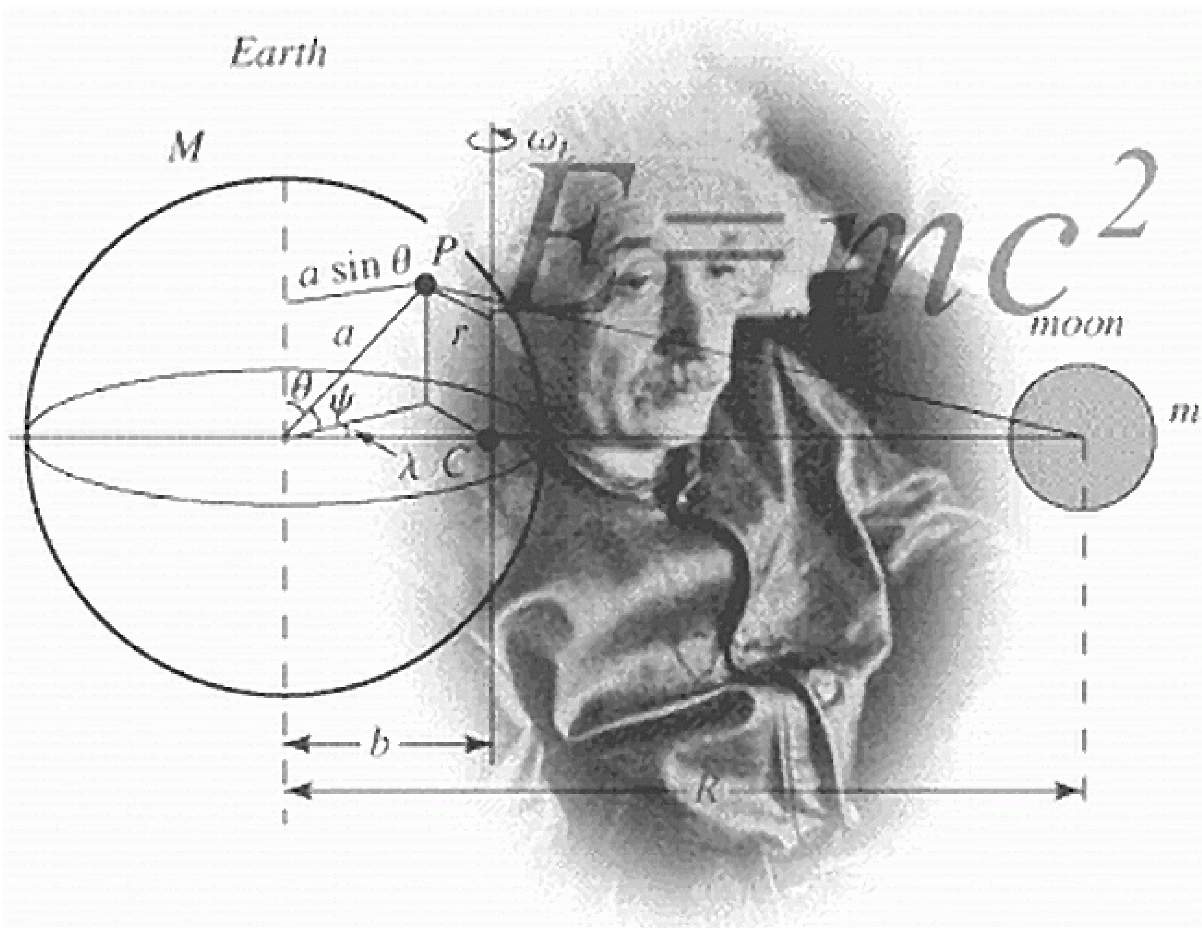
AP PHYSICS 1
SUMMER ASSIGNMENT



2017 - 2018

AP Physics 1

2017 - 2018

Welcome to AP Physics 1! It is a college-level Physics course that is fun, interesting, and challenging on a level you probably have not yet experienced in your high school career. The Advanced Placement (AP) exam will be held in early May, which necessitates a significantly fast pace.

AP Physics 1 requires an exceptional proficiency in algebra, trigonometry, geometry, and graphing. At first, Physics often seems like a course in applied mathematics. While math is heavily employed, it is the *concepts* that are tantamount to truly understanding Physics; it is a science course with math, not vice versa.

This summer assignment will review all prerequisite knowledge expected of you, and will allow us to start on actual Physics subject material immediately when school begins. This packet is mostly a math review that includes mathematical operations that are routine in AP Physics, with an introduction to vectors. It is designed to help you brush up on valuable skills, as well as provide a means to ensure AP Physics 1 is the right course for you. It is the quantity - not the difficulty - of the problems that has the potential to overwhelm; therefore, be sure to space out the completion of the assignment.

By taking the time to review and understand all portions of this assignment, you will help yourself acclimate to the rigor and pacing of AP Physics 1. Use the internet if you must, but these skills are ones you should have already mastered in previous science and/or math courses. It is very important that this assignment be completed individually; it will be a total waste of time to copy it from a friend.

The summer assignment will be due the first week of class, and you will be assessed on its contents within the first three class meetings of the new school year. **Read all directions and show all work neatly on separate paper.** There will be an answer key to the packet posted to the AP Physics 1 class website (please see link at bottom of page) to help ensure you are employing correct methods; the key will be listed under "Summer Assignment". Remember, the final answer is relatively insignificant in the grand scheme of things; it is the *process* that is important.

If you need help with any portion of the assignment, you are welcome (and encouraged) to contact either one of us during the course of the summer. It does not matter which one of us you contact for help or who you may have as a teacher next year – we always work as a team. When we get closer to the beginning of school, we will send out information via "Remind" providing times you may meet us at school and receive more personalized help prior to the assessment.

AP Physics 1 is an amazing opportunity to grow as a critical thinker, problem solver, and exceptional communicator. It will require hard work and significant commitment, but so does anything that is worthwhile. You would never expect to win a race if you didn't train. Similarly, you cannot expect to do well in an AP course (and AP exam) if you do not train academically.

AP Physics 1 is immensely rewarding, but you must take good notes, study, ask questions, read the book, and *understand* the homework. We guarantee that if you do what is asked of you that you will look back at this class with a huge sense of satisfaction! Together, we will work as a team to build the skills you need to be successful on May 8, 2018!

Have a great summer; we greatly look forward to working with you!

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Mrs. Henderson
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Class Website: https://goo.gl/F4n5GD

Link to Packet Solutions: https://goo.gl/z5arRY

"Remind" Sign-up Link: https://www.remind.com/join/ap1201718 *{see reverse side for sign-up instructions}* remind

Sign up for important updates from Mr. Motley and Mrs. Henderson.

Get information for **Heritage High School** right on your phone—not on handouts.

Pick a way to receive messages for **PHYS_AP1_2017-2018**:

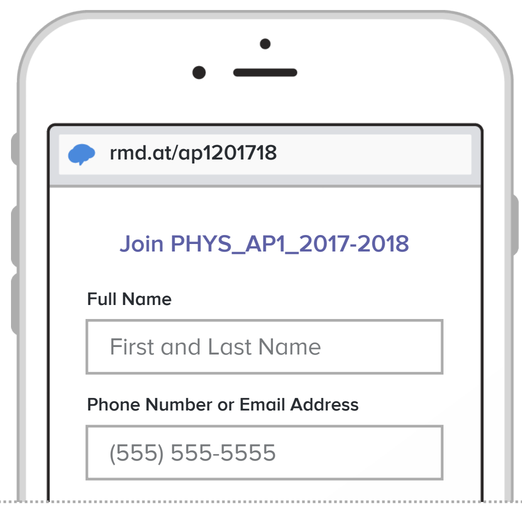
A

If you have a smartphone, get push notifications.

On your iPhone or Android phone, open your web browser and go to the following link:

rmd.at/ap1201718

Follow the instructions to sign up for Remind. You'll be prompted to download the mobile app.



B

If you don't have a smartphone, get text notifications.

Text the message @ap1201718 to the number 81010.

If you're having trouble with 81010, try texting @ap1201718 to (409) 736-7709.

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

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

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

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

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

g. $\left(1.33\right)\sin 25.0^\circ = \left(1.50\right)\sin\theta$ 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. $K = \frac{1}{2}kx^2$ $, x =$ ________________

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

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

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

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

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

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

h. $pV = nRT$ $, T =$ ________________

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

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

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	gram (*g*) to kilogram (*kg*)
centimeters (*cm*) to meters (*m*)	and meters to centimeters	Celsius (^oC) to Kelvin (*K*)
millimeters (*mm*) to meters (*m*)	and meters to millimeters	atmospheres (*atm*) to Pascals (*Pa*)
nanometers (*nm*) to meters (*m*)	and metes to nanometers	liters (*L*) to cubic meters (m^3)
micrometers (μm) to meters (*m*)		

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* = _______________ ^oC

e. 0.77 *m* = _______________ *cm*

f. 8.8×10^{-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*

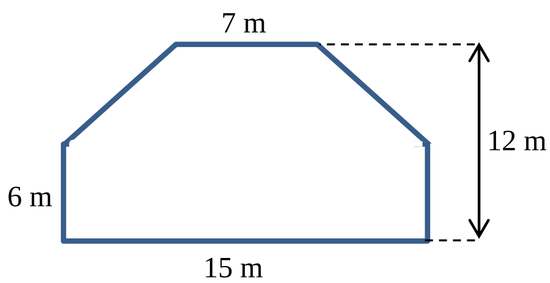
l. 6.23×10^{-7} *m* = _______________ *nm*

m. 1.5×10^{11} *m* = _______________ *km*

Part 2: Geometry

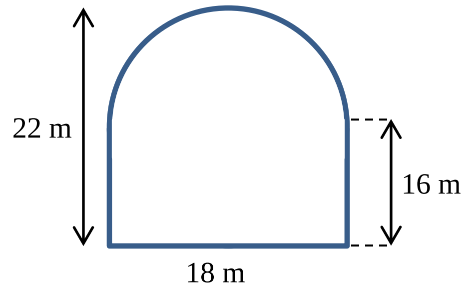
Calculate the area of the following shapes. It may be necessary to break up the figure into common shapes.

1.



Area = __________

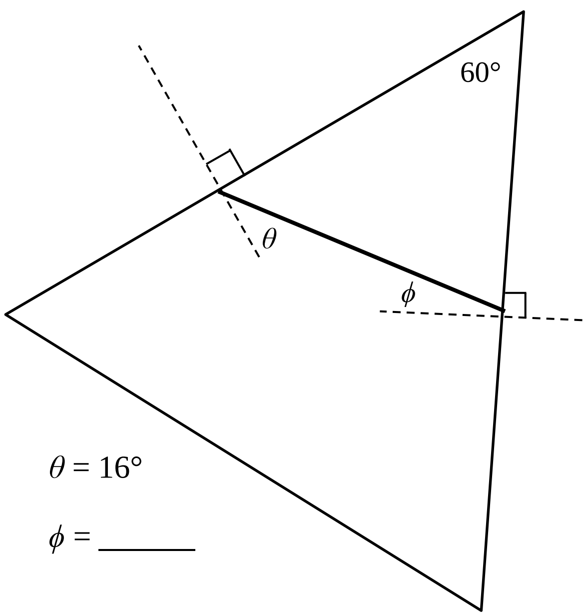
2.



Area = __________

Calculate the unknown angle values for questions 3-6.

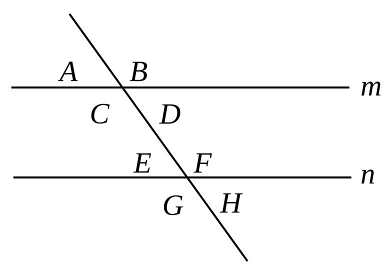
3.



θ = 16°

ϕ = ________

4.

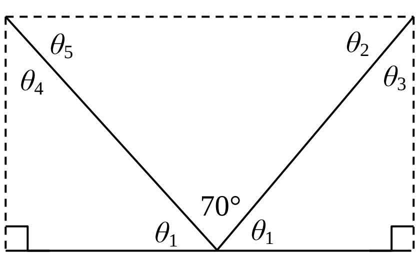


Lines *m* and *n* are parallel.

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

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

5.



θ_1 = ______

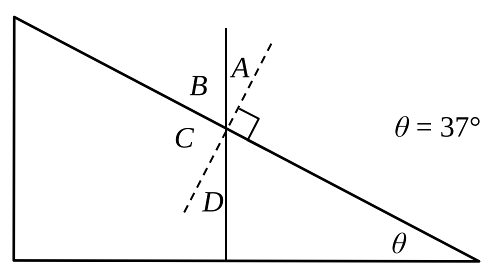
θ_2 = ______

θ_3 = ______

θ_4 = ______

θ_5 = ______

6.



θ = 37°

A = ______ *B* = ______

C = ______ *D* = ______

Part 4: Trigonometry

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

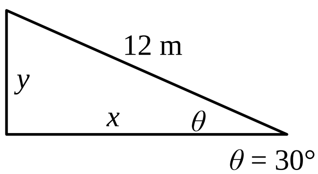
$\sin\theta =$

$\cos\theta =$

$\tan\theta =$

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!)

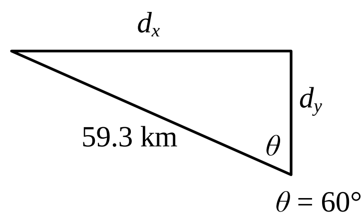
1.



$y =$ ________

$x =$ ________

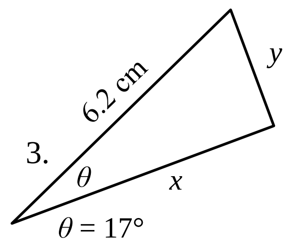
2.



$d_x =$ _______

$d_y =$ _______

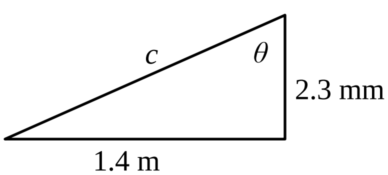
3.



$x =$ _____

$y =$ _____

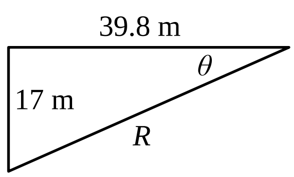
4.



$c =$ _______

$\theta =$ _______

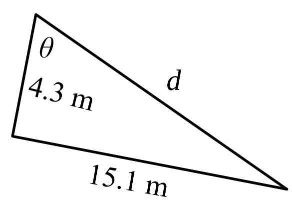
5.



$R =$ _______

$\theta =$ _______

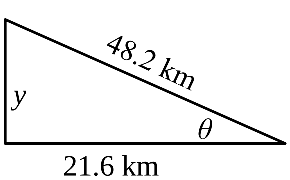
6.



$d =$ _______

$\theta =$ _______

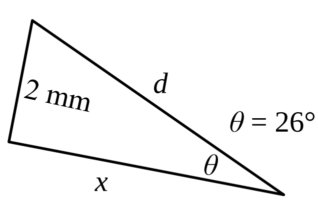
7.



$y =$ _______

$\theta =$ _______

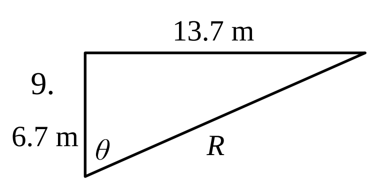
8.



$x =$ _______

$d =$ _______

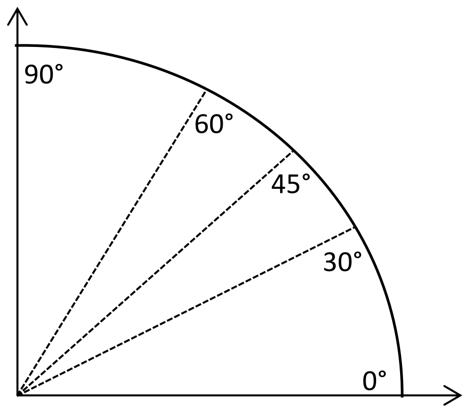
9.



$R =$ _______

$\theta =$ _______

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?

Relationships Among Variables: Consider the following equations:

$$z = \frac{x}{y} \qquad c = ab \qquad l = m - n \qquad r = \frac{s^2}{t^2}.$$

1. As x increases and y stays constant, z ______________________.
2. As y increases and x stays constant, z ______________________.
3. As x increases and z stays constant, y ______________________.
4. As a increases and c stays constant, b ______________________.
5. As c increases and b stays constant, a ______________________.
6. As b increases and a stays constant, c ______________________.
7. As n increases and m stays constant, l ______________________.
8. As l increases and n stays constant, m ______________________.
9. If s is tripled and t stays constant, r is multiplied by ______________________.
10. If t is doubled and s stays constant, r is multiplied by ______________________.

Systems of Equations: Use the equations in each problem to solve for the specified variable in the given terms; simplify.

1. $F_f = \mu F_N$ and $F_N = mg\cos\theta$. Solve for μ in terms of F_f, m, g, and θ.

$F_f = \mu F_N$

$(F_N) = mg\cos\theta$

$F_f = \mu mg\cos\theta$

$\mu = \frac{F_f}{mg\cos\theta}$

2. $F_1 + F_2 = F_T$ and $F_1 \cdot d_1 = F_2 \cdot d_2$. Solve for F_1 in terms of F_T, d_1, and d_2.

3. $F_c = ma_c$ and $a_c = \frac{v^2}{r}$. Solve for r in terms of F_c, m, and v.

4. $T = 2\pi\sqrt{\frac{L}{g}}$ and $T = \frac{1}{f}$. Solve for L in terms of π, g, and f.

PHYSICS SKILLS
GRAPHING TECHNIQUES

Frequently an investigation will involve finding out how changing one quantity affects the value of another. The quantity that is deliberately manipulated is called the *independent variable.* The quantity that changes as a result of the independent variable is called the *dependent variable.*

The relationship between the independent and dependent variables may not be obvious from simply looking at the written data. However, if one quantity is plotted against the other, the resulting graph gives evidence of what sort of relationship, if any, exists between the variables. When plotting a graph, take the following steps.

1. Identify the independent and dependent variables.

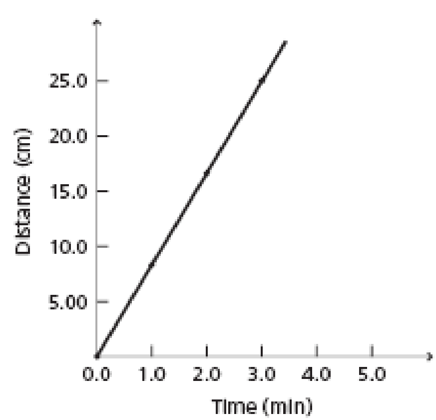
2. Choose your scale carefully. Make your graph as large as possible by spreading out the data on each axis. Let each space stand for a convenient amount. For example, choosing three spaces equal to ten is not convenient because each space does not divide evenly into ten. Choosing five spaces equal to ten would be better. Each axis must show the numbers you have chosen as your scale. However, to avoid a cluttered appearance, you do not need to number every space.

3. All graphs do not go through the origin (0,0). Think about your experiment and decide if the data would logically include a (0,0) point. For example, if a cart is at rest when you start the timer, then your graph of speed versus time would go through the origin. If the cart is already in motion when you start the timer, your graph will not go through the origin.

4. Plot the independent variable on the horizontal (x) axis and the dependent variable on the vertical (y) axis. Plot each data point. Darken the data points.

5. If the data points appear to lie roughly in a straight line, draw the best straight line you can with a ruler and a sharp pencil. Have the line go through as many points as possible with approximately the same number of points above the line as below. **Never connect the dots**.
If the points do not form a straight line, draw the best smooth curve possible.

Distance versus Time



6. Title your graph. The title should dearly state the purpose of the graph and include the independent and dependent variables.

7. Label each axis with the name of the variable and the unit. Using a ruler, darken the lines representing each axis.

The graph shown on the next page was prepared using good graphing techniques. Go back and check each of the items mentioned above.

CW: Graph the following sets of data using proper graphing techniques.
The first column refers to the *y*-axis and the second column to the *x*-axis

1.

Volume (mL)	**Pressure** (torr)
800	100
400	200
200	400
133	600
114	700
100	800
80	1000

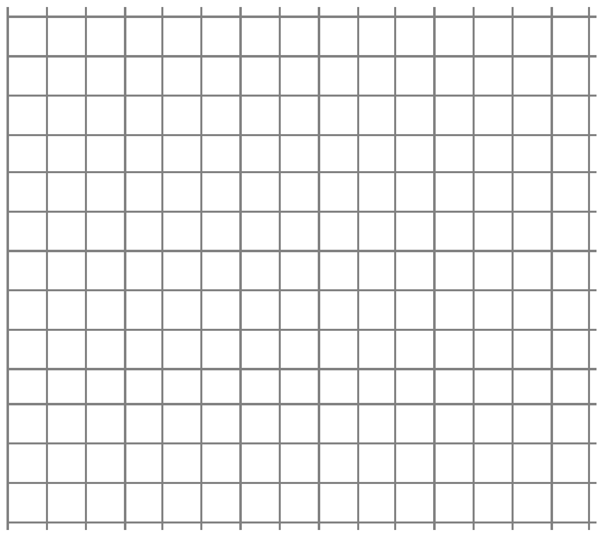
What type of curve did you obtain?

2.

Position (m)	**Time** (s)
0	0
5	1
20	2
45	3
80	4
125	5

What type of curve did you obtain?

3.



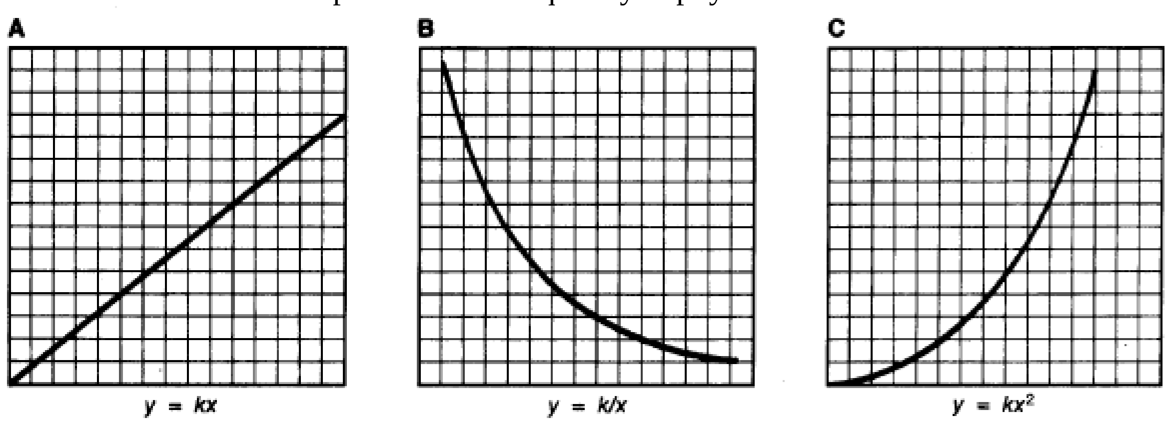
Speed (m/s)	**Time** (s)
0	0
20	1
45	2
60	3
84	4
105	5

What type of curve did you obtain?

PART V. INTERPRETING GRAPHS

In laboratory investigations, you generally control one variable and measure the effect it has on another variable while you hold all other factors constant. For example, you might vary the force on a cart and measure its acceleration while you keep the mass of the cart constant. After the data are collected, you then make a graph of acceleration versus force, using the techniques for good graphing. The graph gives you a better understanding of the relationship between the two variables.

There are **three** relationships that occur frequently in physics:



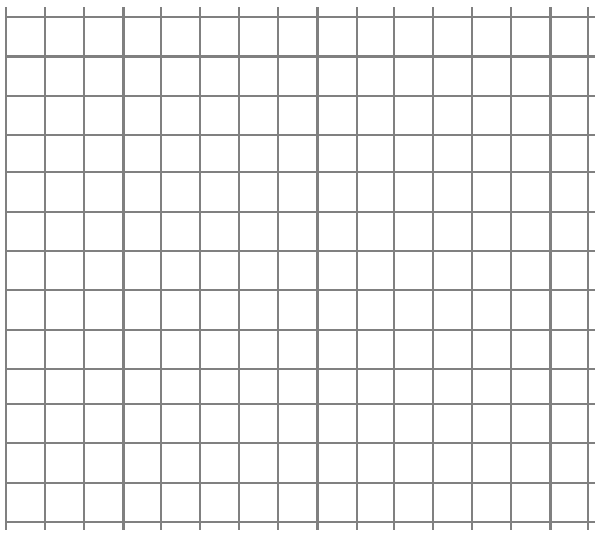
Graph A: If the dependent variable varies *directly* with the independent variable, the graph will be a *straight line*

Graph B: If *y* varies *inversely* with *x*, the graph will be a *hyperbola*.

Graph C. If *y* varies *directly with the square* of *x*, the graph is a *parabola.*

Reading from the graph between data points is called *interpolation.* Reading from the graph beyond the limits of your experimentally determined data points is called *extrapolation.* Extrapolation must be used with caution because you cannot be sure that the relationship between the variables remains the same beyond the limits of your investigation.

1. Suppose you recorded the following data during a study of the relationship of force and acceleration. Prepare a graph showing these data.



Force (N)	**Acceleration** (m/s^2)
10	6.0
20	12.5
30	19.0
40	25.0

a. Describe the relationship between force and acceleration as shown by the graph.

b. What is the slope of the graph? Remember to include units with your slope. (1 N: 1 $kg.m/s^2$)

c. What physical quantity does the slope represent?

d. Write an equation for the line.

e. What is the value of the force for an acceleration of 15 m/s^2?

f. What is the acceleration when the force is 50.0 N?

Vectors

Most of the quantities in physics are vectors. ***<u>This makes proficiency in vectors extremely important</u>***.

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 **<u>magnitude only</u>**.

Examples: time, mass, and temperature

Vector: A physical quantity with **<u>both a magnitude and a direction</u>**. A directional quantity.

Examples: velocity, acceleration, force

Notation: $\vec{A}$ or $\xrightarrow{\vec{A}}$ <u>Length</u> of the arrow is <u>proportional to the vectors magnitude</u>. <u>Direction</u> the arrow points <u>is the direction of the vector</u>.

Negative Vectors

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

$\xrightarrow{\vec{A}}$ $\xleftarrow{-\vec{A}}$

Vector Addition and subtraction

Think of it as vector addition only. The result of adding vectors is called the <u>result</u>ant. $\vec{R}$

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

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.

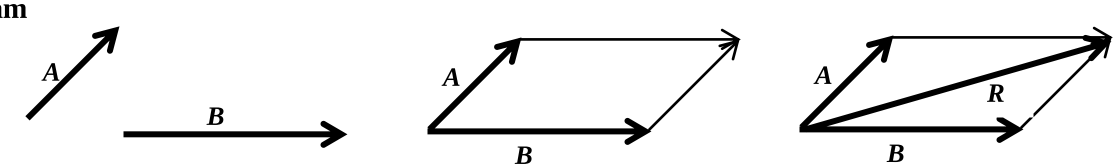
A negative vector has the same length as its positive counterpart, but its direction is reversed.
So if ***A*** has a magnitude of 3 and ***B*** has a magnitude of 2, then ***R*** has a magnitude of 3+(-2)=1.

<u>This is very important</u>. 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^o apart).

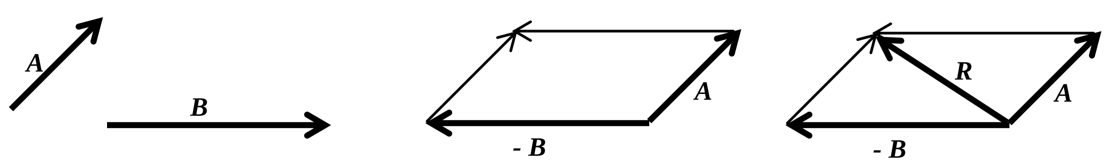
There are two methods of adding vectors

Parallelogram

A + ***B***

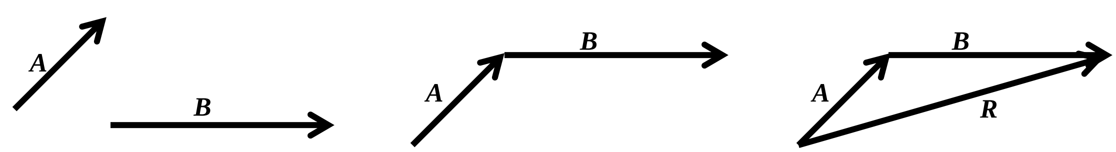


A – ***B***

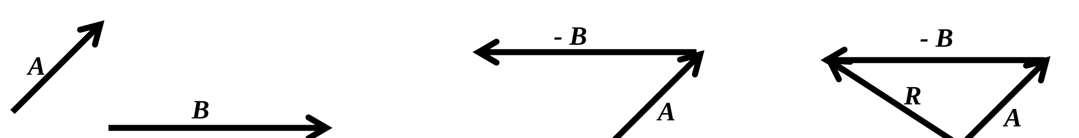


Tip to Tail

A + ***B***



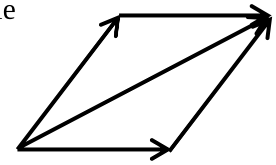
A – ***B***



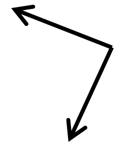
6. Drawing Resultant Vectors

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

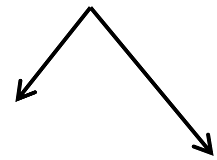
Example



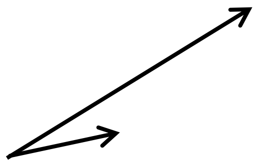
b.



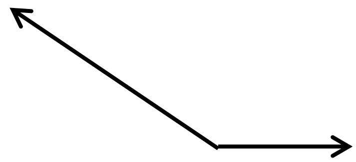
d.



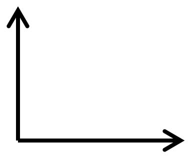
a.



c.

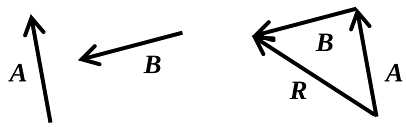


e.

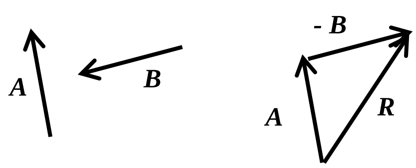


Draw the resultant vector using the tip to tail method of vector addition. Label the resultant as vector ***R***

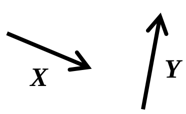
Example 1: ***A*** + ***B***



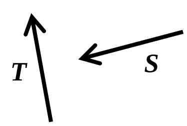
Example 2: ***A*** – ***B***



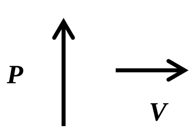
f. ***X*** + ***Y***



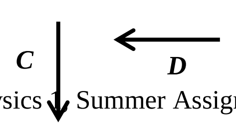
g. ***T*** – ***S***



h. ***P*** + ***V***



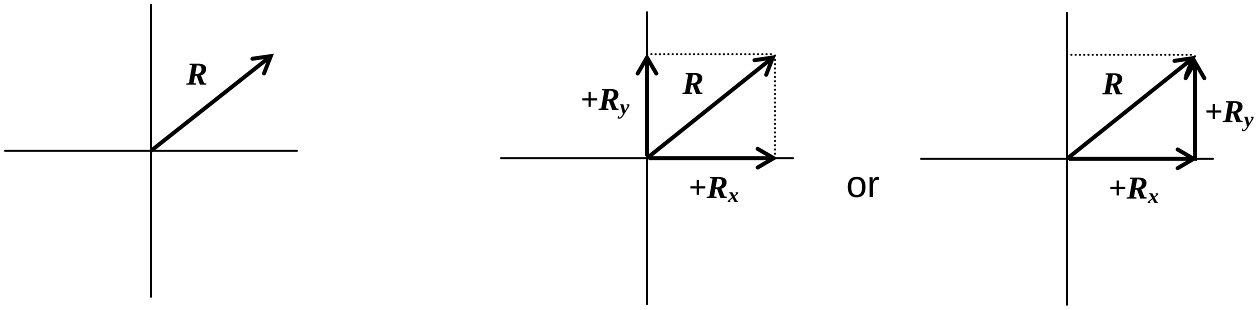
i. ***C*** – ***D***



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.

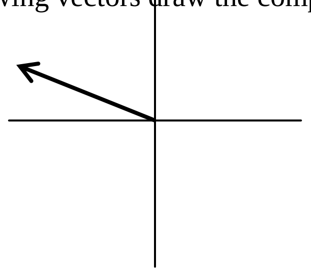


Any vector can be described by an ***x*** axis vector and a ***y*** axis vector which summed together mean the exact same thing. The advantage is you can then use plus and minus signs for direction instead of the angle.

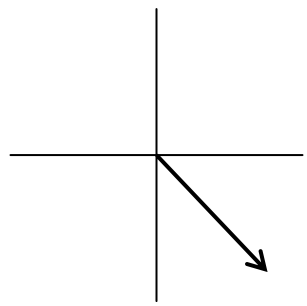
7. Resolving a vector into its components

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

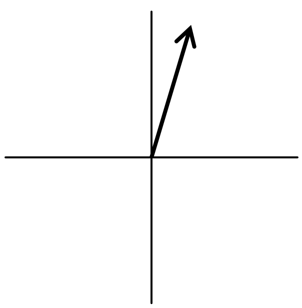
a.



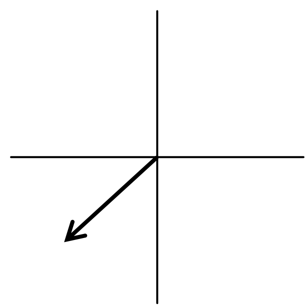
c.



b.



d.



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