AP Physics 2 HW#1: Letter of Introduction

Welcome to AP Physics 2!

At this point in your high school career many of you have taken an AP or honors level course before, but this may be your first AP science course – or your first high school physics course. Regardless of your science background, we all have a lot to learn, and I'm here to guide you towards success. We will be spending a lot of time together next school year, so I would like to get to know a bit about you and why you are taking this class.

Please use these guidelines and prompts in your letter:

- Attach your letter to this assignment using ".doc, .docx, or pdf" format.
- Use **complete** sentences, and try to be as clear as possible. Do not abbreviate words like you would when texting or tweeting. Please **use spell check** and appropriate punctuation. High school is practice for college and professional life, and your professors and employers will expect you to communicate clearly and professionally.
- Begin the letter with a **formal salutation** like "Dear Ms. Ota," or "Hi Ms. Ota,"
- Then, follow these guidelines to introduce yourself so that I can get to know you. Feel free to add additional information as desired, and to share as much or as little as you are comfortable with. Most importantly, be honest:
    - What do you like to do with your free time? What are your interests? What do you wish you had more time to do?
    - Do you have a job? Do you volunteer? If yes, do you work/volunteer during school, summer, nights, weekends? What type of work do you do? What do you enjoy most in your job? What parts of your job are more challenging or frustrating?
    - Tell me about your family (parents, guardians, siblings, pets). What do other people in your family do (work, school, take care of family)?
    - What are some of the most interesting things you have learned so far in science? What classes, teachers or topics have had the greatest impact on you and your desire to continue studying science? What experiences, if any, have you had doing science outside of school?
    - What is your interest in taking AP Physics 2? Why did you register for the class? What do you hope to gain from taking this class? What are you most looking forward to? What are you most anxious about? **(This is important. Be honest here, please.)**
    - What questions do you have for me?
- End the email with a **formal closing** like "Sincerely", "Regards", etc. and add your name as if you signed a letter.
- Submit your letter through Google Classroom.

AP Physics 2: Summer Homework, Part 2 Name _____

(Physics & Math Content & Skills Review)

Familiarize yourself with the textbook:

OpenStax, *College Physics For AP® Courses*. OpenStax CNX. May 31, 2017
http://cnx.org/contents/8d04a686-d5e8-4798-a27d-c608e4d0e187@14.49

The web version of this textbook is available for free online, and should be accessible from any web browser. If you will not have online access, a pdf version is also available to download.

The AP Physics 2 curriculum centers around topics covered in chapters 11 – 34 of the textbook. However, you will find that many of these topics build on content from the previous chapters.

Concept review & textbook outline: Please review the following chapters from the text. You may find it useful to write a brief summary or outline of each chapter.

Chapter 1: Introduction
Chapter 2: Kinematics - sections 2.1–2.4
Chapter 3: Kinematics in Two Dimensions
Chapter 4: Dynamics: Force and Newton's Laws of Motion
Chapter 6: Gravitation & Uniform Circular Motion
Chapter 7: Work, Energy, and Energy Resources

The following problems represent some of the math skills and physics concepts you will be expected to apply in AP Physics 2. If you don't know how to solve a problem, please seek out additional references. You may be quizzed on the material included in this guide during the first week of school.

1) What are some of the differences between classical physics and modern physics?

2) What is the difference between precision and accuracy?

3) Why is it important to conduct a measurement multiple times? Do multiple measurements improve the accuracy of a measurement? Explain why or why not.

4) Why are significant figures used to report measurements? Why is it important to report calculated values using significant figures?

5) Describe Newton's Laws of Motion. Give an example for each.

Units & Unit Analysis. Often, a unit is used to represent a combination of many units. For example, you are probably familiar with the equation Force = mass · acceleration. The commonly used unit for force is the Newton (N).

But by substituting the units for mass and acceleration, we see that if $F = ma$, 1 N = 1 kg·m/s^2.

6) A Joule (J) is a measure of energy. What is a Joule equal to in terms of kg, m, and s?

7) What is a Joule equal to in terms of Newtons, kg, m, and s?

8) The 5 Main Conservation Laws are listed below. For each law give an example to describe how the law can be observed or applied.

   a. Conservation of Mass

   b. Conservation of Charge

   c. Conservation of Energy

   d. Conservation of Linear Momentum

   e. Conservation of Angular Momentum

Simplify or solve.

9) $x^2 \cdot x^{13} =$

10) $\frac{x^{12}}{x^{13}} =$

11) $3^2 \cdot 2^{-3} =$

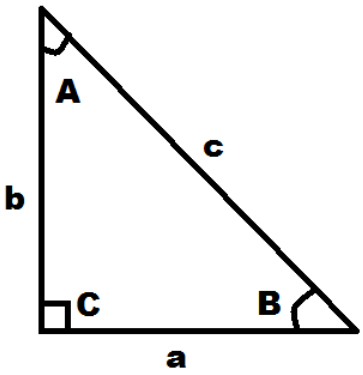
12) $2^{\frac{3}{2}} =$

13) $3^2 + 2^{-3} =$

14) $(2.5 \times 10^3) + (2.7 \times 10^2) =$

15) $(2.5 \times 10^3)\,(2.7 \times 10^2) =$

16) $(2.5 \times 10^3)\,(10^2) =$



Using Pythagorean Theorem & Right Triangle Trigonometry:
Solve for the specified values. The triangle is not drawn to scale!

17) A = 15° and b = 10 m

a = c = B =

18) B = 42° and b = 12 m

a = c = A =

19) b=10 m and a=19 m

c = A = B =

Rearrange the following equations to solve for the specified variables:

20) $a = \frac{c}{d}$ $c =$ $d =$

21) $a = cd + g$ $c =$ $g =$

22) $c = \sqrt{a^2 + b^2}$ $a =$

23) $P = P_0 + \rho gh$ $h =$

24) $P_1 + \rho gh + \frac{1}{2} \rho v_1^2 = X$ $v_1 =$

25) $n_1 \sin\Theta_1 = n_2 \sin\Theta_2$ $\Theta_1 =$

26) $d \sin\Theta = m\lambda$ $\Theta =$ $\lambda =$

27) $F_g = G\frac{m_1 m_2}{r^2}$ $m_1 =$ $r =$

28) $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$ $\varepsilon_o =$ $r =$

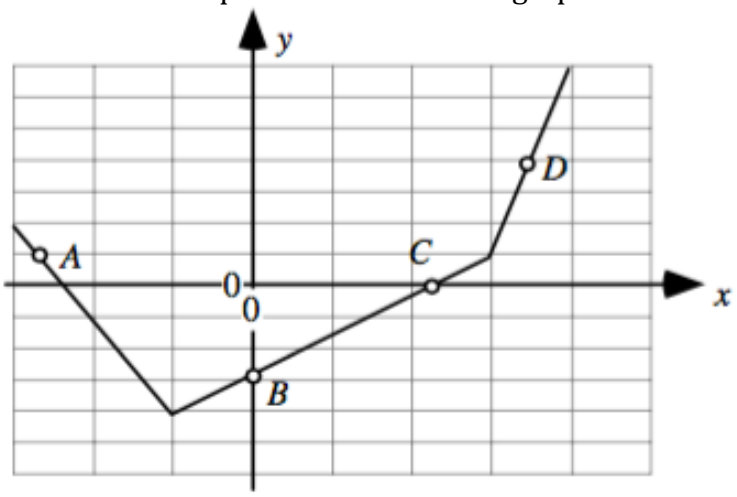
Find the slope, y-intercept, and x-intercept of the graphs of the following equations.

29) $y = -3x + 7$

30) $2y - 6x = 18$

31) Determine the slope, y-intercept, and x-intercept of a graph of the line passing through the points (5,9) and (3,-1)

32) There are four points labeled on the graph below.



a. Compare the slopes at each labeled point, and rank them from highest to lowest.

highest slope _____ _____ _____ _____ lowest slope

b. Use complete sentences to explain your ranking, and justify your answer.

c. Would your answer to part **a** be different if you were asked to rank the magnitude of the slope at each point on the graph? Explain why or why not.

In physics, equations are often used to represent physical phenomena. Substituting in numbers, and looking at the relationships can help us interpret the equations.

33) Lets say that we push a block of mass m with a force of F and it accelerates with a value of a, where $F = ma$.
If we push another block with mass $2m$, how much force is needed to have the same acceleration, a?

34) What if we now push a block of mass $3m$ with a force of $2F$. What will the acceleration be (in terms of a, like 2a, 0.5a, etc)?

35) An object has kinetic energy, $K_1 = \frac{1}{2} mv^2$. How would the kinetic energy of a second object K_2 compare to that of the first object if the second object has the same mass, but three times the velocity? Write an expression for K_2 in terms of K_1

36) An object has kinetic energy, $K_1 = \frac{1}{2} mv^2$. How would the kinetic energy of a second object K_2 compare to that of the first object if the second object has the four times mass, and four times the velocity of the first object? Write an expression for K_2 in terms of K_1.

Solve each system of equations algebraically:

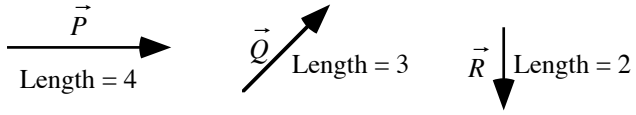
37) $x + y = 17$
$x - y = 7$

38) $6x + 7y = 19$
$x + y = 5$

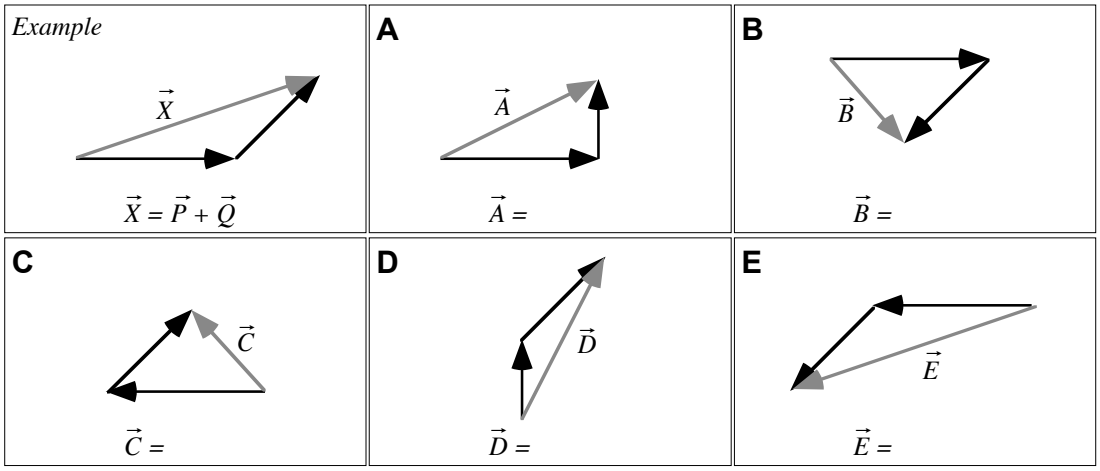
39) $x + 2y - 3z = 5$
$x - y + 2z = -3$
$x + y - z = 2$

40) $2x + y + 3z = 10$
$-3x - 2y + 7z = 5$
$3x + 3y - 4z = 7$

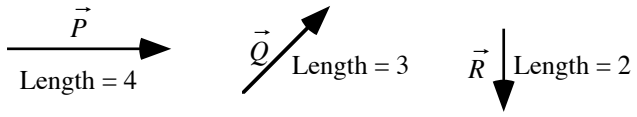
41) A2-QRT04[i]: Three vectors, labeled $\vec{P}$, $\vec{Q}$, and $\vec{R}$, are shown below. The magnitude of each vector is given in arbitrary units.



Write an expression using the vectors $\vec{P}$, $\vec{Q}$, and $\vec{R}$ for each of the resultant vectors shown.



Three vectors, labeled $\vec{P}$, $\vec{Q}$, and $\vec{R}$, are shown below. The length of each vector is given in arbitrary units.



A $\vec{A} = \vec{P} + \vec{Q} + \vec{R}$	**B** $\vec{B} = \vec{P} - \vec{Q} + \vec{R}$
C $\vec{C} = -\vec{P} + \vec{Q} + \vec{R}$	**D** $\vec{D} = -\vec{R} + \vec{Q} + \vec{P}$

In each space provided above, construct a drawing of the resultant of the indicated combination of the vectors $\vec{P}$, $\vec{Q}$, and $\vec{R}$, and then rank the magnitude of these resultant vectors.

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

Explain your reasoning.

[i] Hieggelke, C.; Maloney, D; Kanin, S; O'Kuma, T. (2015) *TIPERs Sensemaking Tasks For Introductory Physics.* Glenville, IL; Pearson Education, Inc.

AP Physics 2 Name

HW #3: Using a Linear Fit to Analyze Data

1. Suppose you have the following data for the position and time of a car as it travels along a highway.

Time (t in seconds)	Position (x in meters)
0	21.2
2	26.8
4	35.7
6	44.5
8	48.8
10	59.4

a. Graph the data. Label both axes using units and an appropriate scale.
b. Use a *straight edge (ruler)* to draw in a best fit line. Try to make it so that about half of the points are above, and half are below the line.
c. This is a "direct" or "linear" relationship. "Linear analysis," (Using a best fit line to determine the slope and intercepts) is a very powerful tool for determining the details of a direct relationship.
d. Determine the slope of your best fit line.
   i. **Circle** two points on the line of best fit (don't choose data points).
   ii. Calculate the slope (including units).

   iii. What physical property does the slope represent?

   iv. Calculate the y-intercept.

   v. Use the slope and intercept to write an equation to describe the relationship between position and time for this car.

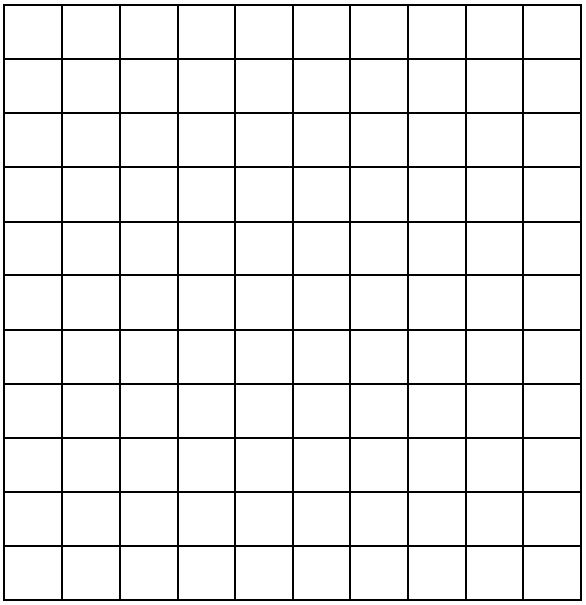
   vi. Write a sentence to describe the relationship between position and time for this car.

   vii. Use your equation to predict the position of the car after 15 seconds.

The previous relationship was linear, but often the relationships that govern physical processes are not linear. Then it is useful to be able to "straighten" a curve by manipulating one of the variables. In the following example, you will manipulate the data to obtain a linear graph.

2. Below is data for the kinetic energy and velocity of a cart. You probably know that as speed increases, kinetic energy also increases. But, you may not know precisely what type of relationship it is. At some time in the past, someone had to determine precisely what the relationship was in order to write an equation. Throughout this course you will be asked to interpret graphs to determine the mathematical relationships governing physical phenomenon.

velocity (**v,** in meters/second)	Kinetic Energy (K, in Joules)
0	0
1	12
2	48.5
3	116
4	195
5	310



a. Graph the data.

b. What type of function does it look like?

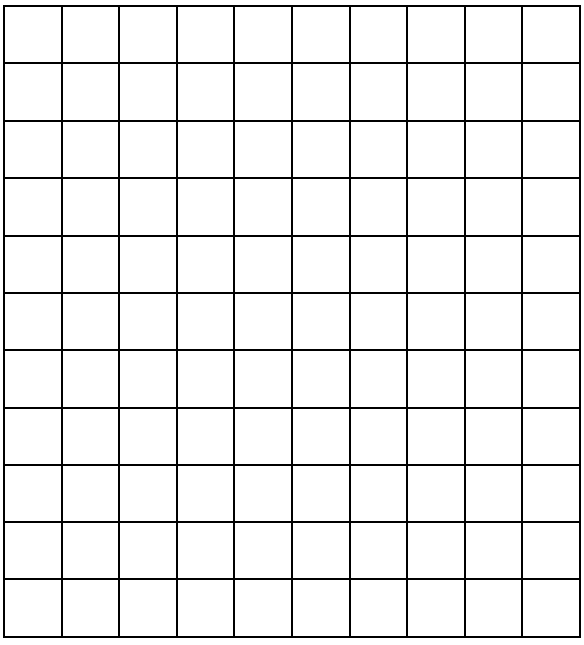
c. What is the generic equation for this type of function?

d. You want a linear relationship of the form $y = mx + b$

*dependent variable = slope * independent variable + y-intercept*

So, instead of graphing K vs. v, try K vs. _____.

velocity (**v,** in meters/second)	Kinetic Energy (K, in Joules)	
0	0	
1	12	
2	48.5	
3	116	
4	195	
5	310	



Now, write the relationship between K and v, by comparing it to y=mx+b…