AP Physics 1 Summer Assignment

1. Scientific Notation:

The following are ordinary physics problems. Write the answer in scientific notation and simplify the units (π=3).

a. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}\,kg}{2.0\times10^{3}\,kg/s^2}} =$ T_s=______________

b. $F = \left(9.0\times10^{9}\,\dfrac{N\cdot m^2}{C^2}\right)\dfrac{(3.2\times10^{-9}C)(9.6\times10^{-9}C)}{(0.32m)^2}$ F=______________

c. $\dfrac{1}{R_p} = \dfrac{1}{4.5\times10^{2}\Omega} + \dfrac{1}{9.4\times10^{2}\Omega}$ R_p=______________

d. $K_{max} = (6.63\times10^{-34}J\cdot s)(7.09\times10^{14}s) - 2.17\times10^{-19}J$ K_{max}=______________

e. $\gamma = 1\Big/\sqrt{1-\dfrac{2.25\times10^{8}\,m/s}{3.00\times10^{8}\,m/s}}$ γ=______________

f. $K = \dfrac{1}{2}(6.6\times10^{2}\text{ kg})(2.11\times10^{4}\text{ m/s})^2 =$ K=______________

g. $(1.33)\sin 25.0^\circ = (1.50)\sin\theta$ θ=______________

2. Solving Equations:

Often problems on the AP exam are done with variables only. Solve for the variable indicated. Don't let the different letters confuse you. Manipulate them algebraically as though they were numbers.

a. $K = \frac{1}{2}kx^2$ $\quad ,x =$ ____________

b. $T_p = 2\pi\sqrt{\frac{\ell}{g}}$ $\quad ,g =$ ____________

c. $F_g = G\frac{m_1 m_2}{r^2}$ $\quad ,r =$ ____________

d. $mgh = \frac{1}{2}mv^2$ $\quad ,v =$ ____________

e. $x = x_o + v_o t + \frac{1}{2}at^2$ $\quad ,t =$ ____________

f. $B = \frac{\mu_o}{2\pi}\frac{I}{r}$ $\quad ,r =$ ____________

g. $x_m = \frac{m\lambda L}{d}$ $\quad ,d =$ ____________

h. $pV = nRT$ $\quad ,T =$ ____________

i. $\sin\theta_c = \frac{n_1}{n_2}$ $\quad ,\theta_c =$ ____________

j. $qV = \frac{1}{2}mv^2$ $\quad ,v =$ ____________

3. Conversion

Science uses the ***KMS*** system (*SI*: System Internationale). ***KMS*** stands for kilogram, meter, second. These are the units of choice of physics. The equations in physics depend on unit agreement. So you must convert to ***KMS*** in most problems to arrive at the correct answer.

kilometers (*km*) to meters (*m*) and meters to kilometers
centimeters (*cm*) to meters (*m*) and meters to centimeters
millimeters (*mm*) to meters (*m*) and meters to millimeters
nanometers (*nm*) to meters (*m*) and metes to nanometers
micrometers (*μm*) to meters (*m*)

gram (*g*) to kilogram (*kg*)
Celsius (°*C*) to Kelvin (*K*)
atmospheres (*atm*) to Pascals (*Pa*)
liters (*L*) to cubic meters (m^3)

Other conversions will be taught as they become necessary.

What if you don't know the conversion factors? Colleges want students who can find their own information (so do employers). Hint: Try a good dictionary and look under "measure" or "measurement". Or the Internet? Enjoy.

a. 4008 *g* = ______________ *kg*

b. 1.2 *km* = ______________ *m*

c. 823 *nm* = ______________ *m*

d. 298 *K* = ______________ °*C*

e. 0.77 *m* = ______________ *cm*

f. $8.8\text{x}10^{-8}$ *m* = ______________ *mm*

g. 1.2 *atm* = ______________ *Pa*

h. 25.0 *μm* = ______________ *m*

i. 2.65 *mm* = ______________ *m*

j. 8.23 *m* = ______________ *km*

k. 40.0 *cm* = ______________ *m*

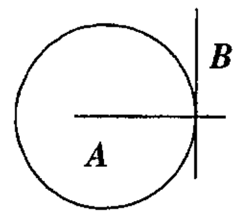
l. $6.23\text{x}10^{-7}$ *m* = ______________ *nm*

m. $1.5\text{x}10^{11}$ *m* = ______________ *km*

4. Geometry

Solve the following geometric problems.

a. Line ***B*** touches the circle at a single point. Line ***A*** extends through the center of the circle.



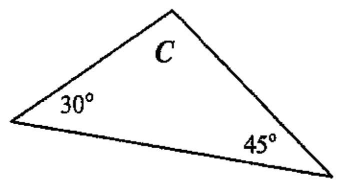
i. What is line ***B*** in reference to the circle?

____

ii. How large is the angle between lines ***A*** and ***B***?

____

b. What is angle ***C***?



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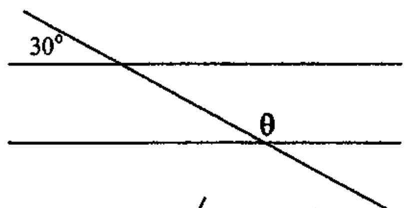
c. What is angle **θ** ?



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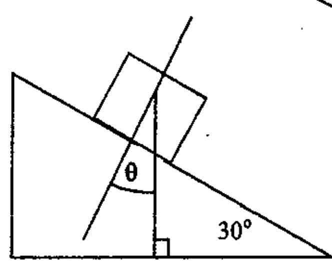
d. How large is *θ*?



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e. The radius of a circle is 5.5 *cm*,

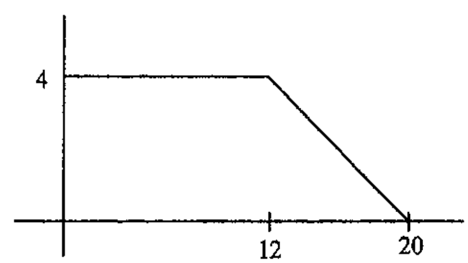
i. What is the circumference in meters?

____

ii. What is its area in square meters?

____

f. What is the area under the curve at the right?



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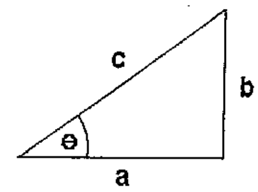
5. Trigonometry

Using the generic triangle to the right, Right Triangle Trigonometry and Pythagorean Theorem solve the following. ***Your calculator must be in degree mode.***



g. $\theta = 55°$ and $c = 32$ *m*, solve for a and b.

____

h. $\theta = 45°$ and $a = 15$ *m/s*, solve for b and c.

____

i. $b = 17.8$ *m* and $\theta = 65°$, solve for a and c.

____

j. $a = 250$ *m* and $b = 180$ *m*, solve for θ and c.

____

k. $a = 25$ *cm* and $c = 32$ *cm*, solve for b and θ.

____

l. $b = 104$ *cm* and $c = 65$ *cm*, solve for a and θ.

____

Vectors

Most of the quantities in physics are vectors. ***This makes proficiency in vectors extremely important***.

Magnitude: Size or extend. The numerical value.

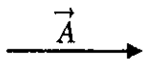
Direction: Alignment or orientation of any position with respect to any other position.

Scalars: A physical quantity described by a single number and units. A quantity described by **magnitude only**.

Examples: time, mass, and temperature

Vector: A physical quantity with **both a magnitude and a direction**. A directional quantity.

Examples: velocity, acceleration, force

Notation: $\vec{A}$ or 

Length of the arrow is proportional to the vectors magnitude.
Direction the arrow points is the direction of the vector.

Negative Vectors

Negative vectors have the same magnitude as their positive counterpart. They are just pointing in the opposite direction.

Vector Addition and subtraction

Think of it as vector addition only. The result of adding vectors is called the resultant. $\vec{R}$

$\vec{A}+\vec{B}=\vec{R}$ 

So if ***A*** has a magnitude of 3 and ***B*** has a magnitude of 2, then ***R*** has a magnitude of 3+2=5.

When you need to subtract one vector from another think of the one being subtracted as being a negative vector. Then add them.

A negative vector has the same length as its positive counterpart, but its direction is reversed.
So if ***A*** has a magnitude of 3 and ***B*** has a magnitude of 2, then ***R*** has a magnitude of 3+(-2)=1.

This is very important. In physics a negative number does not always mean a smaller number. Mathematically −2 is smaller than +2, but in physics these numbers have the same magnitude (size), they just point in different directions (180° apart).

There are two methods of adding vectors

Parallelogram

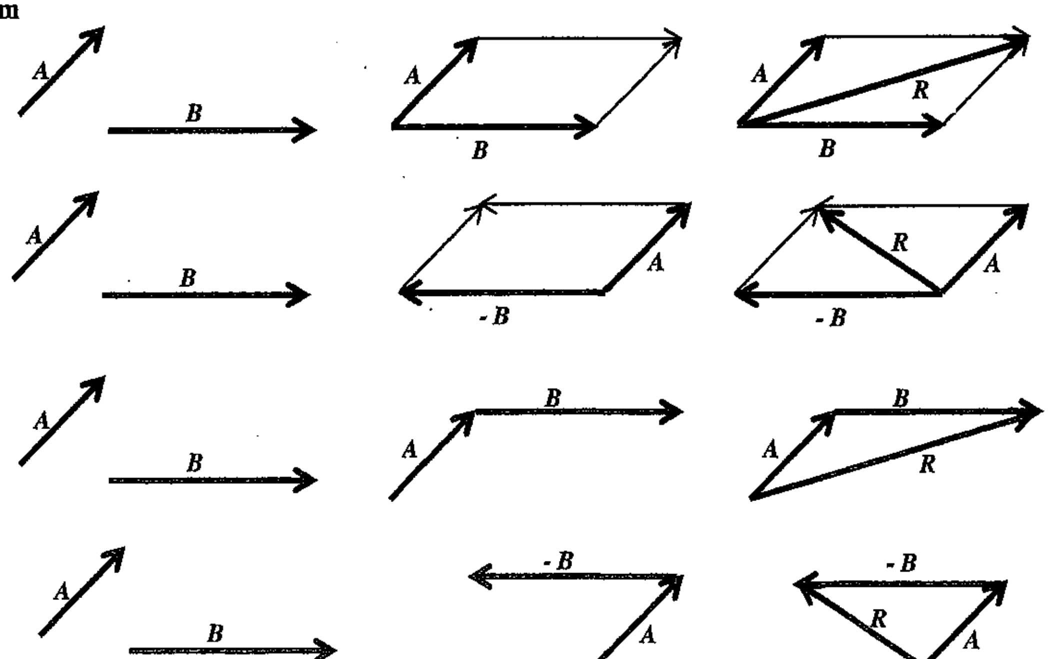
A + B

A − B

Tip to Tail

A + B

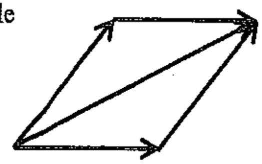
A − B



6. Drawing Resultant Vectors

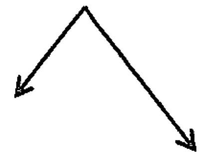
Draw the resultant vector using the parallelogram method of vector addition.

Example

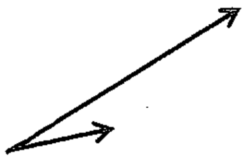


b.

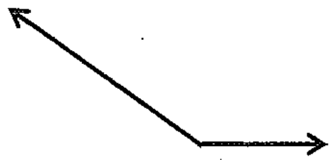
d.



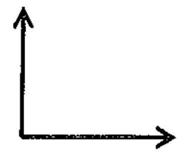
a.



c.

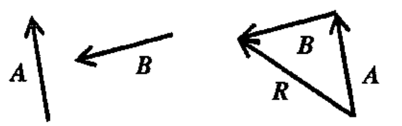


e.

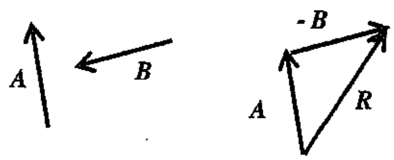


Draw the resultant vector using the tip to tail method of vector addition. Label the resultant as vector ***R***

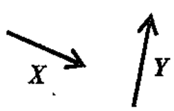
Example 1: $A + B$



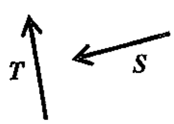
Example 2: $A - B$



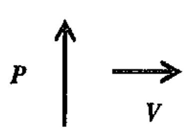
f. $X + Y$



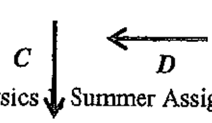
g. $T - S$



h. $P + V$



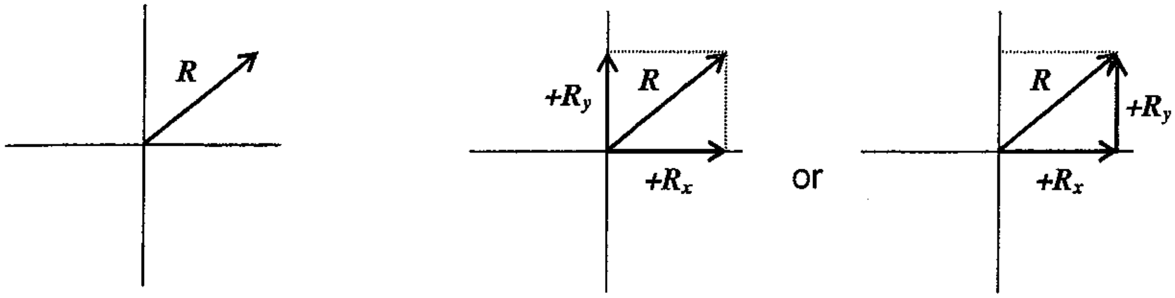
i. $C - D$



Component Vectors

A resultant vector is a vector resulting from the sum of two or more other vectors. Mathematically the resultant has the same magnitude and direction as the total of the vectors that compose the resultant. Could a vector be described by two or more other vectors? Would they have the same total result?

This is the reverse of finding the resultant. You are given the resultant and must find the component vectors on the coordinate axis that describe the resultant.

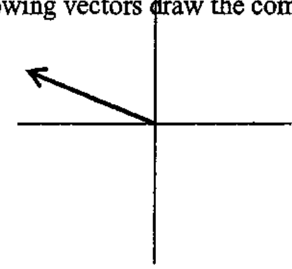


Any vector can be described by an *x* axis vector and a *y* axis vector which summed together mean the exact same thing. The advantage is you can then use plus and minus signs for direction instead of the angle.

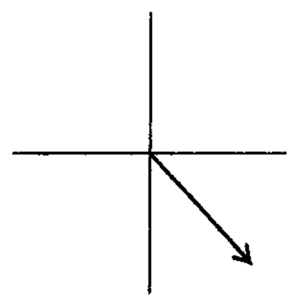
7. Resolving a vector into its components

For the following vectors draw the component vectors along the *x* and *y* axis.

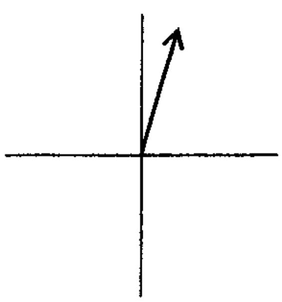
a.



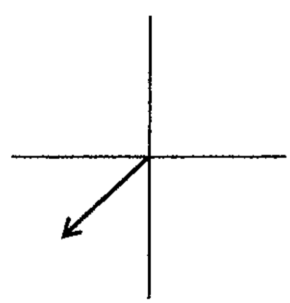
c.



b.



d.



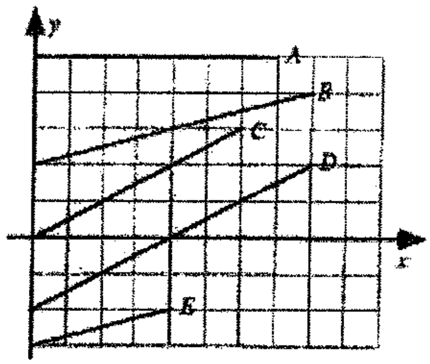
Obviously the quadrant that a vector is in determines the sign of the *x* and *y* component vectors.

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.

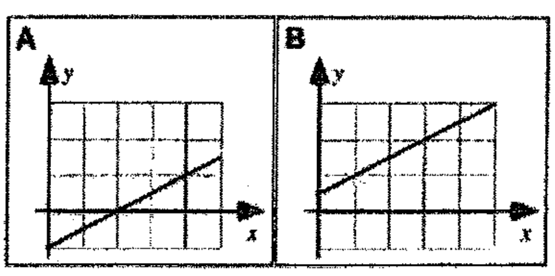


Rank the slopes of the lines in this graph.

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

Explain your reasoning.

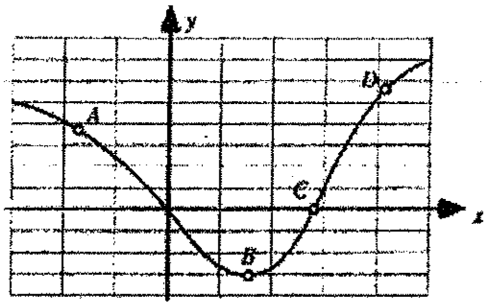
Shown are two graphs.



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.



Rank the slopes of the graph at the labeled points.

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

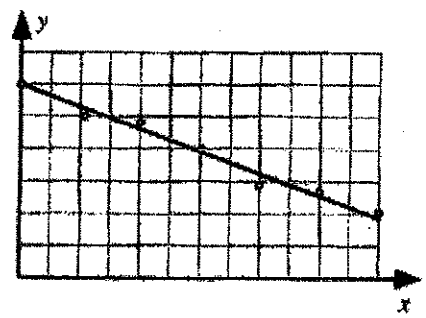
Explain your reasoning.

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."

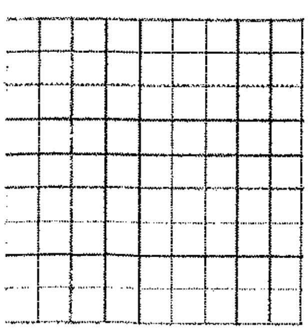
What, if anything, is wrong with this statement? If something is wrong, identify and explain how to correct all errors. If this statement is correct, explain why.



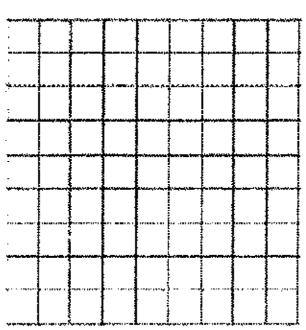
Linear and Non-Linear Functions

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.

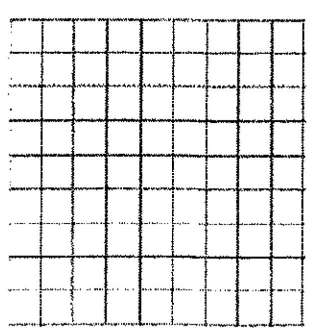
Linear $y = kx$



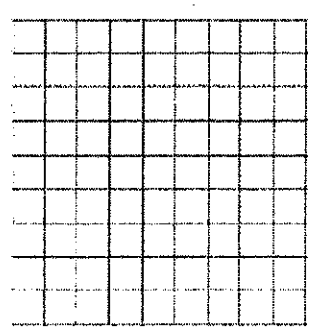
Inverse $y = k/x$



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.

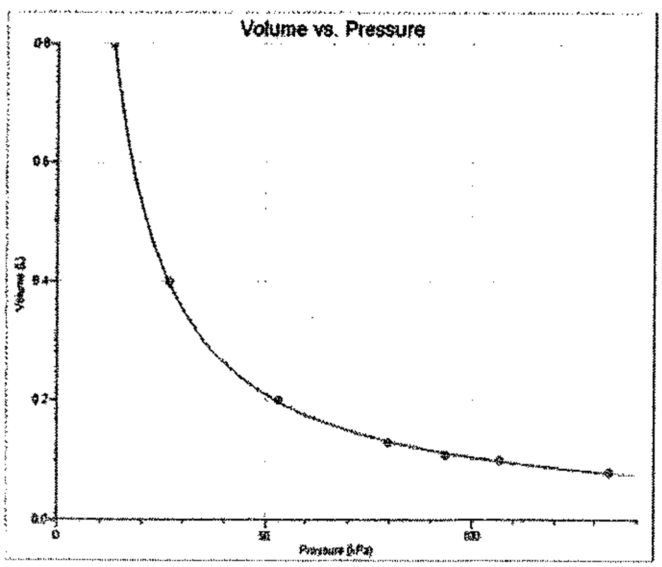
Inverse Graph Vertical Axis:____________________ Horizontal Axis: ____________________

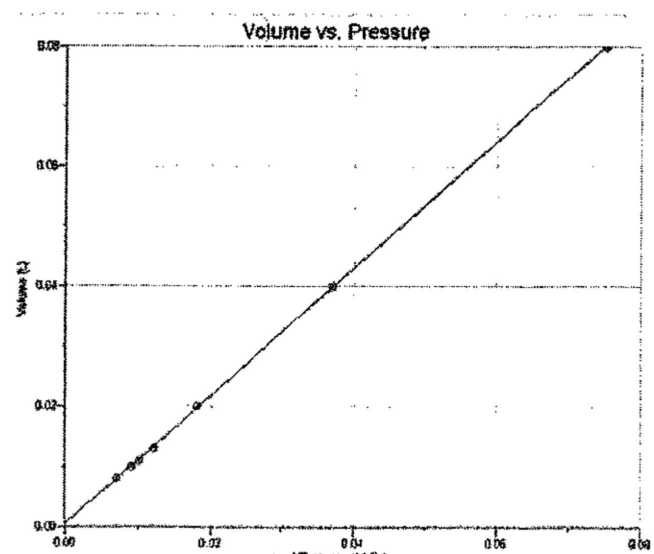
Inverse Square Graph Vertical Axis:____________________ Horizontal Axis: ____________________

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

Chemistry Example

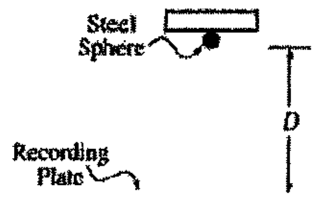
Let's look at an equation you should remember from chemistry. According to Boyle's the law, an ideal gas obeys the following equation $P_1V_1 = P_2V_2 = k$. This states that pressure and volume are inversely related, and the graph on the left shows an inverse shape. Although the equation is equal to a constant, the variables are not in fraction form. One of the variables, pressure in this case, is inverted. This means every pressure data point is divided into one to get the inverse. The graph on the left shows the linear relationship between volume V and the inverse of pressure 1/P. We could now calculate the slope of this linear graph.



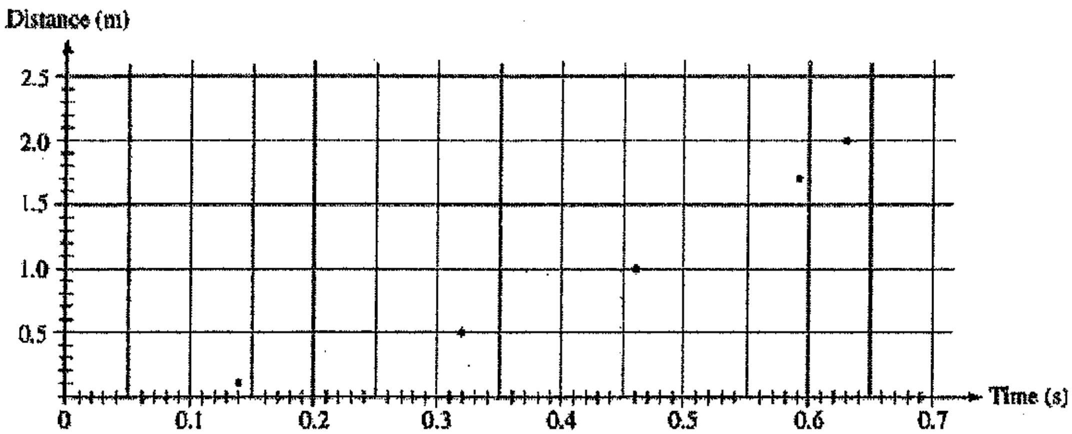


Sample AP Graphing Exercise

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.



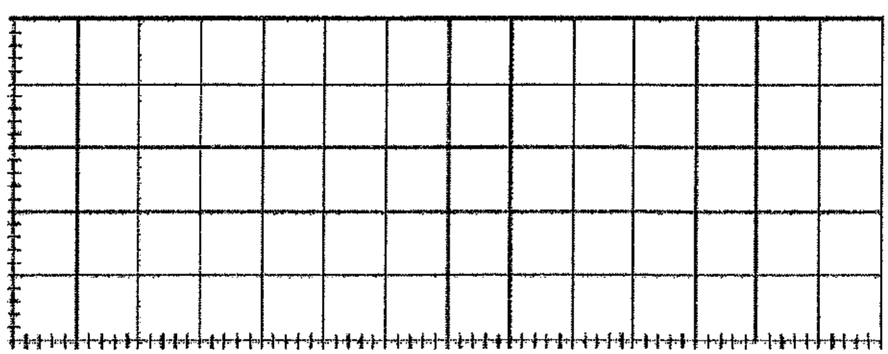
Distance of Fall (m)	0.10	0.50	1.00	1.70	2.00
Time of Fall (s)	0.14	0.32	0.46	0.59	0.63



a) Draw a line of best fit for the distance vs. time graph above.

b) 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?

c) 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.



d) Calculate the value of g by using the slope of the graph.

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!!!***