Name: _____

AP Physics 1 Summer Work 2025

Welcome to AP Physics 1! It is a college level physics course that is fun, interesting and challenging on a level you likely have not yet experienced.

The exercises below are a review of the prerequisite math skills that you need to succeed in AP Physics 1. Make sure to read all directions throughout the packet. All work must be completed with intermediate steps shown as necessary. Final answers can be in fractions and in terms of mathematical constants (g, π, etc.) or can be in whole numbers.

Your work must be legible and linear, and I must be able to follow it easily. Please, no incoherent jumping around the page. To this end, please show your work on a separate sheet of paper if necessary and start a new sheet after every completed part (if you have enough room to neatly show your work on this paper that is fine). Mark your final answers by either circling or boxing them.

Your completed summer work is due the first day of class.

Do not copy work from another student for your own integrity and for your own benefit because all AP Physics 1 students will take a quiz with problems similar to those found on this review the first week of school. You must score a 90% or better on the quiz.

Use a math book or internet for reference. No physics is needed for the majority of the packet. If you have difficulty, please do not hesitate to email me at **kfowler@msad51.org**

Part 1: Scientific Notation

Many numbers in physics will be provided in scientific notation. You need to be able to read and simplify scientific notation. (This section is to be completed without calculators…all work should be done by hand.)

Express the following numbers in scientific notation. Keep the same unit as provided. ALL answers in physics need their appropriate unit to be correct.

1. 8,640,000 kg

2. 7345.2 s

3. 0.000000003 m

4. 0.0067 km/s

Oftentimes, multiple numbers in a problem contain scientific notation and will need to be reduced by hand. Before you practice, remember the rules for exponents.

When numbers are multiplied together, you (*add / subtract*) the exponents and (*multiply / divide*) the bases.

When numbers are divided, you (*add / subtract*) the exponents and (*multiply / divide*) the bases.

When an exponent is raised to another exponent, you (*add / subtract / multiply / divide*) the exponent.

Using the three rules from above, simplify the following numbers in proper scientific notation:

5. $(3 \cdot 10^{6}) \cdot (2 \cdot 10^{4}) =$

6. $(1.3 \cdot 10^{4})/(6 \cdot 10^{-2}) =$

7. $((8 \cdot 10^{3})/(2 \cdot 10^{5}))^{-1} =$

8. $(2 \cdot 10^{-3})^{3} =$

Part 2: Dimensional Analysis

For each of the following dimensional analysis problems be sure to show all work including your conversion factors and crossing out of units:

1. Cumberland Center has an elevation of 5.7×10^4 mm. What is the elevation in km?

2. A small herd of cattle consumed 14 bales of hay in 2 weeks. How many bales will this herd consume in 3 years?

3. If a projectile travels 3.00×10^3 feet in 1 second, how far will it travel in 18 minutes?

4. How many seconds are in 62 months?

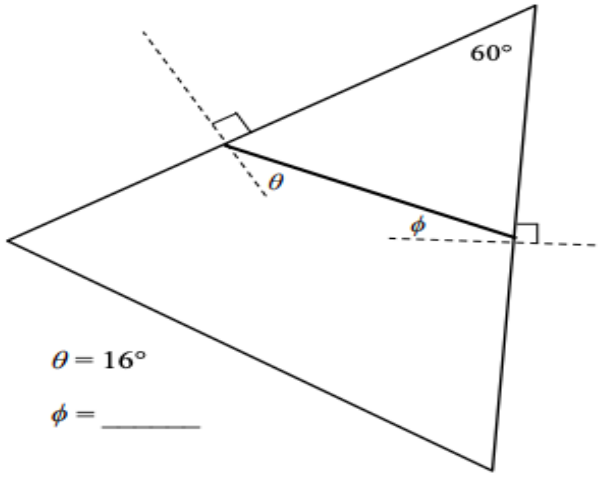
5. A greely High School senior was applying to college and wondered how many applications she would have to send. Mrs. Fowler explained that because of her excellent Chemistry grade she would likely be accepted to one out of every three schools she applied to. She realized that for every application, she would have to write three essays and that each essay would require 2 hours of work. Since writing essays requires serious mental effort she realizes that she will expend 500 calories for each hour of writing, which she can obtain from eating her mother's apple pies, each of which contains 100 calories. If her mother bakes her a pie every three times she cleans her room, how many times will she need to clean her room to gain acceptance to ten colleges?

Part 3: Geometry

Calculate the angles in the following figures:

Calculate the unknown angle values for questions 3-6.

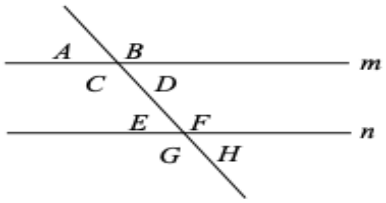
3.



$\theta = 16°$

$\phi =$ _____

4.

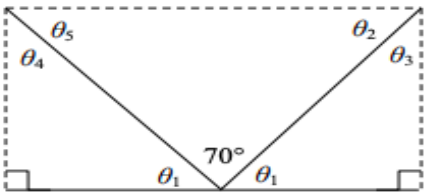


Lines m and n are parallel.

$A = 75°$ $B =$ _____ $C =$ _____ $D =$ _____

$E =$ _____ $F =$ _____ $G =$ _____ $H =$ _____

5.



$\theta_1 =$ _____

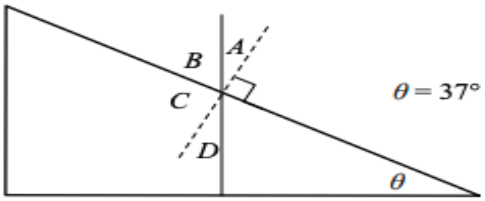
$\theta_2 =$ _____

$\theta_3 =$ _____

$\theta_4 =$ _____

$\theta_5 =$ _____

6.



$A =$ _____ $B =$ _____

$C =$ _____ $D =$ _____

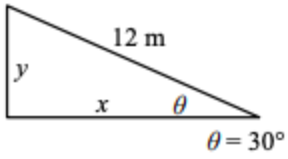
Part 3: Trigonometry

Write the formulas for each one of the following trigonometric functions. Remember SOHCAHTOA!

$sin\theta =$ $cos\theta =$ $tan\theta =$

Calculate the following unknowns using trigonometry. Use a calculator, but show all of your work. Please include appropriate units with all answers. (Watch the unit prefixes!)

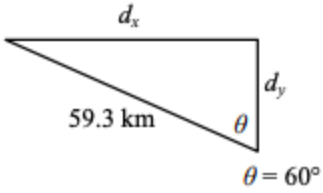
1.



$y =$ _____

$x =$ _____

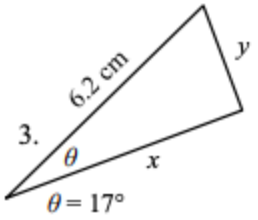
2.



$d_x =$ _____

$d_y =$ _____

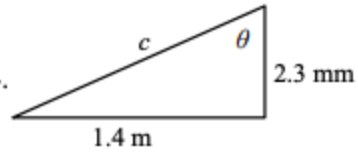
3.



$x =$ _____

$y =$ _____

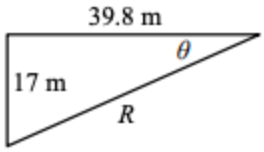
4.



$c =$ _____

$\theta =$ _____

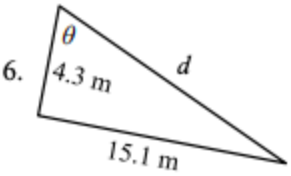
5.



$R =$ _____

$\theta =$ _____

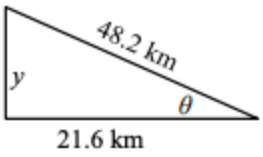
6.



$d =$ _____

$\theta =$ _____

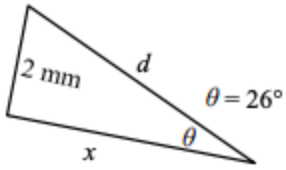
7.



$y =$ _____

$\theta =$ _____

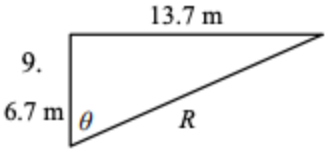
8.



$x =$ _____

$d =$ _____

9.



$R =$ _____

$\theta =$ _____

Part 4: Algebra

Solve the following (almost all of these are extremely **easy** – it is *important* for you to work *independently*). Units on the numbers are included because they are essential to the concepts, however they do not have any *effect* on the actual numbers you are putting into the equations. In other words, the units do not change how you do the algebra. Show every step for every problem, including writing the original equation, all algebraic manipulations, and substitution! You should practice doing all algebra *before* substituting numbers in for variables.

Section I: *For problems 1-5, use the three equations below:*

$v_f = v_0 + a \cdot t$ (1) $x_f = x_0 + v_0 t + \frac{1}{2} a \cdot t^2$ (2) $v_f^{\,2} = v_0^{\,2} + 2a(x_f - x_0)$ (3)

1. Using equation (1) solve for *t* given that $v_0 = 20\ m/s,\ v_f = 25\ m/s,\ and\ a = 10\ m/s^2$

2. $a = 10\ m/s^2,\ x_0 = 0\ m,\ x_f = 120\ m,\ and\ v_0 = 20\ m/s.$ Use the second equation to find *t*.

3. $v_f = -\ v_0\ and\ a = 2\ m/s^2.$ Use the first equation to find t/2.

4. How does each equation simplify when $a = 0\ m/s^2\ and\ x_0 = 0\ m$?

Section II: *For problems 5-9, use the four equations below.*

$\sum F = ma$ $f_s \leq \mu_s N$ $f_k = \mu_k N$ $F_s = -\ k\Delta x$

5. If $\sum F = 10\ N\ and\ a = 1\ m/s^2$, find *m* using the first equation.

6. Given $\sum F = f_k,\ m = 250\ kg,\ \mu_k = 0.2$ and N=10, find *a*.

7. $\sum F = T - 10m$, but *a*=0 m/s^2. Use the first equation to find *m* in terms of T.

8. Use the first equation in Section I, the first equation in Section II and the information given below to find $\sum F$.

   $m = 12\ kg,\ v_0 = 15\ m/s,\ v_f = 5\ m/s,\ and\ t = 12\ s.$

9. Use the last equation to solve for F_s if k=900 N/m and $\Delta x = 0.15\ m$.

Part 5: Graphing and Functions

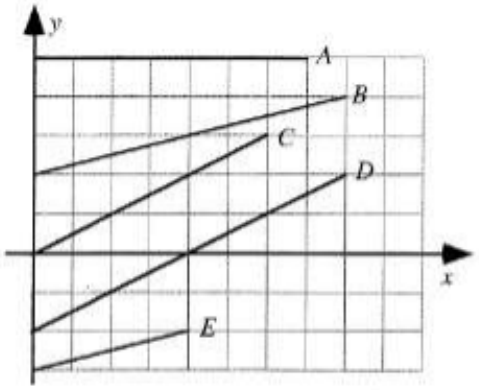
A greater emphasis has been placed on conceptual questions and graphing on the AP exam. Below you will find a few example concept questions that review foundational knowledge of graphs. Ideally you won't need to review, but you may need to review some math to complete these tasks. At the end of this part is a section covering graphical analysis that you probably have not seen before: *linear transformation*. This analysis involves converting any non-linear graph into a linear graph by adjusting the axes plotted. We want a linear graph because we can easily find the slope of the line of best fit of the graph to help justify a mathematical model or equation.

Key Graphing Skills to remember:

1. Always label your axes with appropriate units.
2. Sketching a graph calls for an estimated line or curve while plotting a graph requires individual data points AND a line or curve of best fit.
3. Provide a clear legend if multiple data sets are used to make your graph understandable.
4. Never include the origin as a data point unless it is provided as a data point.
5. Never connect the data points individually, but draw a single smooth line or curve of best fit
6. When calculating the slope of the best fit line you must use points from your line. You may only use given data points IF your line of best fit goes directly through them.

Conceptual Review of Graphs

Shown are several lines on a graph.

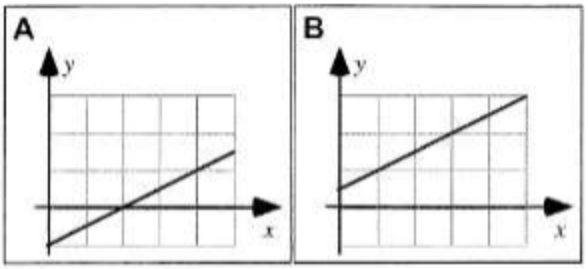


Rank the slopes of the lines in this graph.

					OR			
1 Greatest	2	3	4	5 Least		All the same	All zero	Cannot determine

Explain your reasoning.

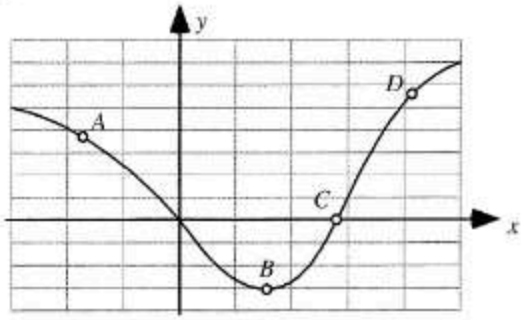
Shown are two graphs.



Is the slope of the graph (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases?* _____

Explain your reasoning.

Four points are labeled on a graph.



Rank the slopes of the graph at the labeled points.

				OR			
					☐	☐	☐
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

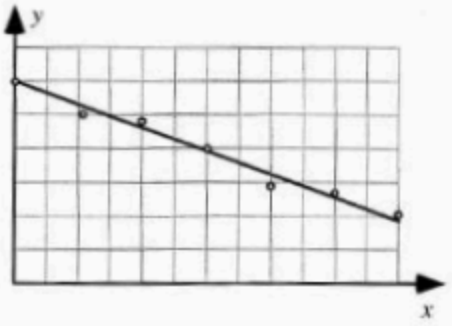
Explain your reasoning.

A1-WWT22: LINE DATA GRAPH—INTERPRETATION

A student makes the following claim about some data that he and his lab partners have collected:

"Our data show that the value of y decreases as x increases. We found that y is inversely proportional to x."

What, if anything, is wrong with this statement? If something is wrong, identify and explain how to correct all errors. If this statement is correct, explain why.



Part 6: Analyzing Linear Motion

Objects have a position (x) and a time (t). If an object is changing its position over a period of time it is said to be in motion. The rate of change of position per unit time is called velocity.

In the following activity, you will watch a very simple simulation and then answer some questions about what you see on the screen:

1. Go to the following website: https://javalab.org/en/constant_velocity_en/.
2. Make sure the turtle's velocity is set to 1 m/s and click the RUN box.
3. The screen shows you three different representations of motion, all of which are part of the AP Physics curriculum:

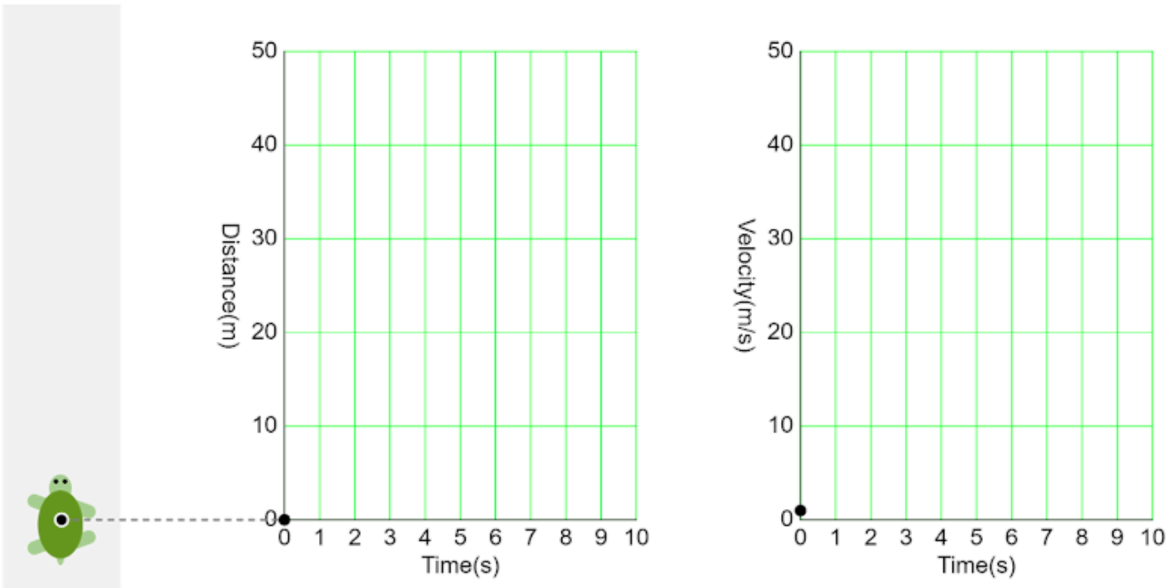
    a particle model (This is a model that treats an object's center of mass as a single particle (represented by a dot), and shows its exact position at equal time intervals. It is also called a motion diagram or a Ticker Tape Diagram

    a position vs. time graph

    a velocity vs. time graph

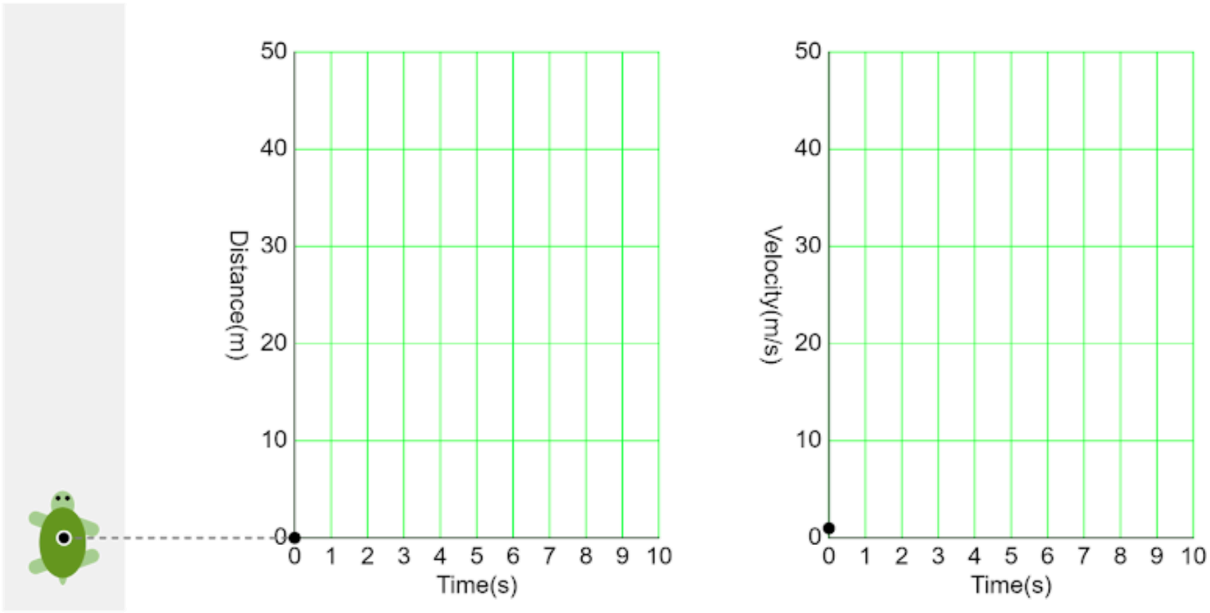
Please use a pencil to draw the particle model (the **dots** you see the turtle create) and use a pencil and a straight-edge to draw the line created on both graphs.

Trial 1: v=1 m/s



4. Click “RESET” and change the turtle’s speed to 5 m/s and run the simulation again. Again, use a pencil to draw the particle model you see on the screen and use a pencil and a straight-edge to draw the line created on both graphs. Write an equation for both graphs directly under each graph.

Trial 2: v=5 m/s



5. Briefly explain how the particle models (dots) in Trial 1 and 2 appear different.

6. Based on what you just wrote, try and use three or less words to describe ***the speed*** of the object moving from left to right depicted in the particle model below.

7. Briefly explain how the distance vs. time graphs for the two trials are the same, referring specifically to the slope.

8. Briefly explain how the distance vs. time graphs for the two trials are different, referring specifically to the slope.

9. Which of the following phrases **best describes** the **slope** of the d vs t graphs created by the simulation? (BE CAREFUL)

A. Increasing and positive
B. Decreasing and positive
C. Constant and positive
D. Constant and negative

Justify your answer:

10. Go to the following webpage: http://www.physicsclassroom.com/class/1DKin/Lesson-3/The-Meaning-of-Shape-for-a-p-t-Graph and, after reading, briefly **explain** the meaning of the slope for a position versus time (d-t) graph.

11. Which of the following phrases best **describes** the velocity of the turtle, if the positive direction is defined as up the screen?

A. Increasing and positive
B. Decreasing and positive
C. Constant and positive
D. Constant and negative

Justify your answer

12. Velocity can be calculated with the simple equation $v = \frac{\Delta d}{\Delta t}$. If Δd means change in position and Δt means change in time, what is the SI unit for velocity?

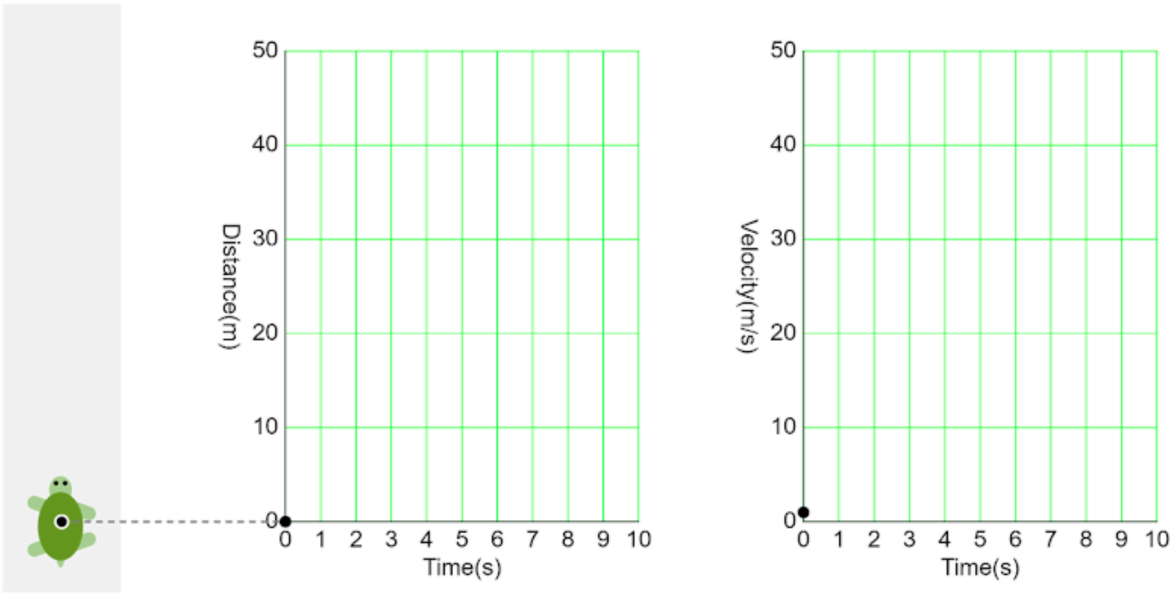
13.. Briefly explain how the velocity vs. time graphs for the two trials are the same, referring specifically to the slope.

14. Briefly explain how the velocity vs. time graphs for the two trials are different.

15. Go to http://www.physicsclassroom.com/class/1DKin/Lesson-4/Meaning-of-Shape-for-a-v-t-Graph and, after reading, explain the meaning of slope on a v-t graph.

16. Define acceleration. What is the acceleration of the turtle during trial 1 and trial 2?

17. Now imagine a scenario where the turtle starts from rest at position d= 0 m and increases its velocity (or accelerates) at a uniform rate of 4 m/s every second. (A turtle is not capable of this kind of acceleration, but let's just imagine for the sake of graphing they are!) Sketch in the particle model and the lines you think you might see on these two graphs in this case of the turtle speeding up. *Hint: Remember what the slopes of these graphs represent and make sure your drawing accurately reflects what you learned.*



18. **Go back to all 6 graphs you sketched and write the correct equations for the lines you drew directly on top of each graph. (Instead of using y's and x's, use the symbol for the variables on the y and x axes - like d and t or v and t)**

Congratulations! You're finished! That wasn't so bad was it? *Trust me*… the blood, sweat, and tears it took to get through all of those problems will make everything later on a lot easier. Think about it as an investment with a guaranteed return.

This course is a wonderful opportunity to grow as a critical thinker, problem solver and great communicator. Don't believe the rumors- it is not impossibly hard. It ***does*** *require hard work, but so does anything that is worthwhile. You would never expect to win a race if you didn't train. Similarly, you can't expect to do well if you don't train academically. AP Physics is immensely rewarding and exciting, but you do have to take notes, study, and read the book (gasp!). I guarantee that if you do what is asked of you then you will look back to this class with a huge sense of satisfaction! I know I can't wait to get started… Let's learn some* ***physics****!!!*