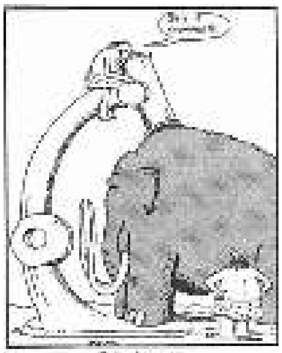
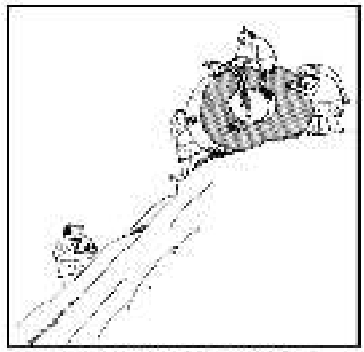
AP-1 Physics Name: ____________________

Summary Assignment Date______________ Period _______

I. The attached pages contain a brief review, hints, and example problems. It is hoped that combined with your previous math knowledge this assignment is merely a review and a means to brush up before school begins in the fall. Please read the text and instructions throughout.

II.





Left: Ponder your point of view and scale.
Middle: "Test it" is only sometimes the best answer.
Right: Know how to use your tools.

Cartoons from various Far Side Comics by Gary Larson

III. When is this assignment due?

Due on our second day of class.

MATH REVIEW

1. The following are ordinary physics calculations. Write the answer in the space provided in scientific notation (when appropriate) and simplify the units. (Scientific notation is used when it takes less time to write than the ordinary number does. As an example 200 is easier to write than 2.00×10^2, but 2.00×10^8 is easier to write than 200,000,000). Do your best to cancel units and attempt to show the simplified units in the final answer.

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

b. $KE = \dfrac{1}{2}\left(6.6\times10^{2}\ kg\right)\left(2.11\times10^{4}\ m/s\right)^2 =$ $KE =$ ______________

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

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

e. $e = \dfrac{1.7\times10^{3}\ J - 3.3\times10^{2}\ J}{1.7\times10^{3}\ J} =$ $e =$ ______________

f. $1.33\sin 25.0^\circ = 1.50\sin\theta$ $\theta =$ ______________

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

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

2. 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. You may do the intermediate algebra steps on scrap. You do not have to show this work here. Write your answers CLEARLY in the spaces provided!

a. $v^2 = v_o{}^2 + 2a(x - x_o)$, $a =$ ________________

b. $K = \frac{1}{2}kx^2$, $x =$ ________________

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

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

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

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

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

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

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

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

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

l. $\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$, $s_i =$ ________________

3. Science uses the ***MKS*** system of units (or ***SI***: System Internationale). ***MKS*** stands for: meter, kilogram, and second. These are the units of choice in physics. The equations in physics require the units on both sides of the equal sign to agree. In most problems you must convert everything to ***MKS*** units in order to arrive at the correct answer. You will need to know (or find) the following conversions:

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? Try the Internet!

Any equality can be used as a conversion factor. For example, if A = B, then the fraction "A over B" and "B over A" both are equal to the number 1! So, if you multiply any quantity by either of those fractions you will not be changing the value; you will simply be "translating" it from one set of units into another. This is known as the "factor-label" method for unit conversions. Let's try a simple one.

Ex. To convert $4,897.62 to cents you will need to know the equality that relates dollars and cents. We all know $1 = 100 cents. This equality provides us with 2 different conversion factors: $\left(\frac{\$1}{100cents}\right)$ or $\left(\frac{100cents}{\$1}\right)$. We need to choose the one that will allow the units to cancel appropriately when we multiply our original quantity by one of these fractions. Hint: do NOT write your fractions on one line with a slash (as A/B). Write them as a 2 line fraction with a horizontal division line between them (as shown below).

So, $\$4{,}897.62 \times \left(\frac{100cents}{\$1}\right)$ = __489,762______cents.

Convert the following quantities ***SHOWING the conversion factors or formulas used in the space provided***. Write your final answer on the line provided. Recall the picket-fence method from chemistry?

a. 4008 *g* = ________________ *kg*

b. 1.2 *km* = ________________ *m*

c. 823 *nm* = ________________ *m*

d. 298 *K* = ________________ ^{o}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. 5.4 *L* = ________________ m^3

l. 40.0 *cm* = ________________ *m*

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

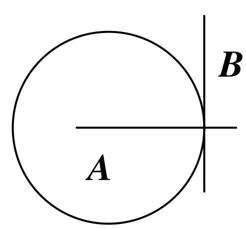
n. $1.5\text{x}10^{11}$ *m* = ________________ *km*

4. 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?

____

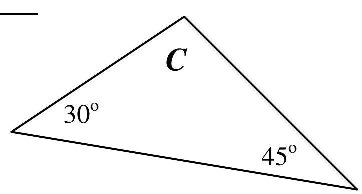


ii. How large is the angle between lines ***A*** and ***B***?

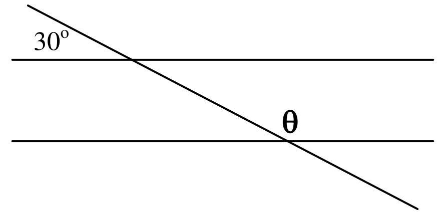
____

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

____



c. What is angle θ ?



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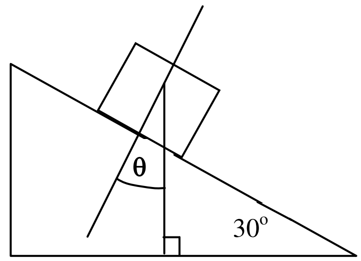
d. How large is *θ*?



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

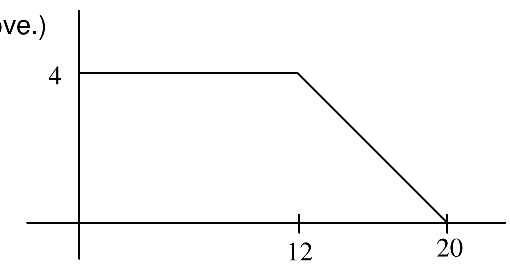
i. What is the circumference in <u>meters</u>? (Show formula, substitution with units, and unit conversions.)

____

ii. What is its area in <u>square meters</u>? (Show all work as above.)

____

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



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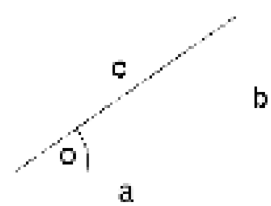
5. Using the generic triangle to the right, Right Triangle Trigonometry, and the Pythagorean Theorem solve the following. ***<u>Your calculator must be in degree mode.</u>*** (Pay attention to units!)



a. θ = 55° and ***c*** = 32 *m*, solve for ***a*** and ***b***.

a = ________________ b = ________________

b. θ = 45° and ***a*** = 15 *m/s*, solve for ***b*** and ***c***.

b = ________________ c = ________________

c. ***b*** = 17.8 *m* and θ = 65°, solve for ***a*** and ***c***.

a = ________________ c = ________________

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

θ = ________________ c = ________________

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

b = ________________ θ = ________________

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

a = ________________ θ = ________________

Vectors

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

Magnitude: Size or extent. The numerical value with its unit.

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

Scalars: A physical quantity described by a single number and its 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 $\xrightarrow{\vec{A}}$ 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.

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

Vector Addition and Subtraction in 1-dimension

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

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

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.

$\vec{A}-\vec{B}$ is really $\vec{A}+-\vec{B}=\vec{R}$ $\xrightarrow{\vec{A}}$ + $\xleftarrow{-\vec{B}}$ = $\xrightarrow{\vec{R}}$

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.

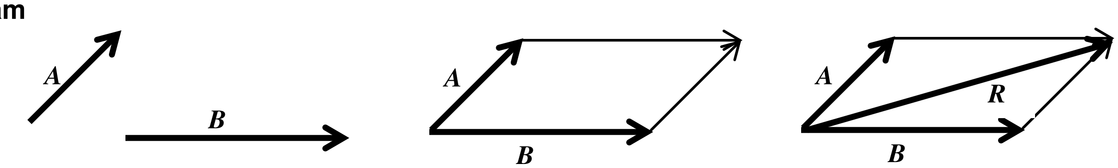
This is very important. Mathematically –2 is smaller than +2, but in physics these numbers have the same magnitude (size), they just point in different directions (180° apart).

Vector Addition and Subtraction in 2-dimensions

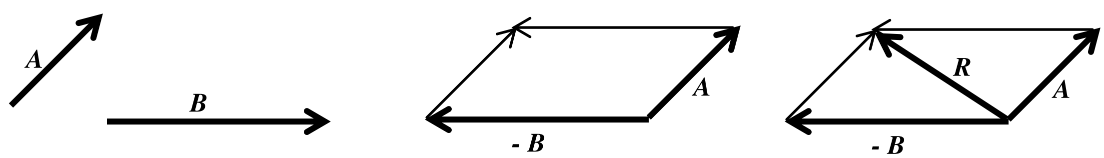
There are two methods of adding vectors

Parallelogram

A + ***B***

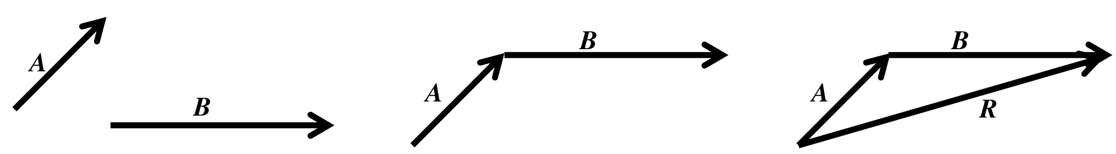


A – ***B***

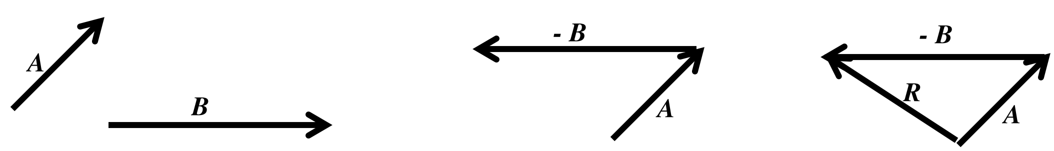


Head to Tail

A + ***B***



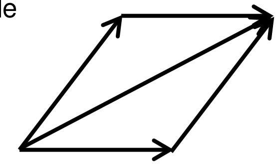
A – ***B***



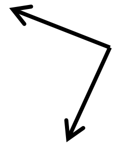
It is readily apparent that both methods arrive at the exact same solution since either method is essentially a parallelogram. It is useful to understand both systems. In some problems one method is advantageous, while in other problems the alternative method is superior. Also, you can verify for yourself that order is not important. **A** + **B** yields the same resultant as **B** + **A**. Usually, if one vector is along an axis, it is easier to start with that vector.

6. Draw and label the resultant **R** vector using the parallelogram method of vector addition.

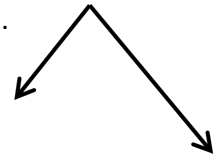
Example



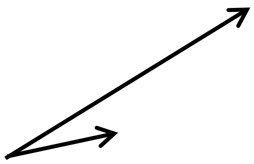
b.



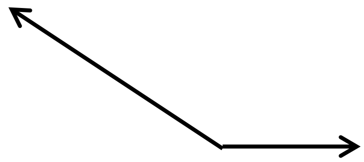
d.



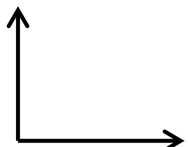
a.



c.

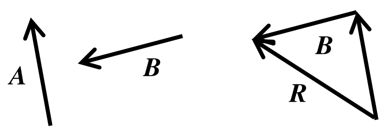


e.

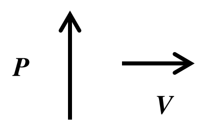


7. Draw the resultant vector using the head to tail method of vector addition. Label the resultant as vector ***R***. (You will need a protractor to try and get the orientations as accurate as possible,)

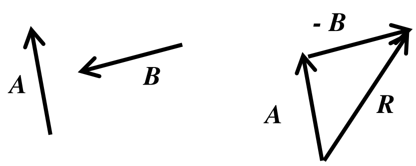
Example 1: ***A*** + ***B***



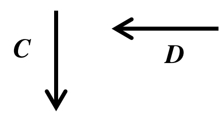
c. ***P*** + ***V***



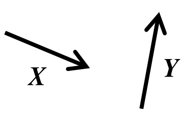
Example 2: ***A*** – ***B***



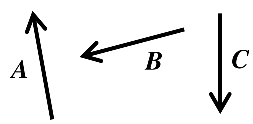
d. ***C*** – ***D***



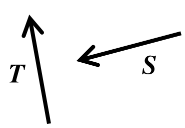
a. ***X*** + ***Y***



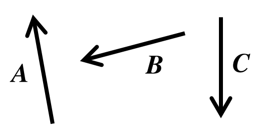
e. ***A*** + ***B*** + ***C***



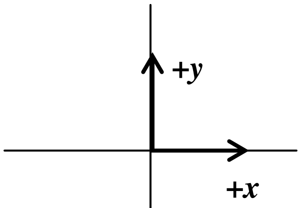
b. ***T*** – ***S***

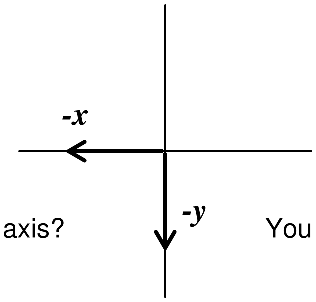


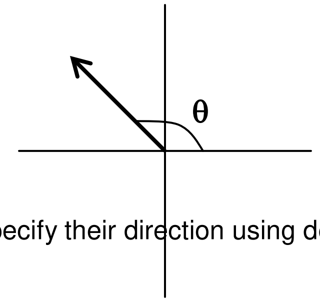
f. ***A*** – ***B*** – ***C***



Direction: What does positive or negative direction mean? How is it referenced? The answer is the coordinate axis system. **In physics a coordinate axis system is used to give a problem a frame of reference.** Positive direction is a vector pointing in the positive ***x*** or positive ***y*** direction, while a negative vector points in the negative ***x*** or negative ***y*** direction (This also applies to the ***z*** direction, which will be used sparingly in this course).





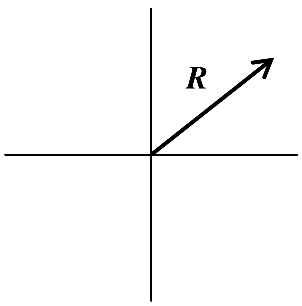


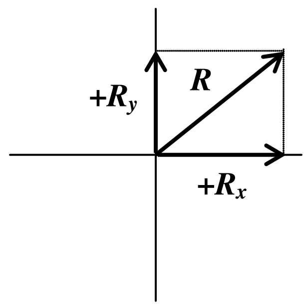
What about vectors that don't fall on the axis? You may just specify their direction using degrees measured from the +x axis.

Vector Components

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.





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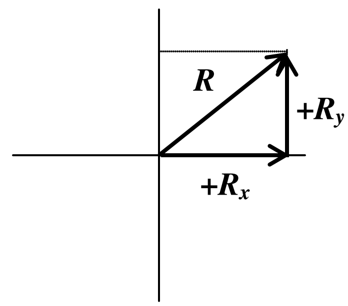
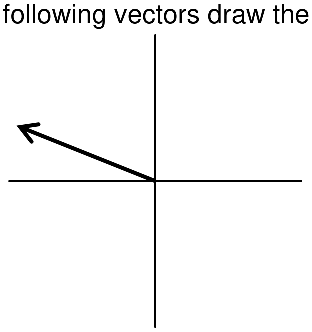


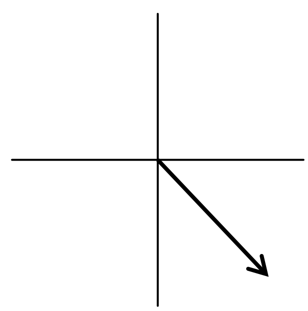
Any vector can be described by an ***x***-axis vector and a ***y***-axis vector which summed together mean the exact same thing. The advantage is you can then use plus and minus signs for direction instead of the angle.

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

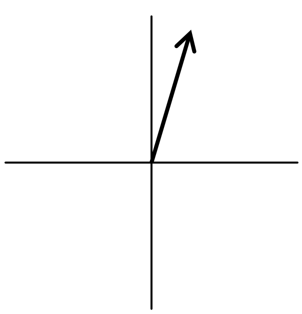
a.



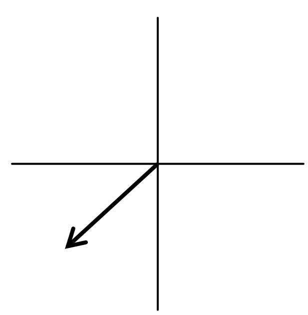
c.



b.



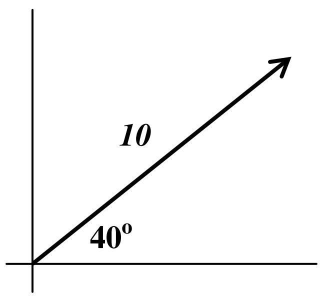
d.

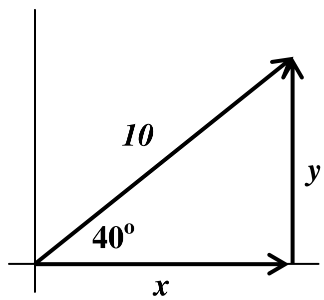


Obviously the quadrant that a vector is in determines the sign of the ***x*** and ***y*** component vectors.

Trigonometry and Vectors

Given a vector, you can now draw the ***x*** and ***y*** component vectors. The sum of vectors ***x*** and ***y*** describe the vector exactly. Again, any math done with the component vectors will be as valid as with the original vector. The advantage is that math on the ***x*** and/or ***y*** axis is greatly simplified since direction can be specified with plus and minus signs instead of degrees. But, how do you mathematically find the length of the component vectors? Use trigonometry.





$$\cos\theta = \frac{adj}{hyp} \qquad \sin\theta = \frac{opp}{hyp}$$

$$adj = hyp\cos\theta \qquad opp = hyp\sin\theta$$

$$x = hyp\cos\theta \qquad y = hyp\sin\theta$$

$$x = 10\cos 40^o \qquad y = 10\sin 40^o$$

$$x = 7.66 \qquad y = 6.43$$

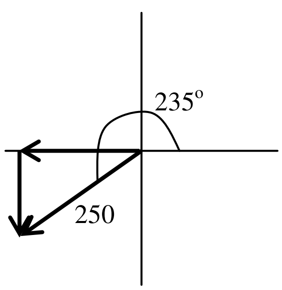
9. Solve the following problems. You will be converting from a polar vector, where direction is specified in ***degrees measured counterclockwise from east***, to component vectors along the ***x*** and ***y*** axis. Remember the plus and minus signs on you answers. They correspond with the quadrant the original vector is in.

   Hint: Draw the vector first to help you see the quadrant. Anticipate the sign on the ***x*** and ***y*** vectors. Do not bother to change the angle to less than 90°. Using the number given will result in the correct + and – signs.

   The first number will be the magnitude (length of the vector) and the second the degrees from east.

   Your calculator must be in degree mode. Label & box your component answers.

   Example: 250 at 235°



$$x = hyp\cos\theta$$
$$x = 250\cos 235^o$$
$$x = -143$$

$$y = hyp\sin\theta$$
$$y = 250\sin 235^o$$
$$y = -205$$

   a. 89 m at 150°

   b. 6.50 m/s at 345°

c. 0.00556 m/s^2 at 60^o

d. 7.5×10^4 at 180^o

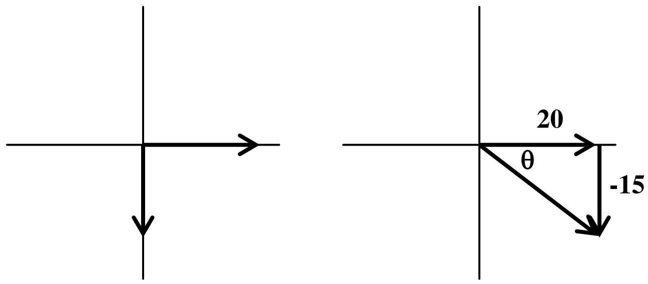
e. 12 at 265^o

f. 990 at 320^o

g. 8653 at 225^o

10. Given two component vectors solve for the resultant vector. This is the opposite of number 9 above. Use Pythagorean Theorem to find the hypotenuse, then use inverse (arc) tangent to solve for the angle.

Example: ***x*** = 20, ***y*** = -15



$$R^2 = x^2 + y^2 \qquad \tan\theta = \frac{opp}{adj}$$

$$R = \sqrt{x^2 + y^2} \qquad \theta = \tan^{-1}\left(\frac{opp}{adj}\right)$$

$$R = \sqrt{20^2 + 15^2} \qquad \theta = \tan^{-1}\left(\frac{y}{x}\right)$$

$$R = 25$$

$$360^o - 36.9^o = 323.1^o$$

a. ***x*** = 600, ***y*** = 400

d. ***x*** = 0.0065, ***y*** = -0.0090

b. ***x*** = -0.75, ***y*** = -1.25

e. ***x*** = 20,000, ***y*** = 14,000

c. ***x*** = -32, ***y*** = 16

f. ***x*** = 325, ***y*** = 998

Congratulations!

This ends the Math Review Summer Assignment for AP Physics 1.

If you were able to successfully conquer this, you're ready to begin AP Physics 1.