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### Course

AP Physics 1

### Contact

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### Description

#### **Hi all and welcome to AP Physics 1!**

This course is designed to be a college level introductory Physics course, both for people who have taken high school Physics and for people who are ready to dive right into an algebra-based college level class.

In class we will work to prepare you to take the AP Physics 1 exam in the spring of 2020. All students in this class will be expected to take that exam.

The required books for this class are Cutnell and Johnson, *Physics* and Jacobs, *5 Steps to a 5 AP Physics 1: Algebra-Based*.

### Summer Work

I have included the exercises for you to do over the summer to that utilize the types of math that you will need to be comfortable with in this class. This work is intended for you to assess your level and give you feedback in areas that might need extra enrichment. **It will not be graded**, but you will be expected to complete it all before the first class next year. Please do not try to do it all at once.

# AP Physics 1 Summer Assignment

## 1. Scientific Notation:

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

a.  $T_s = 2\pi \sqrt{\frac{4.5 \times 10^{-2} \text{ kg}}{2.0 \times 10^3 \text{ kg/s}^2}} =$   $T_s =$  \_\_\_\_\_

b.  $F = \left(9.0 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}\right) \frac{(3.2 \times 10^{-9} \text{ C})(9.6 \times 10^{-9} \text{ C})}{(0.32 \text{ m})^2}$   $F =$  \_\_\_\_\_

c.  $\frac{1}{R_p} = \frac{1}{4.5 \times 10^2 \Omega} + \frac{1}{9.4 \times 10^2 \Omega}$   $R_p =$  \_\_\_\_\_

d.  $K_{\max} = (6.63 \times 10^{-34} \text{ J} \cdot \text{s})(7.09 \times 10^{14} \text{ s}) - 2.17 \times 10^{-19} \text{ J}$   $K_{\max} =$  \_\_\_\_\_

e.  $\gamma = \frac{1}{\sqrt{1 - \frac{2.25 \times 10^8 \text{ m/s}}{3.00 \times 10^8 \text{ m/s}}}}$   $\gamma =$  \_\_\_\_\_

f.  $K = \frac{1}{2} (6.6 \times 10^2 \text{ kg}) (2.11 \times 10^4 \text{ m/s})^2 =$   $K =$  \_\_\_\_\_

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

## 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.  $F_g = G\frac{m_1m_2}{r^2}$  ,  $r =$  \_\_\_\_\_

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

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

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

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  
centimeters (*cm*) to meters (*m*) and meters to centimeters  
millimeters (*mm*) to meters (*m*) and meters to millimeters  
nanometers (*nm*) to meters (*m*) and meters to nanometers  
micrometers ( $\mu m$ ) to meters (*m*)

gram (*g*) to kilogram (*kg*)  
Celsius ( $^{\circ}C$ ) 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.  $4008\text{ g} = \underline{\hspace{2cm}}\text{ kg}$

b.  $1.2\text{ km} = \underline{\hspace{2cm}}\text{ m}$

c.  $823\text{ nm} = \underline{\hspace{2cm}}\text{ m}$

d.  $298\text{ K} = \underline{\hspace{2cm}}\text{ }^{\circ}C$

e.  $0.77\text{ m} = \underline{\hspace{2cm}}\text{ cm}$

f.  $8.8 \times 10^{-8}\text{ m} = \underline{\hspace{2cm}}\text{ mm}$

g.  $1.2\text{ atm} = \underline{\hspace{2cm}}\text{ Pa}$

h.  $25.0\ \mu m = \underline{\hspace{2cm}}\text{ m}$

i.  $2.65\text{ mm} = \underline{\hspace{2cm}}\text{ m}$

j.  $8.23\text{ m} = \underline{\hspace{2cm}}\text{ km}$

k.  $40.0\text{ cm} = \underline{\hspace{2cm}}\text{ m}$

l.  $6.23 \times 10^{-7}\text{ m} = \underline{\hspace{2cm}}\text{ nm}$

m.  $1.5 \times 10^{11}\text{ m} = \underline{\hspace{2cm}}\text{ km}$

#### 4. Geometry

Solve the following geometric problems.

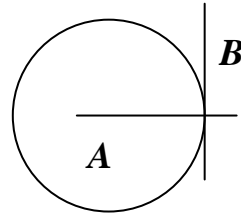
- a. Line **B** touches the circle at a single point. Line **A** extends through the center of the circle.

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

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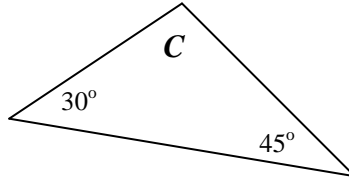
ii. How large is the angle between lines **A** and **B**?

\_\_\_\_\_



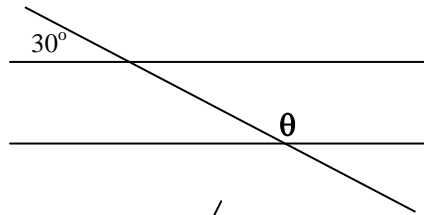
- b. What is angle **C**?

\_\_\_\_\_



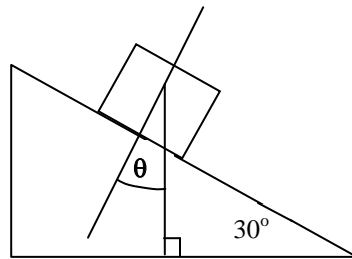
- c. What is angle  $\theta$ ?

\_\_\_\_\_



- d. How large is  $\theta$ ?

\_\_\_\_\_



- e. The radius of a circle is  $5.5 \text{ cm}$ ,

i. What is the circumference in meters?

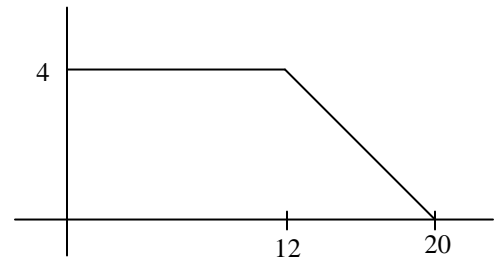
\_\_\_\_\_

ii. What is its area in square meters?

\_\_\_\_\_

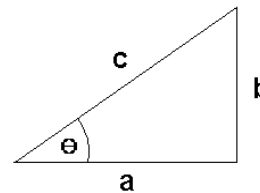
- f. What is the area under the curve at the right?

\_\_\_\_\_



## 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.  $\theta = 55^\circ$  and  $c = 32 \text{ m}$ , solve for  $a$  and  $b$ .

\_\_\_\_\_

h.  $\theta = 45^\circ$  and  $a = 15 \text{ m/s}$ , solve for  $b$  and  $c$ .

\_\_\_\_\_

i.  $b = 17.8 \text{ m}$  and  $\theta = 65^\circ$ , solve for  $a$  and  $c$ .

\_\_\_\_\_

j.  $a = 250 \text{ m}$  and  $b = 180 \text{ m}$ , solve for  $\theta$  and  $c$ .

\_\_\_\_\_

k.  $a = 25 \text{ cm}$  and  $c = 32 \text{ cm}$ , solve for  $b$  and  $\theta$ .

\_\_\_\_\_

l.  $b = 104 \text{ cm}$  and  $c = 65 \text{ cm}$ , solve for  $a$  and  $\theta$ .

\_\_\_\_\_

# 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  $\overrightarrow{A}$  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.



## Vector Addition and subtraction

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

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

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.

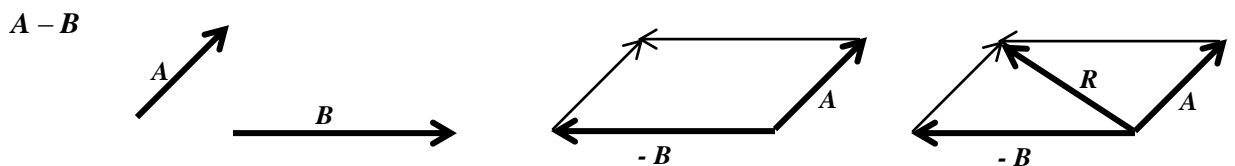
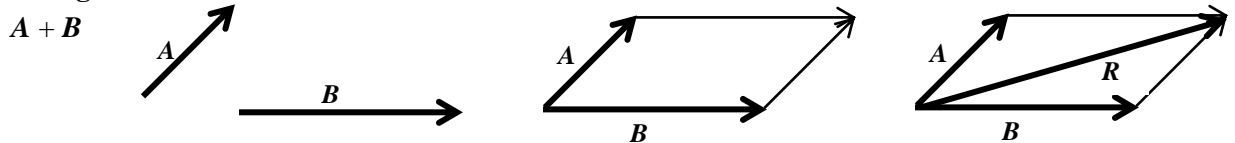
A negative vector has the same length as its positive counterpart, but its direction is reversed.

So if  $A$  has a magnitude of 3 and  $B$  has a magnitude of 2, then  $R$  has a magnitude of  $3+(-2)=1$ .

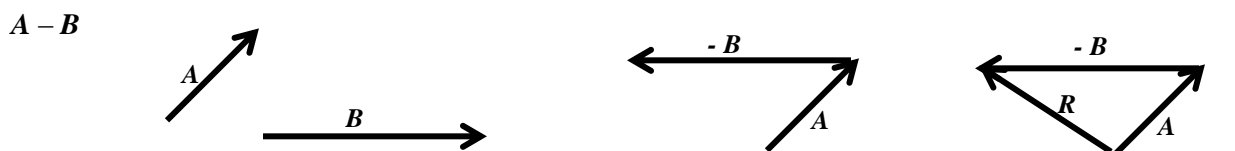
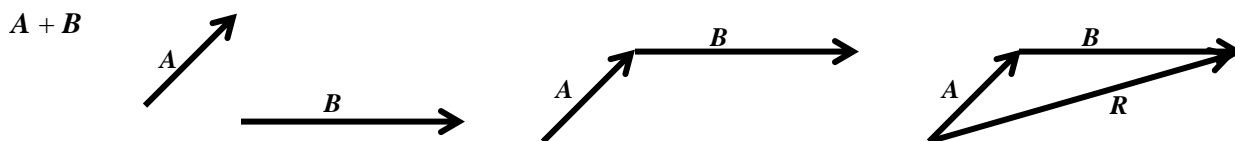
*This is very important.* In physics a negative number does not always mean a smaller number. Mathematically  $-2$  is smaller than  $+2$ , but in physics these numbers have the same magnitude (size), they just point in different directions ( $180^\circ$  apart).

There are two methods of adding vectors

### Parallelogram



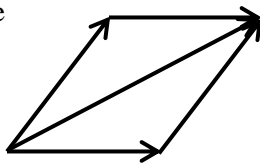
### Tip to Tail



## 6. Drawing Resultant Vectors

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

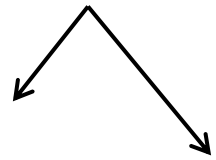
Example



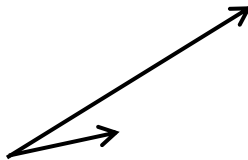
b.



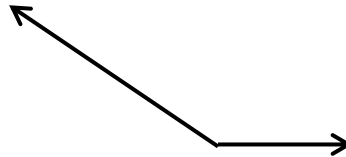
d.



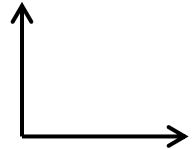
a.



c.

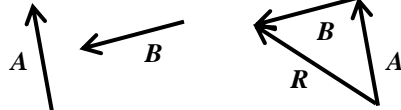


e.

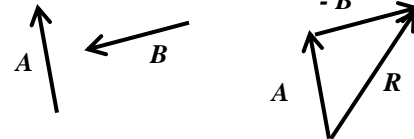


Draw the resultant vector using the tip to tail method of vector addition. Label the resultant as vector  $R$

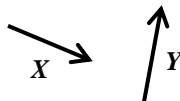
Example 1:  $A + B$



Example 2:  $A - B$



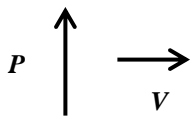
f.  $X + Y$



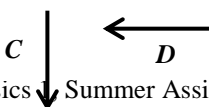
g.  $T - S$



h.  $P + V$



i.  $C - D$

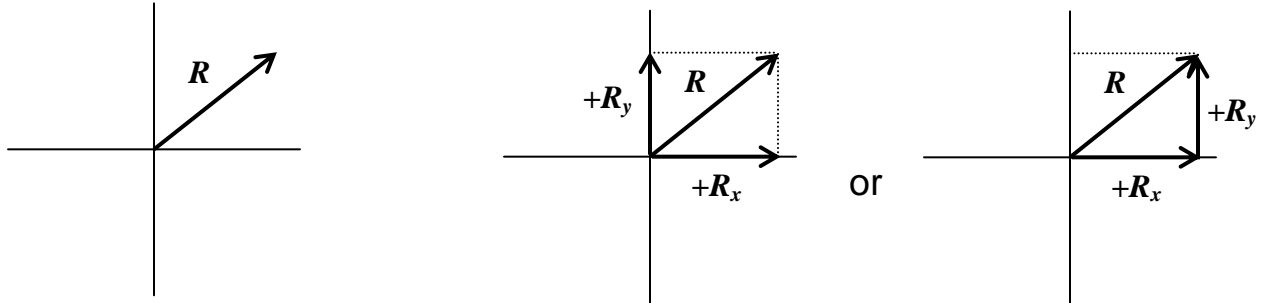




## Component Vectors

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.

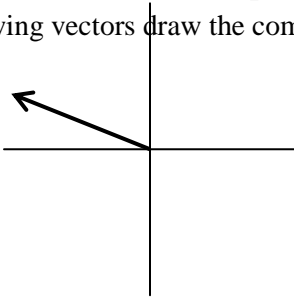


Any vector can be described by an  $x$  axis vector and a  $y$  axis vector which summed together mean the exact same thing. The advantage is you can then use plus and minus signs for direction instead of the angle.

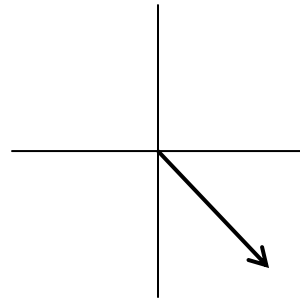
### 7. Resolving a vector into its components

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

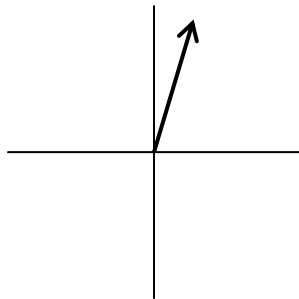
a.



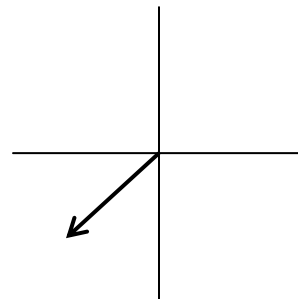
c.



b.



d.



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