AP Physics 1 - Summer Assignment

This assignment is due on the first day of school. You must show all your work in all steps.

Do not wait until the last minute to start this assignment.

Summer Help Session:

Via Schoology this year: Group Code: 3F6Q-4M5H-NGP6X

<u>This material will help you with the first couple of weeks in the course!</u>

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.

Things to know about AP Physics:

1. Do not take AP Physics for the "AP GPA Grade Booster". You take it learn the content and better prepare yourself for college.
2. 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.
3. 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.
4. Your book is your friend. When told to read a chapter or two (or more), you <u>*NEED*</u> to do it. To say you do not 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.
    a. When you are in college (which you are now thanks to AP), reading and taking notes are the key to success in the hard sciences.
5. We now live in the technology era. You have THE INTERNET! I am making resources for you as fast as I can but 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.
6. 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.
7. Your peers are guiding light. Rely on one another so that you can help each other when the time comes and use your time wisely (i.e. socializing during class means you will be doing work for class when you want to socialize outside of class).
8. 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.

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

Basic Algebra

You will be using these skills daily. Familiarize 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!)

1. $K = \frac{1}{2}mv^2$

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

   Answer: ________ Unit: ________

2. $F = G\frac{M_1 M_2}{r^2}$

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

   Answer: ________ Unit: ________

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

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

   Answer: ________ Unit: ________

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

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

   Answer: ________ Unit: ________

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

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

   Answer: ________ Unit: ________

Basic Algebra Cont.

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

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. ${v_f}^2 = {v_i}^2 - 2a(x_f - x_i)$; solve for x_i

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

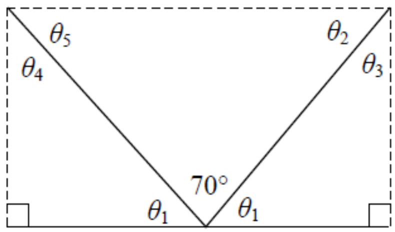
15. $T = 2\pi\sqrt{\frac{m}{k}}$; solve for *k*

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 and you will need to know the trig. for common angles without the use of a calculator (see table below).

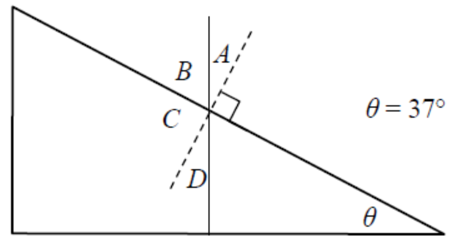
Solve for the missing angles in the following problems:

16.



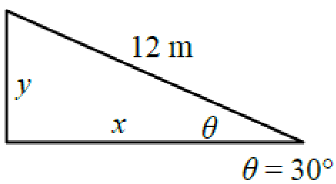
Solve for angles 1-5.

17.



Solve for angles A-D.

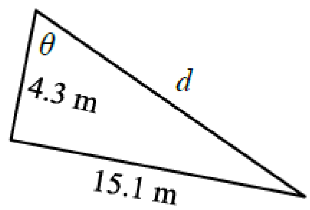
18. Solve for the missing sides:



$y =$ ________

$x =$ ________

19. Solve for missing side and angle:

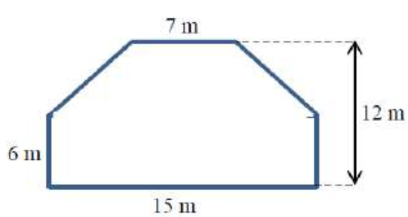


$d =$ ________

$\theta =$ ________

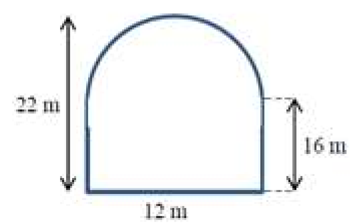
Solve for the area in the following problems:

20.



Area = ________

21.



Area = ________

Complete the following table (learn these values)

Trigonometry Function	**0°**	**30°**	**45°**	**60°**	**90°**
sinθ					
cosθ					
tanθ					

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):

22. 35 kg → g

25. 7.2 cm^2 → m^2

26. 81 m^3 → km^3

23. 1.8μm → m

27. 31 km/hr → m/s

24. 9 MJ → cJ

Graphing/Data Analysis

You must be able to interpret and create graphs by hand and with computer software. 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 (get used to having time on the x-axis). Never connect the dots as it is a scatter plot.

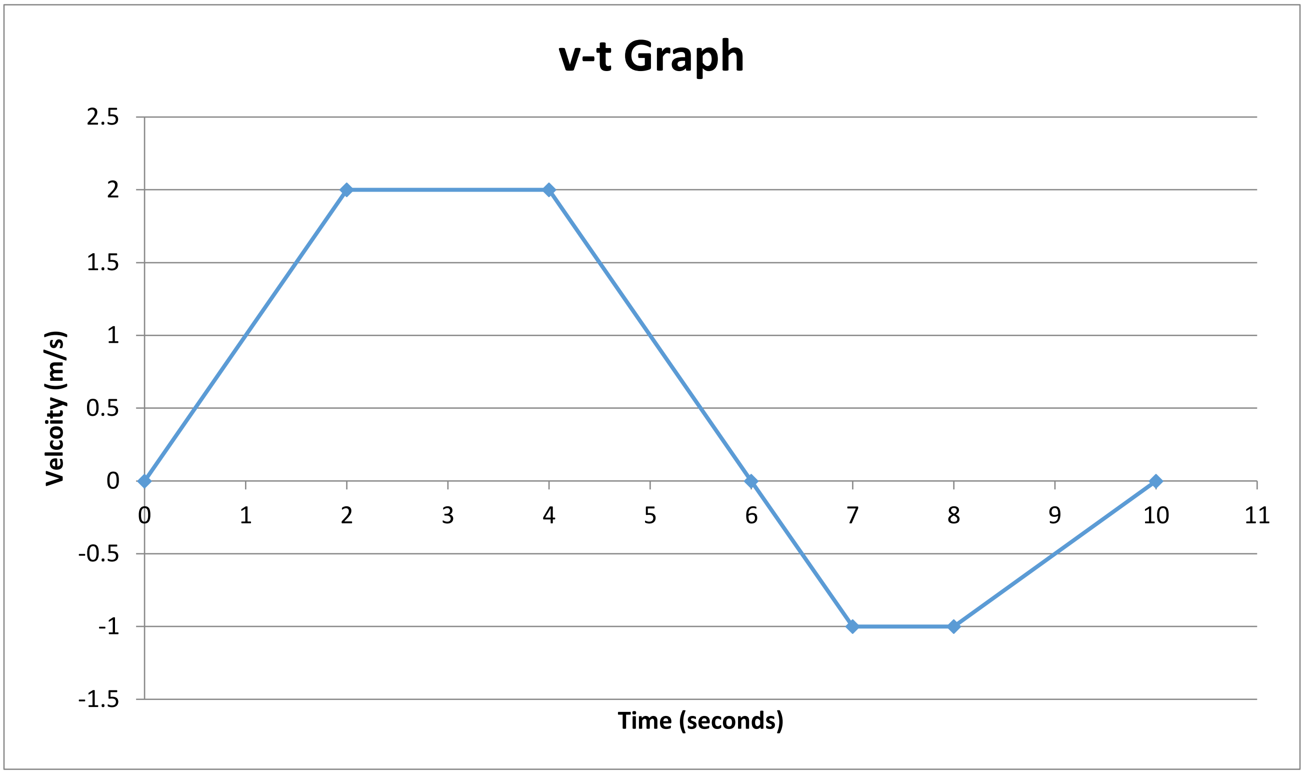
Distance (m)	Time (s)
0.0	0.0
3.6	1.0
7.1	2.0
11.1	3.0
14.6	4.0
18.2	5.0

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

30. Calculate the slope of your best-fit line, with showing all your work. Include your units with the answer.

31. What relationship is found between the distance and time?

Graphing/Data Analysis Cont.



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.

32. What is the slope of the line from 4 seconds to 7 seconds, show your work?

33. What is the area under the curve between 0 seconds and 2 seconds, show your work?

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

35. During which period is the car moving to the left? When did it turn around?

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)

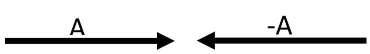
Vectors are measurements that have a magnitude and a direction (e.g. 2 m/s east, 9.8 m/s^2 down, 3 N out, etc.)

Length of vectors are proportional to their magnitude:

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.

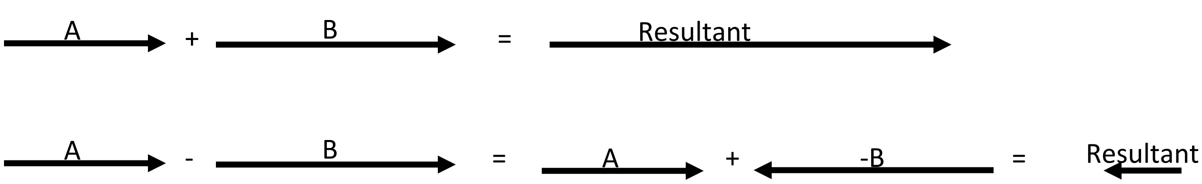


Negative vectors have same magnitude but are 180° opposite direction

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

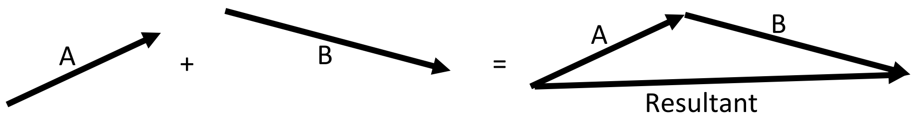
Vector Math:

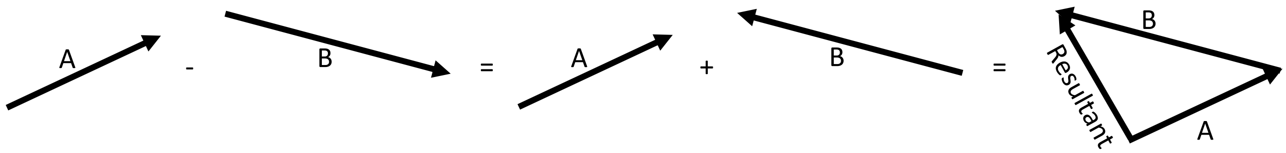
- You can add or subtract vectors but you can always use addition but sometimes with a negative number (subtraction).
  - **Resultant**: The result of adding vectors
    - When adding vectors, there are two methods: *tip-to-tail and mathematical components*.



Vector Math Cont.

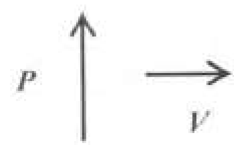
This tip-to-tail method can also be done in two-dimensions





36. X + Y

38. P + V

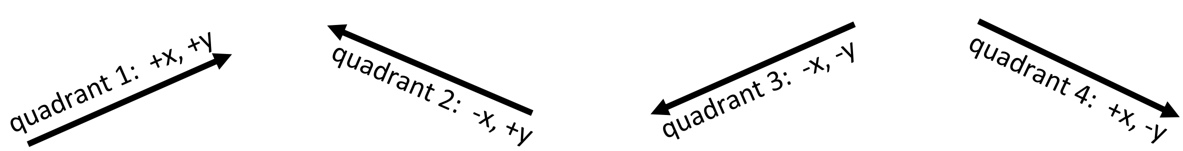


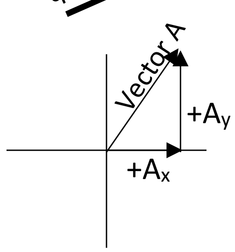
37. T − S

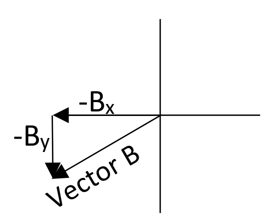
39. C − D

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.

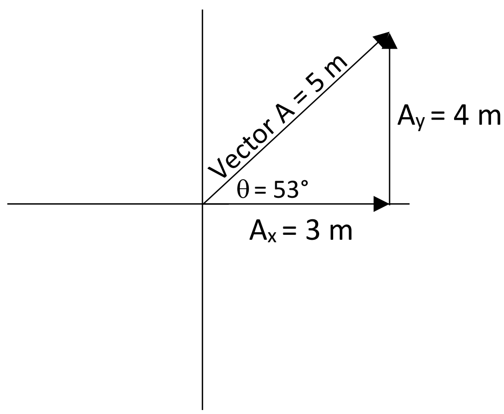
In the _mathematical component method_, we do not connect or move any vector around the paper. We simply use the coordinate plane orientation with the four quadrants and use basic trigonometry to find the horizontal and vertical components that make up the vector (we take the vector as the hypotenuse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







Vector Math Cont.



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!

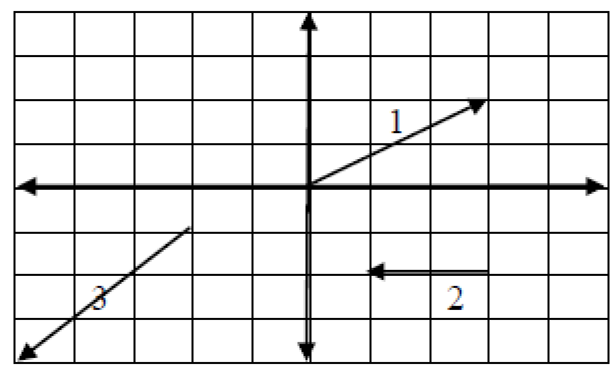
You try it now with the following problems:

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

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

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

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



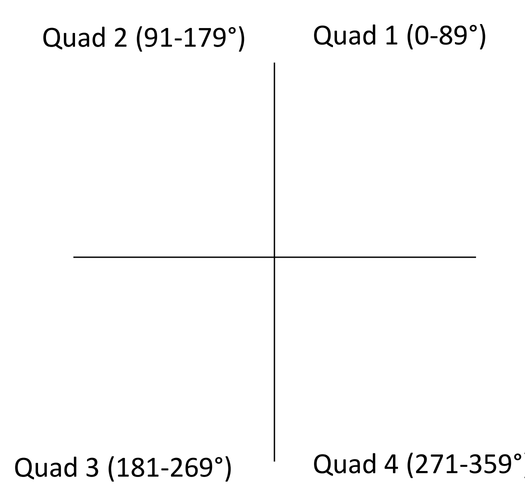
Given a vector (magnitude and direction), you should now be able to graph it on a coordinate plane and using trigonometry find the x- and y-components. Remember to keep your calculator in Degree Mode (i.e. not Radians).

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

43. 15 m @ 77°

44. 8.0 m @ 235°

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



Vector Math Cont.

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

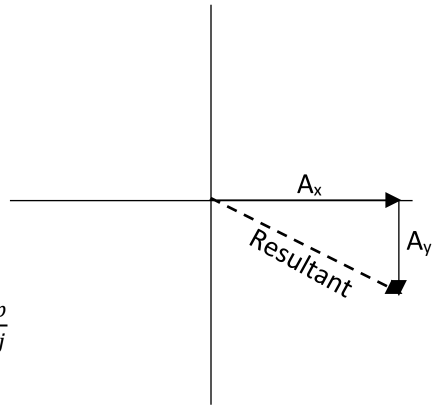
e.g. A_x = 10 m, A_y = -5.0 m

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

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

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

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



Resultant is 11 m @ 333°

46. x = 200, y = 100

47. x = -100, y = 75

48. x = -25, y = -45

49. x = 30, y = -60

Kinematics (science of motion), Labs & Simulations

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).

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

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

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

52. Do the same as above for question 50 but for speed and velocity.

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

Kinematics (science of motion), Labs & Simulations Cont.

Lesson 2

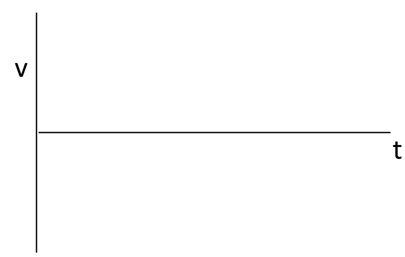
54. Draw an example of a ticker-tape diagram (motion diagram) for an automobile accelerating from rest and moving to the right.

55. Draw a vector diagram (arrows to scale diagram) for the same thing as 53.

Lesson 3 & 4

56. 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

Kinematics (science of motion), Labs & Simulations Cont.

Lesson 5

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

58. What is the total field gravitational value for “Jacksonville”? Use the widget at the bottom of the page.

59. Explain the term “free fall” in your own words.

60. 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).

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

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

Lesson 6

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

$$v = \frac{\Delta x}{\Delta t} \qquad v_f = v_i + at \qquad {v_f}^2 = {v_i}^2 + 2a(\Delta x) \quad x_f = x_i + v_i t + {}^1/_2\, at^2$$

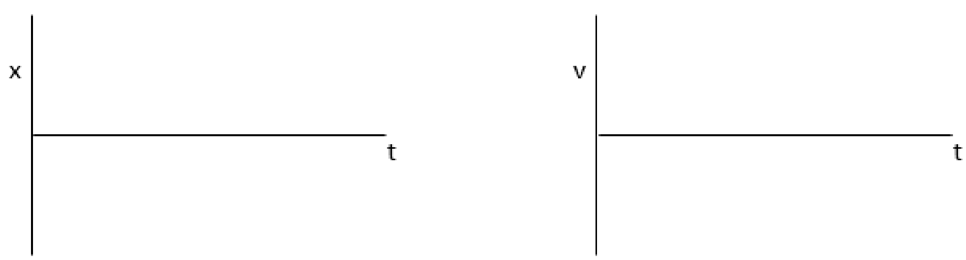
These equations are used often and can have their x-displacements switched with y-displacements for vertical motion.

63. Which one would be best to find the *displacement* of the object after freely falling for 6.0 seconds, assuming it fell in the absence of air resistance and it still has not hit 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).

64. A ball is rolling on the ground with a speed of 2.0 m/s. If it comes to a complete stop in 6.0 seconds, how far has it travelled in total during the 6.0 second interval?

65. Sketch the x-t and v-t graphs for this ball.



66. At $t_0 = 0$, an object is moving to the right with an initial speed of 7.1 m/s but has an acceleration going to the left, which is a constant -5.8 m/s/s.
    a. If a time of 3.9 seconds has gone by, how far left is it now than its original position at time t_0?
    b. What is its total *distance* traveled?