UCONN ECE Physics Name _____

Summer Assignment

Fall 2021 – Spring 2022

We have read the policies and expectations for UCONN ECE Physics in the attached syllabus. We understand and accept these policies.

Student Signature: _____ Date _____

Parent / Guardian Name (print) _____

Parent / Guardian Signature: _____ Date _____

I. Students taking UCONN ECE Physics are often taking other AP courses as well in their senior year. Students are also involved in clubs, sports and other extracurricular activities, which taken alone are all good things. Please take into consideration the time requirements for each class/club/activity and determine for yourself if the workload is adequate for you or may be overwhelming. Try and pick those courses and activities that you truly desire to take. You cannot do everything.

II. UCONN ECE Physics is a rigorous class that covers A LOT of material. This necessitates a very fast pace. This summer homework will allow us to start on the Physics subject matter immediately when school begins. This packet is a math review to brush up on valuable skills, and perhaps a means to assess whether you are correctly placed in UCONN ECE Physics.

III. Physics, and UCONN ECE Physics in particular, requires an exceptional proficiency in algebra, trigonometry, and geometry. In addition to the science concepts Physics often seems like a course in applied mathematics. The following assignment includes mathematical problems that are considered routine in UCONN ECE Physics. This includes knowing several key metric system conversion factors and how to employ them. Another key area in Physics is understanding vectors.

IV. 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.

V. Cell phones will not be allowed out in class AT ANY TIME. If cell phones are out, they will be placed in a secure box and may be picked up after class.

VI. **Please work on this packet AFTER August 1, 2017, however don't wait until the last weekend of the summer**.

VII. **What is due the first day of school, 2021?**

A. **Signed Class Policies and Expectations Sheet**
   1. **Read all of the information included in this document.**
   2. **Complete the section at the top of this form and obtain appropriate signatures (due 8/28/2019).**
   3. **Complete the math problems section (due 9/01/2021).**
   4. **Please print out the above assignments and do your work on the print-outs.**

VIII. ***There will be a test on the math in this packet the third day of school.***

IX. What if I don't get all the problems or don't understand the instructions?

A. Simply do the best you can, but show some work / effort in order to receive credit.
B. Come to class the first day with your questions, in order to resolve these issues prior to the quiz.
C. Contact Mr. Ontko at ontko@csdnb.org

Summer Work

Since physics is the study of relationships in nature, and these relationships are often expressed in the form of mathematical equations, we are requiring you to spend time this summer solving some math problems that we typically see in Physics. The following are ordinary physics problems. Place the answer 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. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}\,kg}{2.0\times10^{3}\,kg/s^2}} =$ _____

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

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

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

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

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

g. $\gamma = \dfrac{1}{\sqrt{1-\dfrac{2.25\times10^{8}\,m/s}{3.00\times10^{8}\,m/s}}} =$ _____

Often problems in Physics 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.

h. $v^2 = v_o^{\,2} + 2a\left(s - s_o\right)$, $a =$ _____

i. $K = \dfrac{1}{2}kx^2$, $x =$ _____

j. $T_p = 2\pi\sqrt{\dfrac{\ell}{g}}$, $g =$ _____

k. $F_g = G\dfrac{m_1 m_2}{r^2}$, $r =$ _____

l. $mgh = \dfrac{1}{2}mv^2$, $v =$ _____

m. $x = x_o + v_o t + \dfrac{1}{2}at^2$, $t =$ _____

n. $B = \dfrac{\mu_o}{2\pi}\dfrac{I}{r}$, $r =$ _____

o. $x_m = \dfrac{m\lambda L}{d}$, $d =$ _____

p. $pV = nRT$, $T =$ _____

q. $\sin\theta_c = \dfrac{n_1}{n_2}$, $\theta_c =$ _____

r. $qV = \dfrac{1}{2}mv^2$, $v =$ _____

s. $\dfrac{1}{f} = \dfrac{1}{s_o} + \dfrac{1}{s_i}$, $s_i =$ _____

Physics uses the ***KMS*** system (***SI***: System International). ***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 (^oC) 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.

t. 4008 *g* = _____ *kg*
u. 1.2 *km* = _____ *m*
v. 823 *nm* = _____ *m*
w. 298 *K* = _____ ^oC
x. 0.77 *m* = _____ *cm*
y. 8.8×10^{-8} *m* = _____ *mm*
z. 1.2 *atm* = _____ *Pa*

aa. 25.0 μm = _____ *m*
bb. 2.65 *mm* = _____ *m*
cc. 8.23 *m* = _____ *km*
dd. 5.4 *L* = _____ m^3
ee. 40.0 *cm* = _____ *m*
ff. 6.23×10^{-7} *m* = _____ *nm*
gg. 1.5×10^{11} *m* = _____ *km*

Solve the following geometric problems.

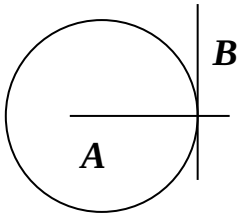
a. Line ***B*** touches the circle at a single point. Line ***A*** extends through the center of the circle.

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

_____

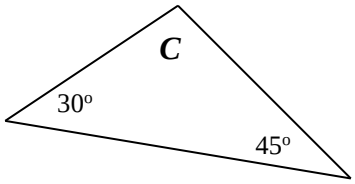
ii. How large is the angle between lines ***A*** and ***B***?

_____



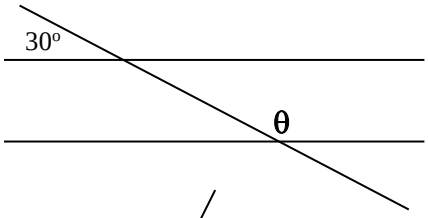
b. What is angle ***C***?

_____



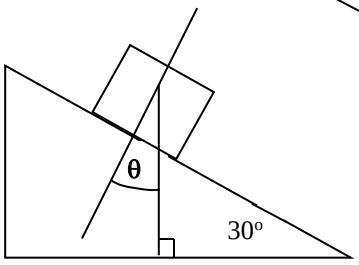
c. What is angle θ ?

_____



d. How large is *θ*?

_____



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

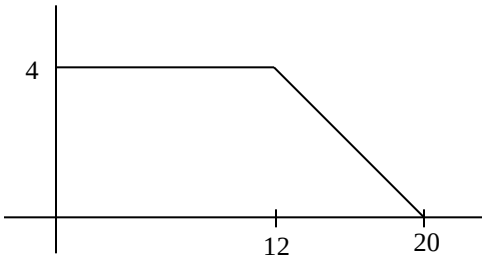
i. What is the circumference in <u>meters</u>?

_____

ii. What is its area in <u>square meters</u>?

_____

f. What is the area under the curve (function) at the right?



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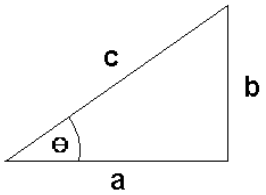
Using the generic triangle to the right, Right Triangle Trigonometry and the Pythagorean Theorem, solve the following. ***<u>Your calculator must be in degree mode.</u>***



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

_____

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

_____

i. ***b*** = 17.8 *m* and $\theta = 65^o$, 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.

_____

Vectors

You may or may not have had vectors in your Algebra II class. If not, read the following guide on vectors, and do your best to solve the problems.

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

Magnitude: Size or extent. The numerical value.

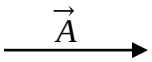
Direction: Alignment or orientation of any position with respect to any other position.

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 

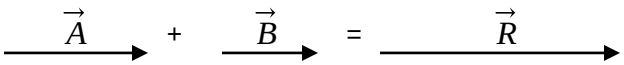
<u>Length</u> of the arrow is <u>proportional to the vectors magnitude</u>.
<u>Direction</u> the arrow points <u>is the direction of the vector</u>.

Negative Vectors

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

Vector Addition and subtraction

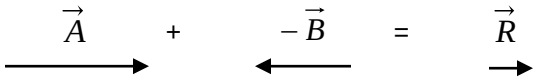
Think of it as vector addition only. The result of adding vectors is called the <u>result</u>ant. $\vec{R}$

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

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



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 (180º apart).

There are two methods of adding vectors that will be discussed in our 2-dimensional kinematics unit.

How are vectors used in Physics?

They are used everywhere!

Speed

Speed is a <u>scalar</u>. It only has magnitude (numerical value).

v_s = 10 *m/s* means that an object is going 10 meters every second. But, we do not know where it is going.

Velocity

Velocity is a <u>vector</u>. It is composed of both magnitude and direction. Speed is a part (numerical value) of velocity.

v = 10 *m/s* north, or ***v*** = 10 *m/s* in the ***+x*** direction, etc.

There are three types of speed and three types of velocity

Instantaneous speed / velocity: The speed or velocity at an instant in time. You look down at your speedometer and it says 20 *m/s*. You are traveling at 20 *m/s* at that instant. Your speed or velocity could be changing, but at that moment it is 20 *m/s*.

Average speed / velocity: If you take a trip you might go slow part of the way and fast at other times. If you take the total distance traveled divided by the time traveled you get the average speed over the whole trip. If you looked at your speedometer from time to time you would have recorded a variety of instantaneous speeds. You could go 0 *m/s* in a gas station, or at a light. You could go 30 *m/s* on the highway, and only go 10 *m/s* on surface streets. But, while there are many instantaneous speeds there is only one average speed for the whole trip.

Constant speed / velocity: If you have cruise control you might travel the whole time at one constant speed. If this is the case then you average speed will equal this constant speed.

A trick question

Will an object traveling at a <u>constant speed</u> of 10 *m/s* also always have <u>constant velocity</u>?

Not always. If the object is turning around a curve or moving in a circle it can have a constant speed of 10 *m/s*, but since it is turning, its direction is changing. And if direction is changing then velocity must change, since velocity is made up of speed and direction.

<u>Constant velocity must have both constant magnitude and constant direction.</u>

Rate

Speed and velocity are rates. A rate is a way to quantify anything that takes place during a time interval. Rates are easily recognized. They always have time in the denominator.

10 *m/s* 10 meters / second

The very first Physics Equation

Velocity and Speed both share the same equation. Remember speed is the numerical (magnitude) part of velocity. Velocity only differs from speed in that it specifies a direction.

$v = \frac{\Delta x}{\Delta t}$ *v* stands for velocity; Δx stands for displacement (change in position); Δt stands for time

Displacement is a vector for distance traveled in a straight line. It goes with velocity. Distance is a scalar and goes with speed. Displacement is measured from the origin. It is a value of how far away from the origin you are at the end of the problem. The direction of a displacement is the shortest straight line from the location at the beginning of the problem to the location at the end of the problem.

How do distance and displacement differ? Supposes you walk 20 meters down the **+ *x*** axis and turn around and walk 10 meters down the **– *x*** axis.

The distance traveled does not depend on direction since it is a scalar, so you walked 20 + 10 = 30 meter.

Displacement only cares about your distance from the origin at the end of the problem. +20 – 10 = 10 meter.

Attempt to solve the following problems. Take heed of the following.

Always use the *KMS* system: Units must be in <u>k</u>ilograms, <u>m</u>eters, <u>s</u>econds.

On the all tests, including the AP exam (Monday, May 14, 2012) you must:

1. **List the original equation used.**
2. **Show correct substitution.**
3. **Arrive at the correct answer with correct units.**

Distance and displacement are measured in meters (*m*)

Speed and velocity are measured in meters per second (*m/s*)

Time is measured in seconds (*s*)

Example: A car travels 1000 meters in 10 seconds. What is its velocity?

$v = \frac{x}{t}$ $v = \frac{1000m}{10s}$ $v = 100\,m/s$

a. A car travels 35 *km* west and 75 km east. What distance did it travel?

b. A car travels 35 *km* west and 75 *km* east. What is its displacement?

c. A car travels 35 *km* west, 90 *km* north. What distance did it travel?

d. A car travels 35 *km* west, 90 *km* north. What is its displacement?

e. A bicyclist pedals at 10 *m/s* in 20 *s*. What distance was traveled?

f. An airplane flies 250.0 *km* at 300 *m/s*. How long does this take?

g. A skydiver falls 3 *km* in 15 *s*. How fast are they going?

h. A car travels 35 *km* west, 90 *km* north in two hours. What is its average speed?