AP PHYSICS
FALL 2010-Spring 2012
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(Everett Community College equivalent: 121,122,123)

SUMMER ASSIGNMENT: we'll go over some of the answers on the first day of school!! I apologize for any "writing" errors ahead of time☺

Please have a science composition notebook ready to set up on the first day. I recommend buying 2 (one for each semester; your choice whether or not it is graph or lined). Labs, activities, thinking problems will go in this notebook. Daily class work, handouts, lectures, etc will go into your binder or another location of your preference.

Many states and school districts follow the college schedule where classes begin in August and end in May. The AP exams are geared towards these schools. So, unfortunately you will have to take the AP exam a month before school gets out here. This means we will have to move at a **fast pace**; and the summer assignment allows us to get a start on the Physics material. This packet is to help you start to become familiar with some basic physics concepts and review some math skills. I plan on checking my email (kerensa.moon@sno.wednet.edu) at least once a week towards the END of the summer; you may email me at anytime.

The AP Physics course requires a *working knowledge of algebra, trigonometry, and geometry*. You also need to know how to do several key metric system conversion factors and use scientific notation. The summer assignment is meant *to review these skills* and help you brush up before school begins. All I ask is that you try every problem (#1-29) and do your best.

It helps to create flash cards of commonly used formulas; units; and the meaning of certain variables (for example; F=force). Good luck and see you in the fall!

Problems: Scientific notation

Scientists are lazy (ha ha ha); in all reality using scientific notation and variables saves time and paper!

#1: Use the internet or another resource tool to find what power centi, pico, milli, nano, femto, micro, kilo, mega, and giga are.

#2: Place the following in scientific notation; don't forget to cancel out any units (*simplify*)

a. $T_s = 2\pi \sqrt{\frac{4.5\ x\ 10^{-2} kg}{2.0\ x\ 10^{3} \frac{kg}{s^2}}}$
b. ½ $((6.6x10^{2}kg)(2.11x10^{4}m/s^{2}))$
c. $2.356x10^{3} - 1.3 \times 10^{-2}$
d. $5.68\ x10^{-3} + 3.4 \times 10^{2}$

Problems: Variables: 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.

#3: $pV = nRT$; solve for T

#4: $x = m\lambda L/d$; solve for d

#5: $F=ma$; solve for a

Problems: SI system; scientists use the metric or SI system in physics. Convert the following.

#6 How many kilometers are there in a meter? How many meters are there in a kilometer?

#7: How many centimeters are there in a meter? How many meters are there in a centimeter?

#8: How many millimeters are there in a meter? How many meters are there in a millimeter?

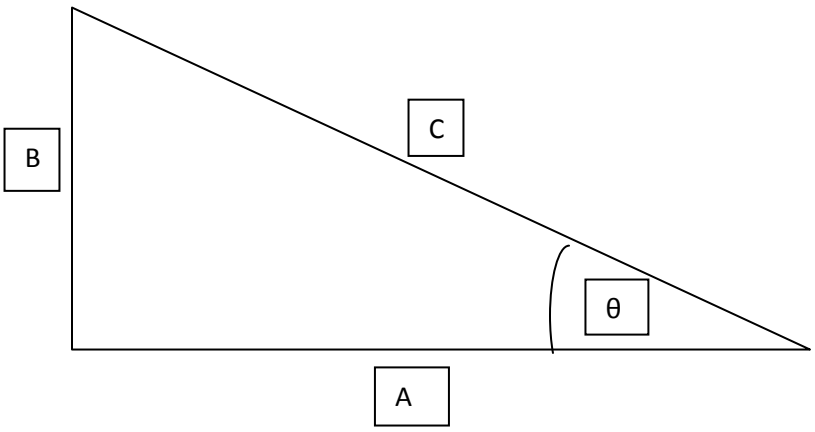
#9: 4008 g = ?kg #10: 1.2km = ?m #11: 298 K = ?degrees C

#12: 0.77m = ?cm #13: 245 C =? Kelvins?

#14: what is the standard unit for Distance? Force? Power? Time? (for example frequency is in the standard unit (or SI) Hertz or Hz)

Problems: Geometry & Vectors

#15. Using the generic triangle to the right, right triangle trigonometry and the Pythagorean Theorem, solve the following. *Your calculator must be in the degree mode!* Not all problems may be solvable.



a. c=32 m and θ=55°; **solve for a & b**
b. θ=45° and a= 15m/s; **solve for b & c**
c. b= 17.8m and θ=65°; **solve for a & c**
d. a=250m and b=180m; **solve for c & θ**
e. a=25cm and c=32cm; **solve for b & θ**
f. b=104m and c=65cm; **solve for a & θ**

Problems: Vectors

Most of the quantities in physics are vectors. This makes proficiency in vectors extrememly important. Let';s go over some vocab (whoopie. . . .very exciting I know☺)

Magnitude: Size, or numerical value

Direction: Orientation, position, or cardinal direction (N, E, W, S)

Scalars: A physical quantity described by a single number(s); it's just a magnitude.

Examples: time, mass, temperature, speed

Vector: Have a magnitude and direction

Examples: velocity, acceleration, force

In a drawing or notation: $\vec{A}$ *or* $\vec{A}$

Length of arrow= proportional to the vectors magnitude

Direction of the arrow=direction of the vector

Okay so let's talk about resultant (oooohhhh; another vocab word sometimes it is also called displacement). A resultant is the vector sum of 2 or more vectors. In physics a negative number does NOT ALWAYS mean a smaller number (VERY IMPORTANT POINT; you have been trained really well in math, but now it's time for physics). For a vector; it has the SAME magnitude but is in the opposite direction. So one more time: a negative vector is just like a positive one; just in the opposite direction.

Rules for "adding" vectors

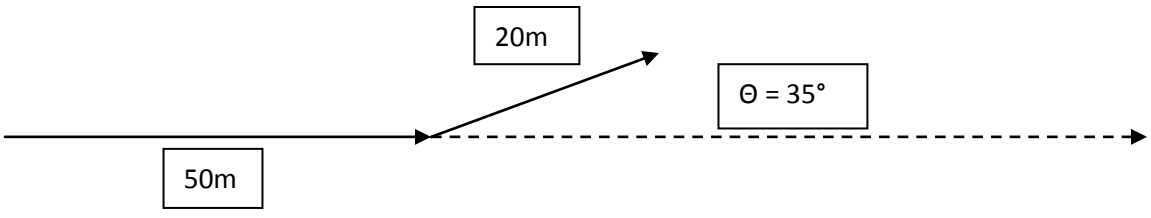
Same plane, same direction = addition: R= A + B (for example 5cm North and 15cm North; the resultant = 20 cm North)

Same plane, opposite direction = subtract: R= A - B (larger of the two numbers wins the direction; like 4 meters West and 8 meters East the resultant = 4 meters East)

What if they are exactly 90° apart? Draw a picture of the scenario (you'll do lots of drawing in physics); use the Pythagorean Theorem ($R^2 = A^2 + B^2$) to solve for the resultant. For example a truck drove 50m east turned and headed 20m North; what was the truck's overall displacement? *$R^2 = 50m^2 + 20m^2$* *ANS = 54m NE*

But what if they are not in the same plane and they are not exactly 90° apart? Draw a picture of the scenario; use the Law of Cosines to solve: $R^2 = A^2 + B^2 - 2ABcos\theta$ (this formula can also be used with the Law of Sines to solve for all sides of a triangle). Let's say the same truck went 50m east turned 35° and then headed another 20m; what is the truck's resultant (aka displacement)?

$R^2 = 50m^2 + 20m^2 - 2(50m)(20m)cos35°$ *ANS= 35.5m NE*



Hints for solving: Draw the scenario; figure out what formula/concept to use; solve

Distance: is scalar and does not depend on direction

Displacement: is the overall total from the point of origin and is a vector; so it does depend on distance

Problem: Your turn; Find the displacement/resultant for each

#16

a. 4500 m to the right & 345 m to the right
b. 65m up and 20m down
c. 20m/s east and 15 m/s south
d. 32 cm west and 16 cm north
e. 86m/s east, 55° turn northward, 55m/s NE
f. 35mph west, 25° turn southward, 65mph SW

What if you are given the vector and you need to find its components? (aka find the x and y) AGAIN, make sure your calculator is in degree mode.

To find the x: (hyp)(cosθ) To find the y: (hyp)(sinθ)

Find the components of a 250m vector at 235°

ANS (250m)(cos235°) = -143m (or x) (250m)(sin235°) = -205m (or y)

OMG . . .your turn again☺

Problem: Vector Components

#17

a. 6.50 at 345°
b. 89 at 150°
c. 0.00556 at 60°
d. 145 at 20°

Misc Practice: Anything from above can show up below . . .oh come on . . you want to find the answers ☺

#18. The mass of the parasitic wasp *Caraphractus cintus* can be as small as $5x10^{-6}$kg. What is its mass in (a) grams? (b) milligrams? (c)micrograms?

#19. The largest diamond ever found had a size of 3106 carats. One carat is equivalent to a mass of 0.200g. Use the fact that 1 kg (1000g) has a weight of 2.205 lbs under certain conditions, and determine the weight of this diamond in pounds.

#20. You are driving into St. Louis, Missouri and in the distance you see the famous Gateway-to-the-West arch. This monument rises to a height of 192m. You estimate your line of sight with the top of the arch to be 2.0° above the horizontal. Approximately how far (in km) are you from the base of the arch?

#21. In wandering, a grizzly bear makes a displacement of 1563m due west, followed by a displacement of 3348m in a direction 32° NW. What are the (a) the magnitude and (b) the direction of the displacement needed for the bear to return to its starting point? Specify the direction relative to due east.

#22. The speed of an object and the direction in which it moves constitute a vector quantity known as the velocity. An ostrich is running at a speed of 17.0 m/s in a direction of 68° NW. What is the magnitude of the ostrich's velocity component that is directed (a) due north and (b) due west?

Problems (jump start into the first few chapters): Kinematics, Velocity, Distance, Speed, and Time

Okay, I'm going to "throw" a lot of vocab at you all at once 'cause I care.

Kinematics: The study of the motion of objects and involves the study of the following: distance, time, velocity, speed, acceleration

Dynamics: deals with the topics of forces on motion (we'll deal with this later)

Mechanics: kinematics + dynamics = this branch of physics

Speed: distance/ time in the standard SI unit of m/s (scalar); is a *v* in a formula

Velocity: distance/time in a particular direction in the standard SI unit of m/s (vector); is a *v* in a formula

Distance: standard SI unit is meters; is an *x* in a formula

Time: standard SI unit is seconds; is a *t* in a formula

Displacement: overall or difference in distance (x); represented as Δx *or* $x - x_o$ (Δ = delta=difference and x = final and x_o=starting distance); SI unit is meters

Instantaneous: that particular value in that moment in space and time

Acceleration: is the change in velocity divided by the change in time; SI unit of m/s^2 and is an *a* in a formula

Formulas for 1-Dimensional Kinematics

Speed: x/t

Average Velocity: $\Delta x/\Delta t$ with a direction

Average Acceleration: $\Delta v/\Delta t$

Problem: Rearrange

#23

a. If average velocity equals

   $v= x-x_o / t-t_o$ SOLVE for x

b. If average acceleration equals

   $a= v-v_0/ t -t_0$ SOLVE for v

What about if acceleration is constant? (aka . . .velocity is changing at the same rate over time; if velocity doesn't change then there is NO ACCELERATION)

Formula for uniform acceleration: $a = v\text{-}v_0 / t$ then $v = v_o + at$ again v= final and v_0= starting

Let's add distance in (since velocity is distance/time)

Distance as related to initial distance, initial speed, acceleration, and time: $x = x_0 + v_o t + \frac{1}{2} at^2$

What if you don't have the time?

Speed as related to initial speed, acceleration, and distance: $v^2 = v_o^2 + 2a(x\text{-}x_o)$

With the formulas listed above you can find anything related to 1D kinematics: speed, velocity, time, distance, or acceleration of an object.

Hints:

- *Draw a picture of the scenario and or identify the variables that you have*
- *Figure out the best formula (the one that has you doing the LEAST amount of work) to use to find your unknown variable*
- *Solve it* ☺

Problem: Kinematics: just the basics

#24. You nose out another runner to win the 100.000 m dash. If your total time for the race was 11.800 s and you aced out the other runner by 0.001 s, by how many meters did you win?

#25. The speed of sound is 344 m/s. You see a flash of lightning and then hear the thunder 1.5 seconds later. How far away from the lightning strike are you?

#26. A race car accelerates from rest to a speed of 287 km/h in 6.8 seconds. What is its average acceleration in standard SI unit?

#27. The space shuttle undergoes an acceleration of 53.9 m/s^2. How fast is it traveling at the end of 55.2 s?

#28. You are in an elevator that is accelerating you upward at 4.55 m/s^2. How much time till you are traveling at 11.0 m/s?

#29. A car is traveling at 108 km/h, stuck behind a slower car. Finally the road is clear and the car pulls over to make a pass. The driver stomps on the gas pedal and accelerates up to a speed of 135 km/h. If it took 3.5 s to reach this speed, what is the average acceleration in standard SI unit?