$

11. Given that  $v$  is 5 m/s and  $r$  is 2 meters, find  $a$ .
12. Originally,  $a = 12 \text{ m/s}^2$ , then  $r$  is doubled. Find the new value for  $a$ .
13. Use the second equation to find  $\theta$  when  $\tau = 4 \text{ Nm}$ ,  $r = 2 \text{ m}$ , and  $F = 10 \text{ N}$ .

**Section IV:** For problems 14 – 21, use the equations below.

$$K = \frac{1}{2}mv^2 \qquad W = F(\Delta x) \cos \theta \qquad P = \frac{W}{t}$$

$$\Delta U_g = mgh \qquad U_s = \frac{1}{2}kx^2 \qquad P = Fv_{avg} \cos \theta$$

14. Use the first equation to solve for  $K$  if  $m = 12 \text{ kg}$  and  $v = 2 \text{ m/s}$ .
15. If  $\Delta U_g = 10 \text{ J}$ ,  $m = 10 \text{ kg}$ , and  $g = 9.8 \text{ m/s}^2$ , find  $h$  using the second equation.
16.  $K = \Delta U_g$ ,  $g = 9.8 \text{ m/s}^2$ , and  $h = 10 \text{ m}$ . Find  $v$ .
17. Use the third equation to find  $W$  if you know that  $F$  is 10 N,  $\Delta x$  is 12 m, and  $\theta$  is  $180^\circ$ .
18. Given  $U_s = 12 \text{ joules}$ , and  $x = 0.5 \text{ m}$ , find  $k$  using the fourth equation.
19. For  $P = 2100 \text{ W}$ ,  $F = 30 \text{ N}$ , and  $\theta = 0^\circ$ , find  $v_{avg}$  using the last equation in this section.

**Section V:** For problems 20 – 22, use the equations below.

$$p = mv \qquad F\Delta t = \Delta p \qquad \Delta p = m\Delta v$$

20.  $p$  is 12 kgm/s and  $m$  is 25 kg. Find  $v$  using the first equation.
21. “ $\Delta$ ” means “final state minus initial state”. So,  $\Delta v$  means  $v_f - v_i$  and  $\Delta p$  means  $p_f - p_i$ . Find  $v_f$  using the third equation if  $p_f = 50 \text{ kgm/s}$ ,  $m = 12 \text{ kg}$ , and  $v_i$  and  $p_i$  are both zero.
22. Use the second and third equation together to find  $v_i$  if  $v_f = 0 \text{ m/s}$ ,  $m = 95 \text{ kg}$ ,  $F = 6000 \text{ N}$ , and  $\Delta t = 0.2 \text{ s}$ .

**Section VI:** For problems 23 – 25 use the three equations below.

$$T_s = 2\pi\sqrt{\frac{m}{k}} \qquad T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{1}{f}$$

23.  $T_p$  is 1 second and  $g$  is  $9.8 \text{ m/s}^2$ . Find  $l$  using the second equation.
24.  $m = 8 \text{ kg}$  and  $T_s = 0.75 \text{ s}$ . Solve for  $k$ .
25. Given that  $T_p = T$ ,  $g = 9.8 \text{ m/s}^2$ , and that  $l = 2 \text{ m}$ , find  $f$  (the units for  $f$  are Hertz).



**Section VII:** For problems 26 – 29, use the equations below.

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

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

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

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

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

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

**Section VIII:** For problems 30 – 35 use the equations below.

$$V = IR$$

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

$$P = IV$$

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

$$R_s = (R_1 + R_2 + R_3 + \dots + R_i) = \Sigma R_i$$

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

30. Given  $V = 220 \text{ volts}$ , and  $I = 0.2 \text{ amps}$ , find  $R$  (the units are ohms,  $\Omega$ ).

31. If  $\Delta Q = 0.2 \text{ C}$ ,  $t = 1 \text{ s}$ , and  $R = 100 \Omega$ , find  $V$  using the first two equations.

32.  $R = 60 \Omega$  and  $I = 0.1 \text{ A}$ . Use these values to find  $P$  using the first and third equations.

33. Let  $R_s = R$ . If  $R_1 = 50 \Omega$  and  $R_2 = 25 \Omega$  and  $I = 0.15 \text{ A}$ , find  $V$ .

34. Let  $R_p = R$ . If  $R_1 = 50 \Omega$  and  $R_2 = 25 \Omega$  and  $I = 0.15 \text{ A}$ , find  $V$ .

35. Given  $R = 110 \Omega$ ,  $l = 1.0 \text{ m}$ , and  $A = 22 \times 10^{-6} \text{ m}^2$ , find  $\rho$ .

### Part 6: Graphing and Functions

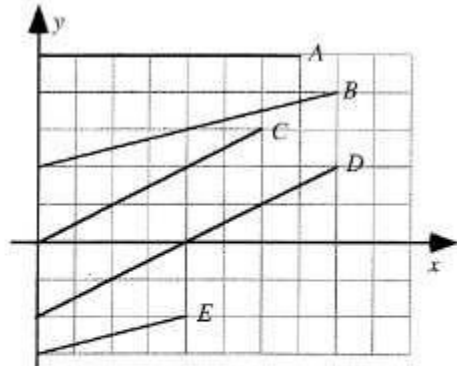
A greater emphasis has been placed on conceptual questions and graphing on the AP exam. Below you will find a few example concept questions that review foundational knowledge of graphs. Ideally you won't need to review, but you may need to review some math to complete these tasks. At the end of this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

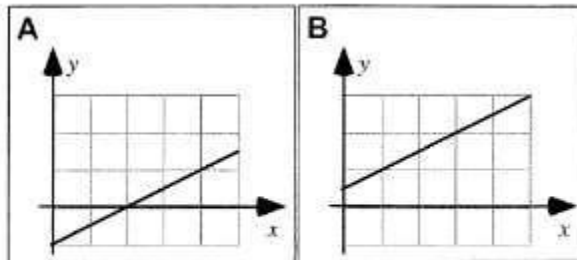


Rank the slopes of the lines in this graph.

<input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/>	OR	<input style="width: 100%; height: 20px;" type="checkbox"/>	<input style="width: 100%; height: 20px;" type="checkbox"/>	<input style="width: 100%; height: 20px;" type="checkbox"/>
1	2	3	4	5		All	All	Cannot
Greatest				Least		the same	zero	determine

Explain your reasoning.

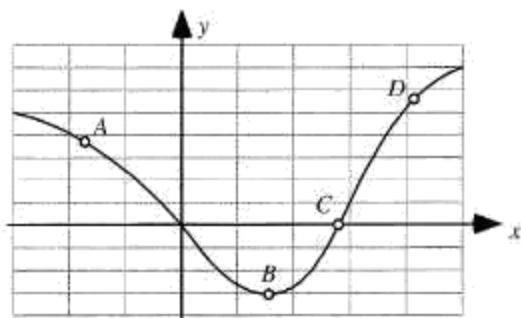
Shown are two graphs.



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				

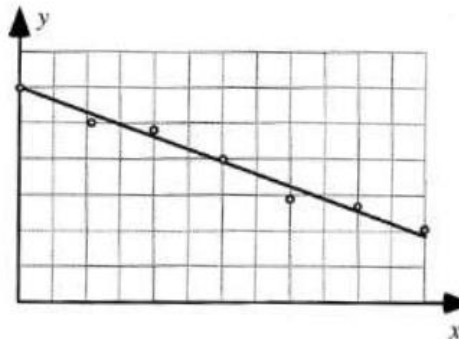
Explain your reasoning.

**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.**



## ***Part 7: Scalars and Vectors Preview***

Hooray for the Internet! Watch the following two videos. 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.

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

### ***Summary 1***

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

### ***Summary 2***

**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 those 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 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!!!***