AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

Greek Letters

In Physics, we use variables to denote a variety of unknowns and concepts. Many of these variables are letters of the Greek alphabet. If you are not familiar with these letters, you should become so. While there is no practice work for this section and while you do not have to outright memorize these letters at this point, you need to have this exposure so that when class starts and you see this on the board: μ you don't call it, "that funny-looking m-thing".

These variables have specific names and I will be using these names. You need to do this as well.

Greek Letter	Name	Commonly used for
α	Alpha (lowercase)	Angular acceleration, radiation particle
β	Beta (lowercase)	Radiation particle
Δ	Delta (uppercase)	Showing a change in a quantity
ε	Epsilon (lowercase)	Permittivity
ϕ	Phi (lowercase)	Magnetic Flux, work function
γ	Gamma (lowercase)	Radioactivity, relativity
λ	Lambda (lowercase)	Wavelength
μ	Mu (lowercase)	coefficient of friction
π	Pi (lowercase)	Mathematical constant
θ	Theta (lowercase)	Angle name
ρ	Rho (lowercase)	Density, resistivity
Σ	Sigma (uppercase)	Showing the sum of numbers
τ	Tau (lowercase)	Torque
ω	Omega (lowercase)	Angular velocity
ξ	Xi (uppercase)	Electromotive force; induced voltage

The Metric System

Everything in physics is measured in the metric system. The only time that you will see English units is when you convert them to metric units. The metric system is also called SI (from the French, "Système International"). In the SI system fundamental quantities are measured in meters, kilograms, and seconds.

Here are the metric prefixes that we will use throughout the year:

Name of prefix	Numerical value	Abbreviation
pico-	10^{-12}	p
nano-	10^{-9}	n
micro-	10^{-6}	μ
milli-	10^{-3}	m
centi-	10^{-2}	c
kilo-	10^{3}	k
mega-	10^{6}	M
Giga	10^{9}	G

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

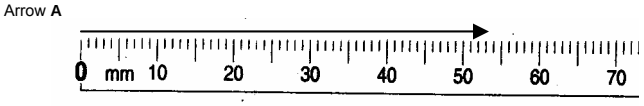
Note that the symbol for micro- is the lowercase Greek letter mu. Its name is "mu" (pronounced "me-you") and not, "that funny-looking m-thing".

To help memorize some of these prefixes: micro- is the same prefix used in the word, "microscope" which is a tool used to view very small things. Mega- and micro- both start with the letter "m" and stand for, respectively, "million" and "millionth.

I. Measurements and Significant Figures

When using a measuring device, you **MUST** estimate between the smallest marks on the instrument. For example, if a ruler is marked off in increments of whole milliimeters, you estimate the length of an object to the closest tenth of a millimeter.

Use the ruler below to measure the length of the arrow. Remember to estimate between the smallest marks.



The length of the arrow is _____ mm.

Precision is also important in labs and when solving problems. In Physics, the same thing is true—you can not round numbers at will. You must obey the rules for significant figures.

	example	# of sig.figs.
Non - zero numbers are significant.	**126 245 g**	**6**
Zeros between non - zero numbers are significant.	**12 027 m**	**5**
Zeros at the end of the number to the right of the decimal are significant.	**23.00 kg**	**4**
Zeros in front of non zero numbers are not signifcant.	**0.0502 s**	**3**
Zeros at the end of the number to the left of the decimal are not significant unless they were measured. Use scientific notation for clarity.	**1000 m** **1.00×10^3 m**	**unknown, could be 1 to 4** **3, zeros would not be shown unless they were measured.**

When adding or subtracting numbers, the precision of the answer can be no greater than the precision of the least precise value.

```
    9 7 . 3        (least precise value, your answer will be rounded to the same
                    decimal place as this value)
      4 . 3 2
+     0 . 1 4 7
-------------
  1 0 1 . 7 6 7    → round to nearest 1/10th so final answer is 101.8
```

97.3 is only known to the nearest $1/10^{th}$, 4.32 to the nearest $1/100^{th}$, and 0.147 to the nearest $1/1000^{th}$. Therefore the final answer must be rounded to the nearest $1/10^{th}$.

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

When multiplying or dividing numbers, the final answer has the same number of significant figures as the measurement having the smallest number of significant figures.

	9	.	8	1				3 significant figures
x	0	.	0	0	5	3		2 significant figures
	0	.	0	5	1	9	9	3 round to 2 significant figures → 0.052

In laboratory work, values calculated from measurements cannot be more precise than the measurements themselves. For example, if we measure the sides of a cube to be 0.252 m, 0.253 m, and 0.251 m, when the volume is determined we use significant figure rules.

0.252 x 0.253 x 0.251 = 0.016002756 in a calculator.

However, we can only keep three significant figures, so you would record 0.0160 m^3.

Note that significant figures rules are a guideline to determine precision of calculations. The actual experimental conditions and procedures may result in precision that is worse than what significant figures rules allow. But the precision of calculations based on one-time measurements cannot be better than what the significant figures rules allow.

In Physics, we often use the slope of a best-fit line to average together the results of many measurements.

Problems:

1. Two students are measuring the density of a block of wood. The measurements of the block are length = 0.240 m, width = 0.152 m and height = 0.205 m. The mass is measured to be 4.253 kilograms. Calculate the density to the correct number of significant digits. (Recall that density is mass divided by volume.) How could this experiment be improved using the slope of a graph? What would you graph?

2. To determine the average velocity of a bowling ball, students measure the distance traveled as 15.00 meters, and the time as 10.35 seconds. Calculate the average velocity to the correct number of significant figures. (Recall that velocity is displacement divided by time.) Considering human reaction time, do you think significant figures rules give a valid estimation of the precision of the experiment? Explain. How could this experiment be improved using the slope of a graph? What would you graph?

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

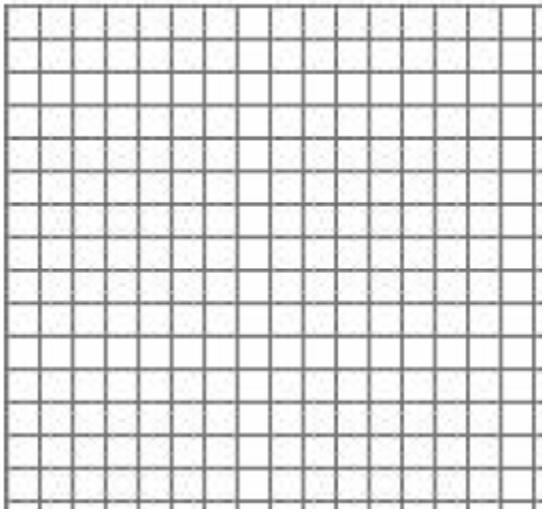
Graphing and Graph Interpretation

You should be familiar with graph construction (by hand and on a calculator). This is a topic that often appears on AP exams and is an easy way to score points on any assignment.

Note: When you are told to graph Apples vs. Oranges, the first thing goes on the y-axis. The second thing is on the x-axis.

Fill in the following table and plot the points on the grid below as distance versus time. Be sure to correctly label the graph (axes labels, including units, and title)

Time, *t* (s)	Distance, *d* (m)
0.0	0 m
1.0	5.1 m
2.0	9.9 m
3.0	15.2 m



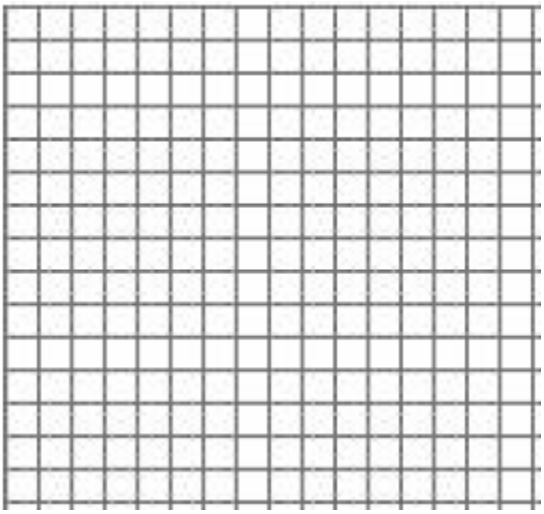
Draw the best fit line through your data points. Use a graphing calculator to plot the graph. Record the equation of the best-fit line. What is the slope of the line that you plotted (with correct units)?

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

Plot position vs. time on the axes below.

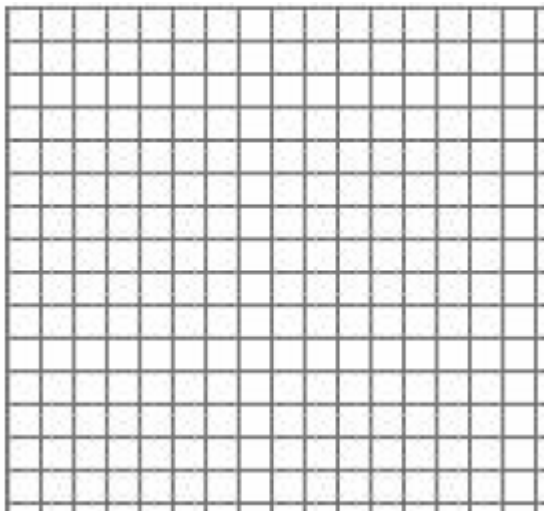
Time	**Position**
0.0 s	0.0 m
1.0 s	4.1 m
2.0 s	15.8 m
3.0 s	36.2 m



On your graphing calculator, create this plot and find the equation of the best fit curve. Record this best-fit equation below.

This graph has a changing slope. What does its slope represent?

This quadratic function can be "linearized" by squaring the time values, and plotting position vs. time squared. Try this with this data.



Find the equation of this best fit line on your graphing calculator. Record the equation of this best fit curve below.

Find the slope of this graph (use correct units). What does it represent?

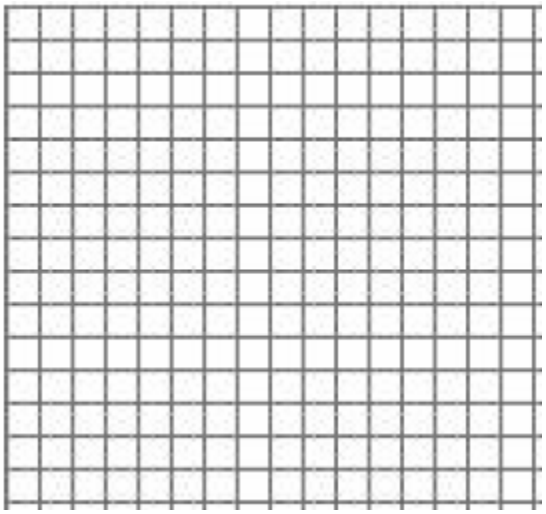
AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

Other function types.

The results of a class experiment investigating the relationship between mass and acceleration are shown in the table below. The force applied to each mass was the same.

Mass (kg)	Acceleration (m/s^2)
1.0	6.00
2.0	3.00
3.0	2.00
4.0	1.50
4.8	1.25
6.0	1.00



a. Plot the values given and draw the curve that best fits the points.

b. What is the relationship between mass and acceleration produced by a constant force (describe the plot you created in a.)?

c. What can you say about the relationship between the values for mass and those for acceleration? Use a graphing calculator to find the equation of the best-fit curve to your data. Record it below.

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

Algebra & Functions

A working knowledge of algebra is essential to success in physics. In AP Physics, there is more symbolic algebra, where symbols are used exclusively (no numbers!).

A **direct proportion** is a function whose graph is a non-horizontal line that passes through the origin. **y = kx ; k is the constant of proportionality**

A **linear** function has a graph that is a non-horizontal line. **y = mx + b; m is the slope of the line and b is the y-intercept.** A direct proportion is a special case of a linear function, where b = 0.

A **quadratic** function has a graph that is a parabola. When y is proportional to x^2, the graph goes through the origin and has a slope that increases as x increases. **$y = ax^2 + bx + c$**

An **inverse** relation has a graph that is a hyperbola (in the first quadrant). When y is proportional to 1/x, the graph is asymptotic to the x and y axes. **y = k/x**

Identify the variable relationships.

1. *F = -kx, (F vs. x) This function is _____. K represents the _____ of the graph.*
2. *U = mgh, (U vs. h) This function is _____. mg represents the _____ of the graph*
3. *$x = ½ at^2$ (x vs. t) This function is _____. Its graph will look like _____. If x is graphed vs. t^2 the slope will be _____.*
4. *a=F/m (a vs. m). This function is _____. Its graph will look like _____.*

Solve the following. Show work for credit:

5. Solve for d_i $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
6. Solve for a. $y = v_o t - \frac{1}{2} a t^2$
7. Solve for θ_2 $n_1 \sin\theta_1 = n_2 \sin\theta_2$
8. Solve for L $T = 2\pi\sqrt{\frac{L}{g}}$
9. Solve for V_2 $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

AP Physics B Summer Assignment

Read all information carefully and complete all problems. You must show your work for the problems to receive credit. Work may be shown on a separate sheet of paper if necessary.

Many physics properties follow quadratic rather than linear relationships. In Algebra 2 you learned how to solve quadratic equations by graphing, factoring, or using the quadratic formula. We will need these techniques for solving physics problems. Solve the following quadratic equations.

11. $x^2 + 2x - 8 = 0$

12. $x^2 + 6x + 9 = 0$

Many of the topics in Physics 1 will be expanded upon in AP Physics B. It will be very beneficial to you to refresh some math skills before you begin AP Physics B. In particular, vectors will be used heavily in Mechanics and Magnetism.

1. Read Chapter 1: Introduction and Mathematical Concepts
    a. Answer the following questions in Chapter 1 on pp. 19-24. Check your work (the odd answers are in the back of the book). Show all your work in solving these problems, explain each answer completely. Conceptual Questions #15, 16; Problems #11, 29, 35.
2. Read Chapter 2: Kinematics in One Dimension
    a. Answer the following questions in Chapter 2 on pp. 49-54. Check your work (the odd answers are in the back of the book). Show all your work in solving these problems. Conceptual Questions #5, 7; Problems #3, 15, 23, 37, 41, 58, 59, challenge problem 77.

Other Answers (that are not in the back of the book):
Chapter 1: Conceptual Question #16: vectors A and B are perpendicular
Chapter 2: #58 – A: -20 m/s^2, B: 10 m/s^2, C: 40 m/s^2