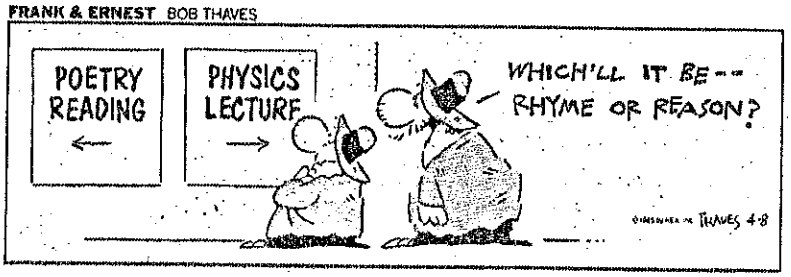
AP Physics - Summer Assignment

L. Henry – Rm 318

Physics, and AP Physics in particular, is a science course that will demand an exceptional knowledge of algebra-based mathematics, trigonometry, and geometry. It will sometimes feel as if you are in another mathematics class that consists of only word problems. Because much of physics requires application of algebraic mathematics, it is strongly recommended that students have a solid foundation before entering this class to be successful. The purpose of the summer assignment is to help reinforce this foundation and make it easier for you during the first few weeks of class. The assignment is broken up into four parts.



Assignment #1: Mastering Physics and Schoology group

Join the AP Schoology group.
Access code - XF9FB-98PTZ

REGISTER with Mastering Physics (Knight College Physics online text and resources):

Go to **www.pearsonmylabandmastering.com**.

Under the large **Register** section on the right side of the page, click the **Student** button. Read the onscreen instructions and click **OK! Register now.**

Next, enter the **Course ID** for your course henry02634

After this, either **Create** a new Pearson username and password, or, if you've already registered for another Pearson product (i.e. MyMathLab), **Sign In** with that username and password.

On the next page, click the **Access Code** button and input the following access code:
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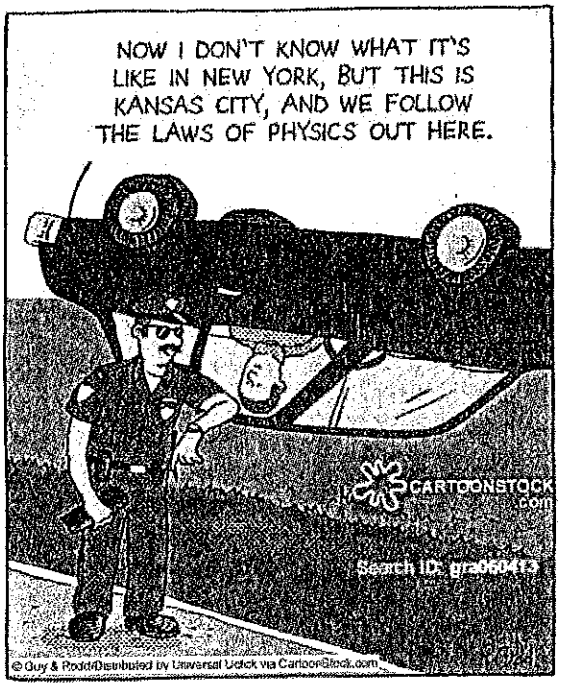
You are now registered! When you are given a Mastering Physics (MP) assignment (see below), go to **www.pearsonmylabandmastering.com** and click the **Sign In** button in the top right. Enter your username and password.



Things to know about AP Physics

1. **Ignore your grade:** if you focus on the content, do your work on time with the course pacing, ask questions as often as needed and you will do well.

2. **Conceptual knowledge is more important than the math.** We will cover concept after concept and to truly do well in the class, you need to be ready to apply that knowledge in a different way as the question being asked will always be different than you expect.

   a. This means you need to be involved in the course and study regularly. If you do so, you can build upon your knowledge and gain a deeper understanding of the concepts.

3. **Your book is your friend.** When told to read a chapter or two (or more), you *NEED* to do it. To say you don't understand it or it does not make sense means you need to read it again (and again and again). Remember to read and understand the words in bold, the diagrams and their captions and review the practice problems done for you as well as the chapter summary. When you are in college, reading and taking notes are the key to success in the hard sciences.

4. We now live in the technology era. **You have THE INTERNET!** You will find hundreds of videos teaching you everything and it will be worth it to find good sites and bookmark them.

5. **If you are spending an exceptionally large amount of time on one problem, skip it.** You will realize that the answer will come to you later when you take a break and refer back to #1.

6. **Do not cram.** If the course was primarily a memorization-based content, then you could most likely get away with this but unfortunately AP Physics is completely application-based. Therefore, after cramming for eight hours on a certain scientific law and sample problems and you are certain you will do well, the test will have questions asked in a way you have never seen before and now you do not know what to do. First, refer back to #1 again and learn that you have to understand the concepts well enough that you can apply it when you are asked any type of questions by myself or AP Collegeboard.

Always use the correct number of significant figures in your answers whether it is scientific notation or regular notation.

When dealing with significant figures, remember that all non-zero numbers are considered significant. If there is a decimal in the number, the all numbers are significant starting with the first non-zero number and continuing until the end. If there is no decimal, then only non-zero numbers and zeroes in the middle of non-zero numbers are significant.

e.g. 123 – 3 sig figs; 101 – 3 sig figs; 1010 – 3 sig figs; 1010. – 4 sig figs; 0.010 – 2 sig figs; 0.00001 – 1 sig fig

Assignment #2: Math Review --

Print out this assignment and complete it in its entirety (#1-43). Mail to me by the due date at the address listed on the first page of the summer assignment.

<u>Basic Algebra</u>

You will be using these skills daily. Familiarize yourself with these physics equations as you solve them with the correct number of significant figures and correct unit of measurement. (Hint: Whatever you do with the #s you do with the units!) Show your work!!

1. $KE = 1/2\ mv^2$

   $KE = \frac{1}{2}\ (210kg)(10.5\ m/s)^2 =$ _____

2. $F = G\frac{M_1M_2}{r^2}$

   $F = (6.67 \times 10^{-11}\frac{Nm^2}{kg^2}) \cdot \frac{(5.64\cdot10^{24}\ kg)(1.99\cdot10^{31}kg)}{(1.51\cdot10^{15}\ m)^2} =$ _____

3. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$

   $\frac{1}{R_p} = \frac{1}{24\ \Omega} + \frac{1}{18\ \Omega} =$ _____

4. $\tau = rF\sin\theta$

$\tau = 1.4\,m \cdot 28\,N \sin 47° =$ _____

5. $T = 2\pi\sqrt{\frac{l}{g}} =$

$T = 2\pi\sqrt{\frac{0.34\,m}{9.8\,\frac{m}{s^2}}} =$

_____

Once again, this will be a daily routine in this class but now you must do it with just variables. So put away your calculator and use your head. Don't get confused with the letters, think of them as numbers and algebraically rearrange for the chosen variable.

6. $U_g = mgh$; solve for h

7. $P = \frac{W}{t}$; solve for t

8. $a_c = \frac{v^2}{r}$; solve for v

9. $qV = \frac{1}{2}mv^2$; solve for v

10. $y_f = y_i + v_i t + \frac{1}{2}at^2$; solve for a

11. $F = k\frac{q_1 q_2}{r^2}$; solve for q_2

12. $R = \rho\frac{l}{a}$; solve for ρ

13. $v_f^{\,2} = v_i^2 - 2a(x_v - x_i)$; *solve for* x_i

14. $n_1 \sin\theta_1 = n_2 \sin\theta_2$; solve for θ_2

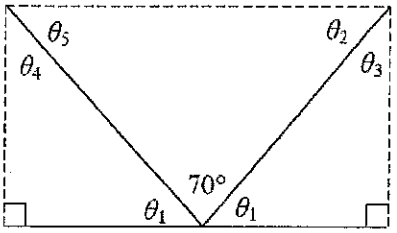
15. $T = 2\pi\sqrt{\frac{m}{k}}$; solve for k

Basic Geometry/Trigonometry

You will use basic geometry (area, perimeter, shapes, angles, etc.) and trigonometry (sin, cos, and tan) often. You will need to know the basic geometry equations for shapes and areas.

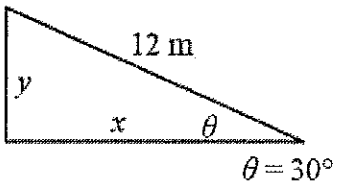
Solve for the missing angles in the following problems:

16.



Solve for angles 1-5.

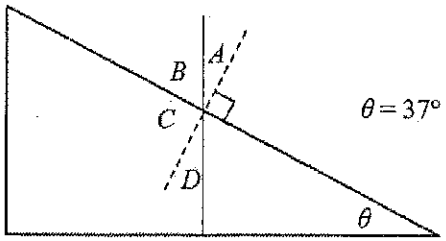
17. Solve for the missing sides:



$y =$ _____

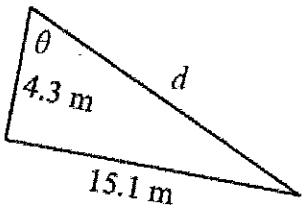
$x =$ _____

18.



Solve for angles A-D.

19. Solve for missing side and angle:



$d =$ _____

$\theta =$ _____

Measurements, Metric, and Converting

Like all science classes, all measurements will be made with the metric system, SI Units. Therefore, you must be absolutely comfortable with the metric prefixes, their magnitude of power compared to the base unit and be able to convert between them quickly.

Complete the following table:

Metric Prefix	Power	Symbol
Tera-		
Giga-		
Mega-		
kilo-	10^3	k
base unit	10^0	-
centi-		
milli-		
micro-		
nano-		
pico-	10^{-12}	p

Convert the following using dimensional analysis (show your work):

20. 35 kg → g

23. 7.2 cm^2 → m^2

21. $1.8\mu m \rightarrow m$

24. $81\ m^3 \rightarrow km^3$

22. $24.9\ MJ \rightarrow cJ$

25. $27.31\ km/hr \rightarrow m/s$

Graphing/Data Analysis

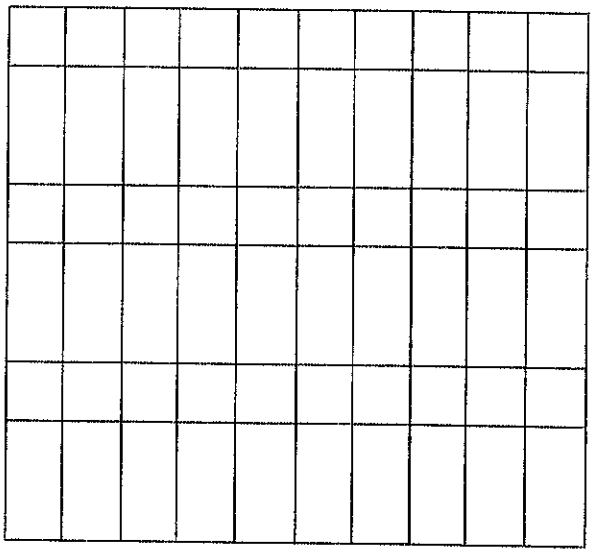
You must be able to interpret and create graphs by hand and with computer software (I prefer Excel but you can also use Google Sheets). There are videos on YouTube that can help you learn how to use either. These come often on FRQs (Free Response Questions).

Remember to always spread the data out to take full use of the graph's axes and label them with titles and correct units.

Do not break the graph unless absolutely necessary and then put a title on too.

28. Take the following data and create a distance versus time graph in the blank graph below (get used to having time on the x-axis). **Never connect the dots** as it is a scatter plot. Be CERTAIN to include a title, axis labels and units, and a caption below the graph (briefly describing what is shown in the graph).

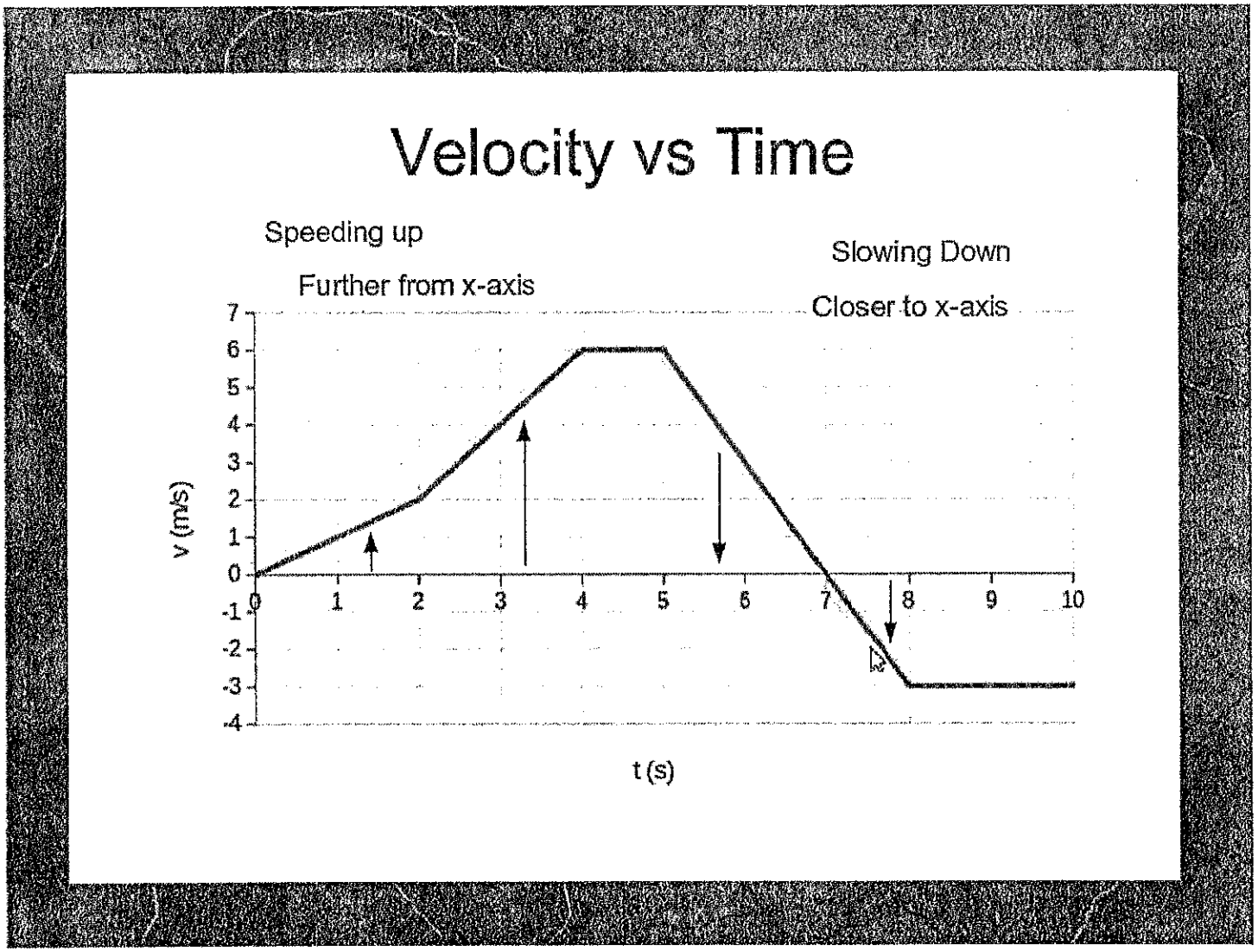
Distance (m)	Time (s)
0.0	0.0
3.6	1.0
7.1	2.0
11.1	3.0
14.6	4.0
18.2	5.0



Answer the questions on the next page.

26. Add in a best-fit line with a straight edge. Write briefly what two things make a "best-fit line".

27. What relationship is found between the distance and time? Provide data to support your answer.



This graph depicts a car starting from rest and moving to the right (positive direction). Interpret the graph and answer the questions below and remember to show your work when calculating.

28. What is the slope of the line from 4 seconds to 7 seconds?

29. What is the area under the curve between 0 seconds and 2 seconds?

30. At what time(s) is the car not moving?

31. During which period of time is the car moving to the left?

Scalar and Vector Quantities

Measurements of quantities in physics will either be scalar or a vector.

Scalar quantities are measurements that are described by only a magnitude, number only (e.g. 30 m/s, 25 kg, 5 s, etc.)

Scalar is usually said to always be positive but it can have a negative sign in front of it. This means that the scalar quantity is being removed from the system

Examples:

Time (measured in seconds)

Mass (measured in kilograms)

Distance/Length (measured in meters)

Speed (measured in meters per second, m/s)

Vectors are measurements that have a magnitude and a direction (e.g. 2 m/s east, 9.8 m/s^2 down, 3 N out, etc.)

Length of vectors are proportional to their magnitude: 5 m/s east → 10 m/s east →

Examples:

Displacement (measured in meters)

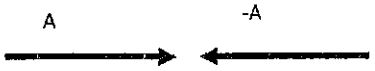
Velocity (measured in meters per second, m/s)

Acceleration (measured in meters per second per second, m/s^2)
Force (measured in Newtons, N)

Momentum (measured in kilograms meters per second, kgm/s)

- Vectors can be positive or negative at any time.

- The negative is not a value less than zero as it is in math but an identification of the direction it is traveling.
- You have a positive direction and a negative direction, which is the exact opposite of the positive.



Negative vectors have same magnitude but are 180° opposite direction

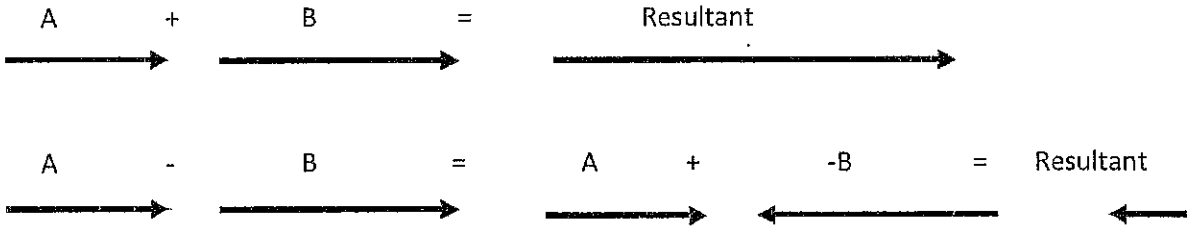
Vectors can be moved to any location as long as direction and magnitude are not altered.

Vector Math:

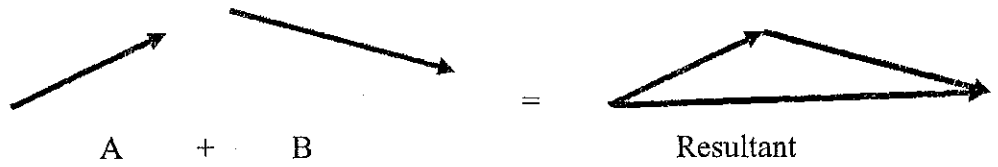
You can add or subtract vectors but you can always use addition but sometimes with a negative number (subtraction).

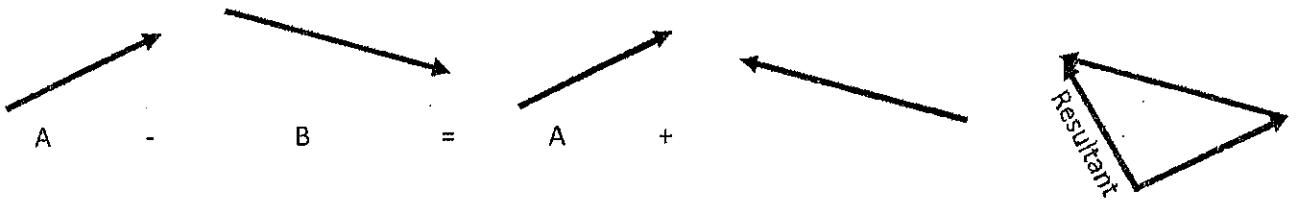
- **Resultant**: The result of adding vectors

When adding vectors, there are two methods: *tip-to-tail and mathematical components*.

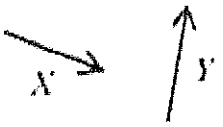


This tip-to-tail method can also be done in two-dimensions



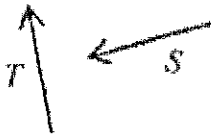


32. $X + Y$



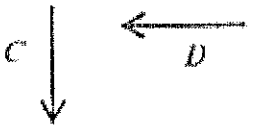
34. $P + V$

$T - S$



33.

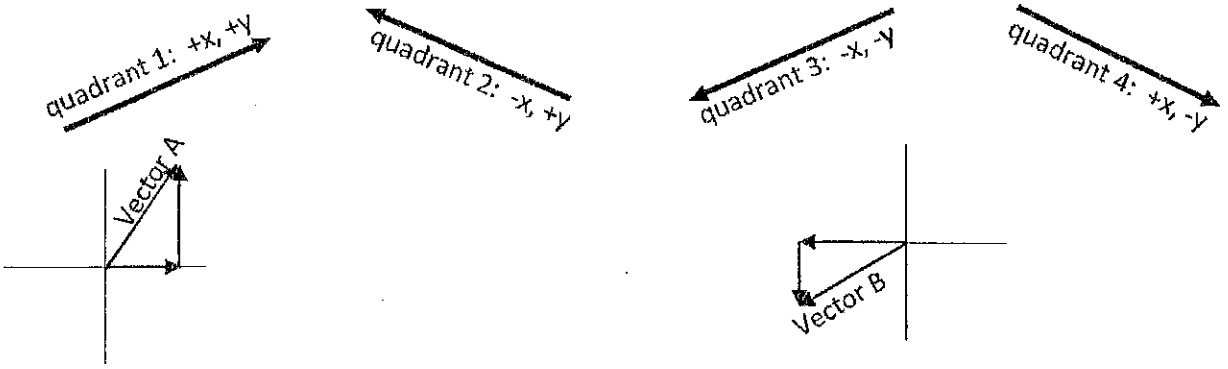
$C - D$

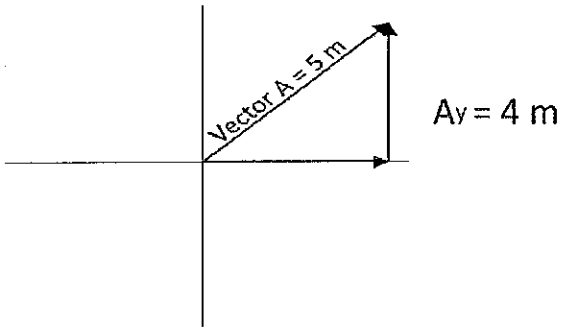


35.

The above examples demonstrated the *tip-to-tail method* where you can move vectors around as long as the tip of one vector touches the tail (back end) of the next vector. The resultant will start at the tail end of the first vector and move in a straight path to the tip of the last vector. It is the only vector in the diagram that is not tip-to-tail.

In the *mathematical component method*, we do not connect or move any vector around the paper. We simply use the coordinate plane orientation with the four quadrants and use basic trigonometry to find the horizontal and vertical components that make up the vector (we take the vector as the hypotenuse and make a right triangle).





Vector A has a magnitude of 5 m and a direction of 53° above the x-axis. Using trigonometry, you can find the sides and the missing angles.

∴ (means therefore) the horizontal x-component is 3 m and the vertical component is 4 m. Pythagorean theory is essential!

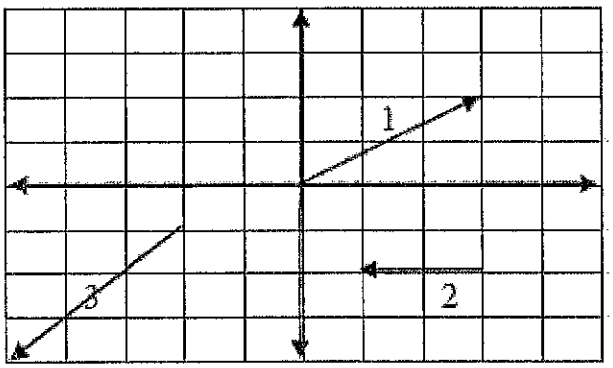
You try it now with the following problems:

Find the magnitude of the x- and y-components for the three vectors (some will be negative or zero)

34. Vector 1 x-component:
y-component:

35. Vector 2 x-component:
y-component:

36. Vector 3 x-component:
y-component:

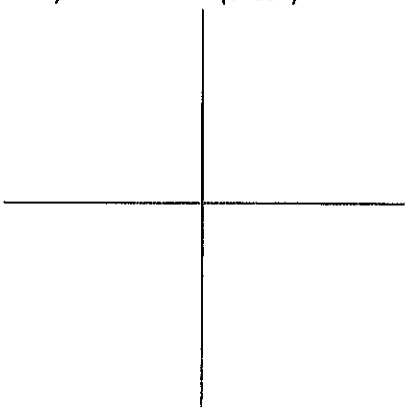


Given a vector (magnitude and direction), you should now be able to graph it on a coordinate plane and using trigonometry find the x- and y-components. Remember to keep your calculator in Degree Mode (i.e. not Radians).

Take the following vectors, draw it on a coordinate plane and calculate the components:

37. 15 m @ 77°

Quad 2 (91-179°) Quad 1 (0-89°)



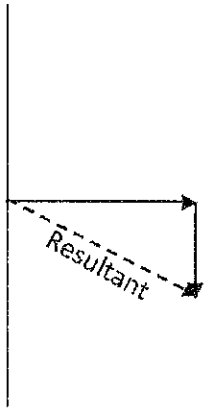
38. 8.0 m @ 235°

39. 11 m @ -45° (think about it – negative)

Quad 3 (181-269°) Quad 4 (271-359°)

Now work backwards! Take these components and find the vector's magnitude and direction.

e.g. A_x = 10 m, A_y = -5.0 m



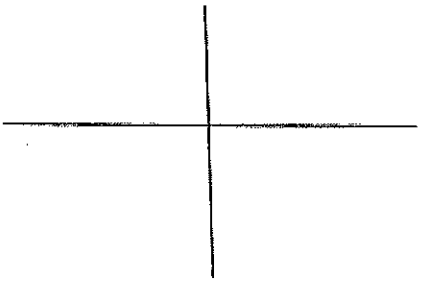
$$\sqrt{A_x^2 + A_y^2} = Resultant$$

$$\sqrt{10^2 + (-5)^2} = 11\ m$$

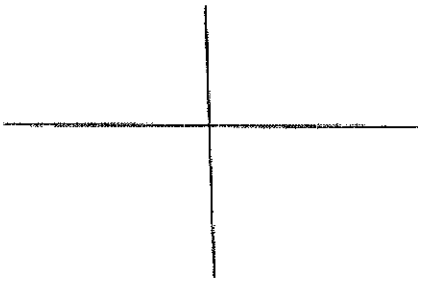
$$\tan\theta = \frac{opp}{adj} \quad therefore \quad \theta = \tan^{-1}\frac{opp}{adj}$$

$$\theta = \tan^{-1}\frac{-5.0}{10} \text{ or } -27° \text{ or } 333°$$

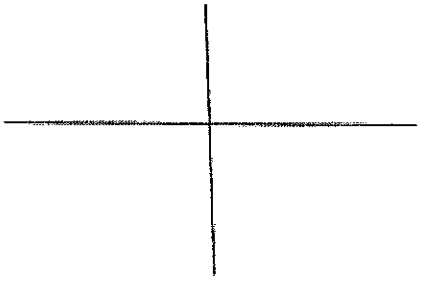
40. x = 200, y = 100



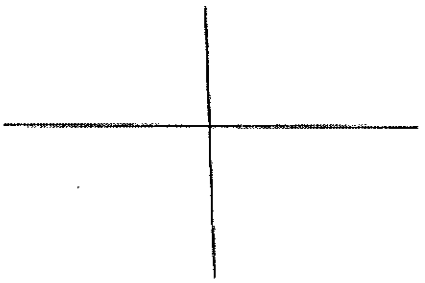
41. x = -100, y = 75



42. x = -25, y = -45

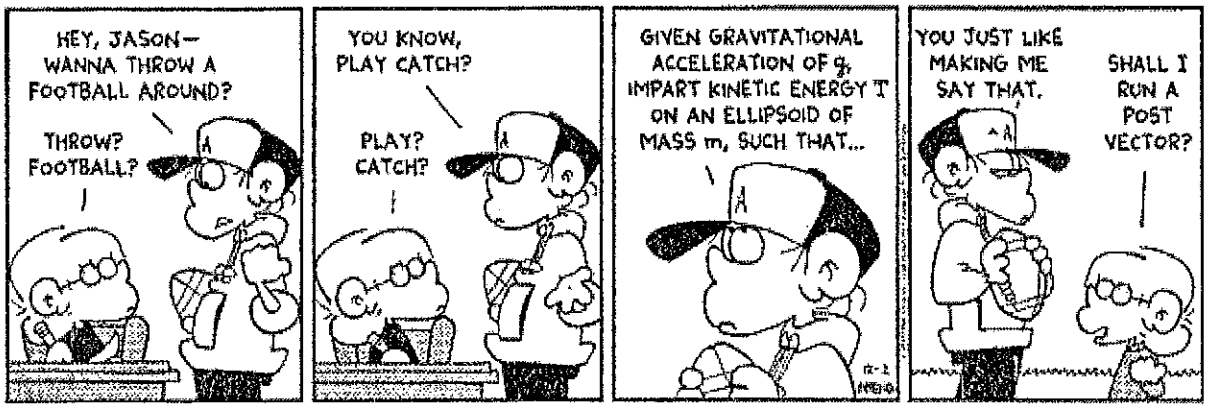


43. x = 30, y = -60



Assignment #3 -- Kinematics (science of motion), Labs & Simulations -- Due August

There will be times throughout the year when you will be required to go online to complete online simulation labs as well as research topics being discussed in the class. Here is your first! One of the best resources for basic physics understanding and application is www.physicsclassroom.com, so be sure to bookmark it for future reference (hyperphysics is another). Print out this assignment, complete questions #44-58



You will use this website to complete the following questions and graphs, which will give you the foundation needed for not only the first unit of study (Kinematics), but for the whole course as it is cumulative!

Go to www.physicsclassroom.com

Click on the link on the left for "Physics Tutorial"

In the middle under "The Physics Classroom Topics" choose the link "1-D Kinematics"

Take your time, record some notes for yourself and slowly read over all the material found in lesson 1 through lesson 6.

Answer and complete the following:

Lesson 1

44. Describe in your own words the meaning of a vector's magnitude.

45. Differentiate between displacement and distance and include the following: when are they ever the same and when are they different?

46. Do the same as above for question 45 but for speed and velocity.

47. How does acceleration relate to velocity and give an example of when one would experience a negative acceleration?

Lesson 2

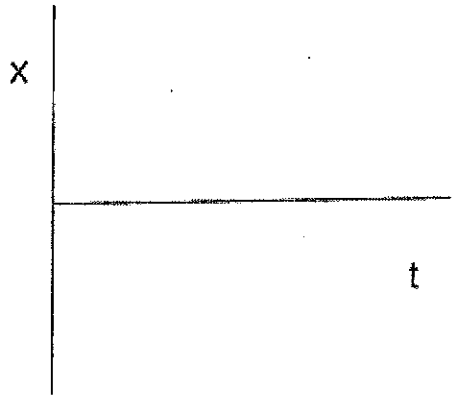
48. Draw an example of a ticker-tape diagram for an automobile accelerating from rest and moving to the right.

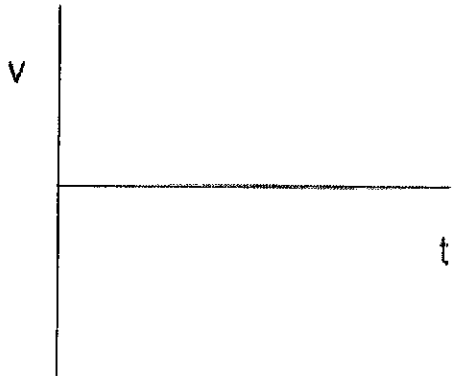
49. Draw a vector diagram for the same thing as 48.

Lesson 3 & 4

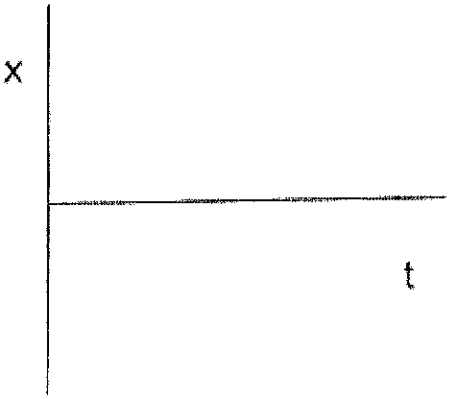
50. Sketch a position versus time (position-time or x-t) graph and a velocity versus time (v-t) graph for each of the following scenarios (assume right is positive for both displacement and velocity):

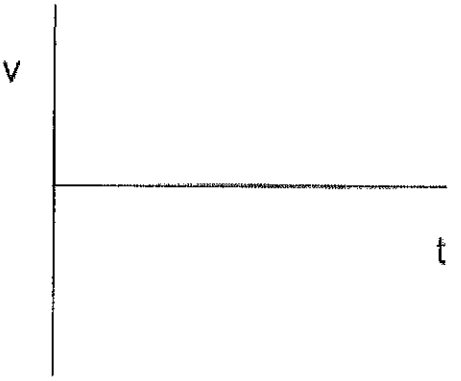
a. A car moving to the right at a constant velocity



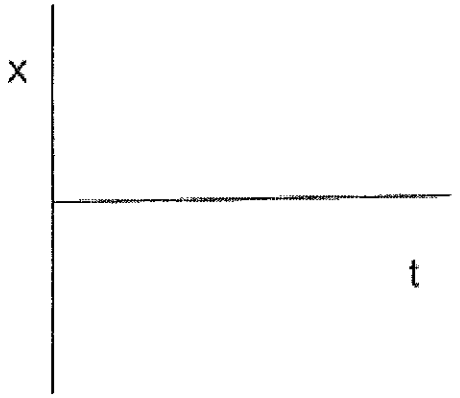


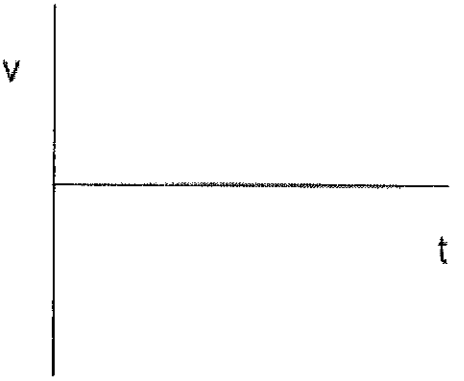
b. A car moving to the right with an increasing velocity.





c. A car moving to the right with a decreasing velocity.





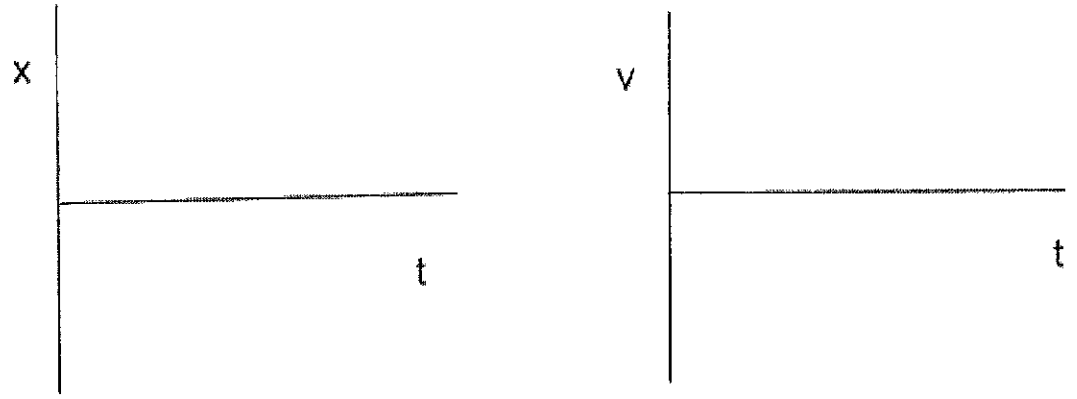
Lesson 5

51. What is the symbol for gravity and what value does it represent (memorize both for the whole year!)?

52. What is the total field gravitational value for "Jacksonville"? Use the widget at the bottom of the page.

53. Explain the term "free fall" in your own words.

54. Draw the curves for both x-t and v-t graphs below for an object in free fall assuming up is positive (the object would be dropping *down* toward the surface of Earth).



55. What value would the acceleration on the object above have now? Does it change anytime during its fall? Describe the motion of its fall.

56. If there was no air resistance, which object falls faster: an unfolded piece of paper or an anvil?

Lesson 6

Although physicsclassroom.com writes them differently, these are the first four kinematic equations and the first four equations you will learn/use throughout the whole year (cumulative remember that!):

$v = \frac{\Delta x}{\Delta t}$ $\quad v_f = v_i + at$ $\quad v_f^2 = v_i^2 - 2a\Delta x$ $\quad x_f = x_i + v_i t + \frac{1}{2}at^2$

These equations are used often and can have their x-displacements switched with y-displacements for vertical motion.

57. Which one would be best to find the distance the object fell from free-fall if it fell for six seconds, assuming it fell in the absence of air resistance and it still hasn't it the ground? Solve this problem and show all steps of work

(you will need to replace the variables x with y as the object is moving only on the y-axis).

58. In AP Physics, , you may be asked to design and/or critique a lab design. So, for practice, design a lab to answer the following question:

What is the height of the flagpole in front of D W Daniel?

Equipment provided: meter stick, protractor, string, a set of masses, straws, metric tape measure, masking tape (you do not need to use all the equipment)

Be sure to clearly outline the procedure that should be followed to answer the question. Consider all aspects of a good lab. Write out the procedure in PARAGRAPH form, NOT as a list of steps. Do not list the equipment either. Simply include the equipment as needed in the paragraph. Also include an explanation (and example) of the calculations that must be done to complete the lab.

Assignment #4 -- Mastering Physics Module (Kinematics - 1D) - Due Aug 28 (nothing to hand in)

Log onto Mastering Physics. Look at the calendar and click on the assignment (Kinematics Module) that is due on August 28 Follow the instructions to complete the module.

ENJOY THE REST OF YOUR SUMMER!

I'm looking forward to a GREAT year!!!