Name: ______________________________

AP Physics C Summer Assignment 2023

Overview

"look deep into nature, and then you will understand everything better"
Albert Einstein

Welcome to the AP Physics C course. AP Physics C is a Calculus/Algebra-based physics course that will be a rigorous and eye-opening introduction into exploring the phenomena of our world through the lens of physics. Physics is a fundamental experimental science and learning an experimental science requires the co-development of science 'practice' skills along with physics content knowledge. The AP Physics C course emphasizes the co-development of these skills, which will enhance students' investigative abilities. This year, you will be responsible for constructing physics knowledge through inquiry, cultivating critical thinking, reasoning skills, and a deep understanding of ideas in physics.

Grading

The assignment will be graded the first week of the semester and count as an Exam grade.

Textbook

Fundamentals of Physics by Halliday/Resnick/ Walker, 6th Edition 

Suggested Time

This assignment was designed so that you spend approximately one hour per week on each of the activities. Structure your time wisely over the summer so that you can manage the workload for this assignment and any others you may have.

Show ALL WORK-label each week's assignment and include your name on the top of each page. Each problem should be clearly labeled and work should be easy to follow. Writing prompts must be clearly hand-written or typed.

Summer Assignment Table of Contents

Mathematics Review

Part 1: Solving Symbolically

During class and on the AP exam, problems will be worked with variables only. Solve for the variable indicated-don't let the different variables confuse you; we will develop these mathematical relationships in class.

Manipulate/rearrange these equations algebraically as though they were numbers. For example:

Example 1:
Solve for Q:

$$U=\frac{kQ}{r^2}$$

$$U=\frac{kQ}{r^2}$$

Multiply r ^{2} to both sides:

$$r^2 * U = \frac{kQ}{r^2} * r^2$$

Divide both sides by k:

$$\frac{r^2 * U}{k} \quad \frac{kQ}{k}$$

$$Q=\frac{r^2 * U}{k}$$

Example 2:
Solve for r:

$$U=\frac{kQ}{r^2}$$

$$U=\frac{kQ}{r^2}$$

Multiply r ^{2} to both sides:

$$r^2 * U = \frac{kQ}{r^2} * r^2$$

Divide both sides by U:

$$\frac{r^2 * U}{U} \quad \frac{kQ}{U}$$

Take the square root of both sides :

$$r\ 2= \sqrt{\frac{kQ}{U}}$$

$$r= \sqrt{\frac{kQ}{U}}$$

$mgh = \frac{1}{2}mv^2$	1. Solve for v. ________	$a = (v_f - v_o)/t$	7. Solve for v_f ________
$pV = nRT$	2. Solve for T. ________	$T = 2rc\sqrt{\frac{\ }{g}}$	8. Solve for g. ________
$x = x_0 + v_0 t + \frac{1}{2}at^2$	3. Solve for t. ________	$\sin\theta_c = \frac{n_1}{n_2}$	9. Solve for 0c. ________
$B=\frac{\mu o\ I}{2rc\ r}$	4. Solve for r. ________	$F = G\frac{m_1 m_2}{r^2}$	10. Solve for r. ________
$v = \sqrt{2a\Delta x}$	5. Solve for x. ________	$I = \frac{\varepsilon - IR_2}{R_1}$	11. Solve for I. ________
$a = (v_f - v_o)/t$	6. Solve for t. ________	$\frac{1}{f}=\frac{1}{do}+\frac{1}{dt}$	12. Solve for dt. ________

Part 2: Algebraic Manipulation

After you have practiced how to solve equations symbolically, put this skill to use in more complex scenarios. Often in this course you will need to set up and solve equations using a variety of algebraic strategies. Review your algebra knowledge and skills below.

Solve for the variable specified:

1. Find: v_f $v_f = v_o + at$ Given that: • $V_0 = 0$ • t=4 • $a =$ 3.2 =____________________	2. Find: v_o $x_f = x_o + v_o t + \frac{1}{2}at^2$ Given that: • $X_0 = 0$, • $t = 25$ • $t = 2$ • $a = 10$ =____________________	3. Find:µ $f = \mu N$ Given that: • $f = mg$ sin0 • $N = mgcos0$ • $0 = 30°$ =____________________
4. Find: p_1 $\rho_1 V_1 g = \rho_2 V_2 g$ Given that: • $V = A*h$ • $A1$ = A2 • $h_1 = 2h_2$ • P2 = 10 = ____________________	5. Find: t $Xf1 = 5 - 2t$ $Xf2 = -1 + 2t$ Given that: • $x_{f1} = x_{f2}$ =____________________	6. Find: T, A_1 $A1 = T-3m$ $A2 = mg - T$ Given that: • $a1$ = a2 • $m = 5$ • $g = 10$ =____________________

Part 3: Operations with Units

In each topic you will experience physical quantities with specific units. You will need to grow comfortable with recognizing and manipulating expressions with each of these units.

Simplify the expressions of units:

1. m/s	2. m/s2	3. m.kg/s	4. $\frac{\frac{kg*m}{s^2}*m}{s}$

Refer power of ten prefixes and conversions to answer the following questions:

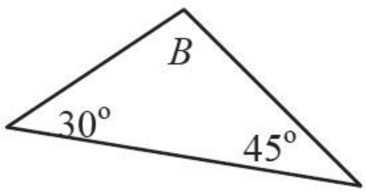
5. How many *cm* are in a m?	6. How many *ml* In a l?	7. How many *cm* In a km?	8. How many in *µm a mm?*

9. How many cm^2 are in m^2?	10. How many *ml^3* in *a l^3?*	11. How many cm^2 in a km^2?	12. How many μm^2 in a mm^2?

Part 4: Geometry Review

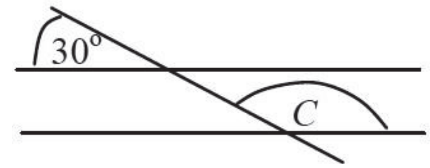
In this class you will find yourself analyzing physical scenarios and diagrams. Recall your geometry coursework in answering the following questions.

1. What is the value of angle B?



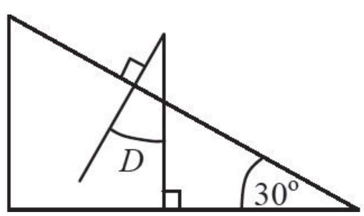
2. The radius of a circle is 5.5 cm. Determine the *area* **in** square meters.

3. The two horizontal lines are parallel.



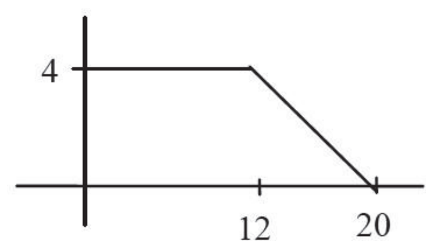
What is the value of angle C?

4. How large is angle D?

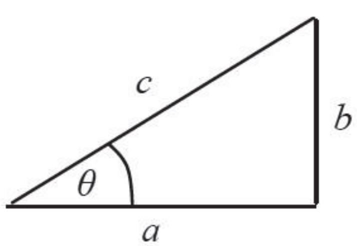


5. The radius of a circle is 5.5 cm. Determine the *circumference* **in** meters.

6. Determine the area under the graph below.



7. Use the following triangle to answer the questions below:



a. Given: a=25.0, c=32.0
Determine b and 8

b. Given: a= 250, b = 180
Determine c and 8

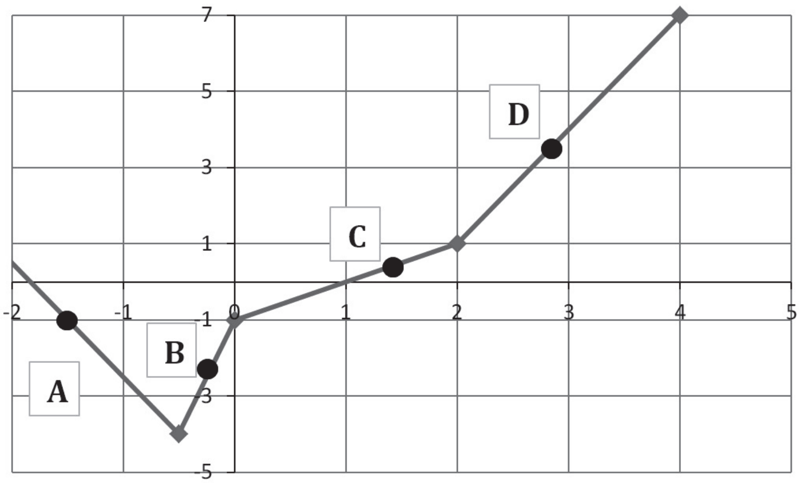
c. *Given:* b = 17.8, 8=65°
Determine a and c.

d. Given: 8 = 45.0° , a = 15.0 Determine b and c

e. Given: b =65.0, c = 104
Determine a and 8

Part 5: Graphing Review

Activity 1: Four points are labeled on the following graph. Rank the slopes of the curve at each of the labeled points. Explain your reasoning.

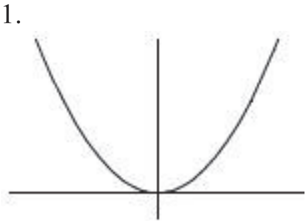
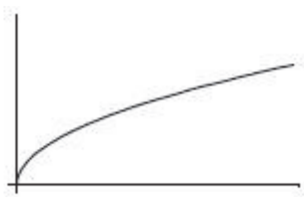
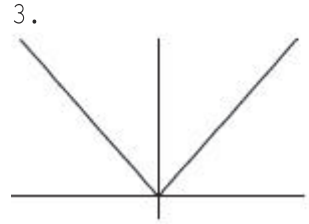
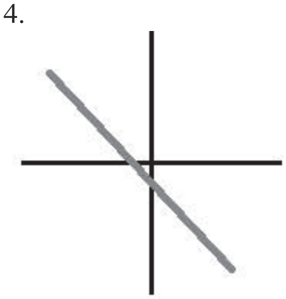
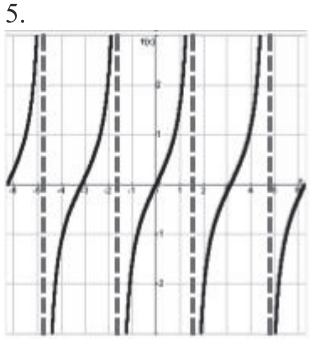
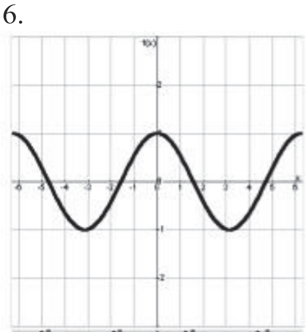
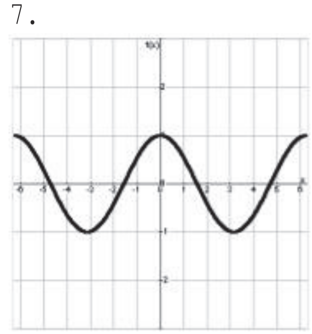
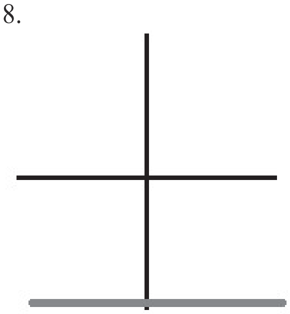


______ ______ ______ ______

Smallest Slope — Largest Slope

Explain:

Activity 2: Below each graph, correctly write the equation of the function that corresponds each graph.

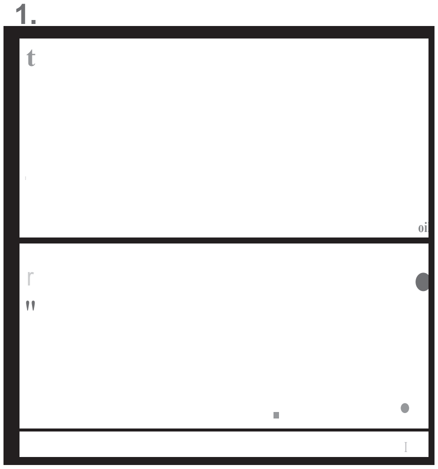
1.  $f(x) =$	2.  $f(x) =$	3.  $f(x) =$	4.  $f(x) =$
5.  $f(x) =$	6.  $f(x) =$	7.  $f(x) =$	8.  $f(x) =$

Activity 3: Match the graph to the correct description. Pay attention to the location of the axes in the pictures. Some descriptions may be used more than once.

Word Bank

A. Constant Slope (Negative)
B. Constant Slope (Positive)
C. Constant Function (Negative Intercept)
D. Constantly Decreasing Slope in Positive Direction
E. Constantly Decreasing Slope in Negative Direction
F. Constant Function (Positive Intercept)
G. Constantly Increasing Slope in Positive Direction
H. Constantly Increasing Slope in Negative Direction
I. Constantly Increasing Slope in Negative Direction

1.



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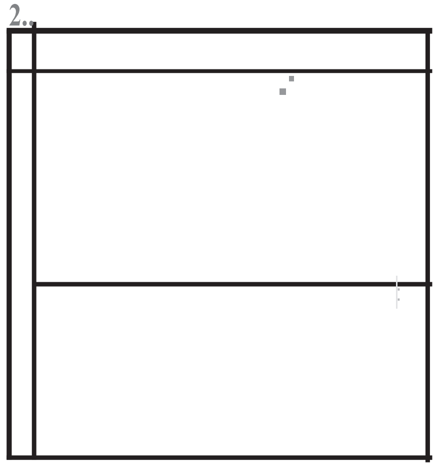

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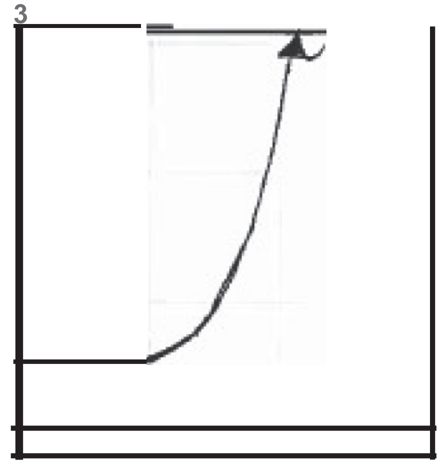

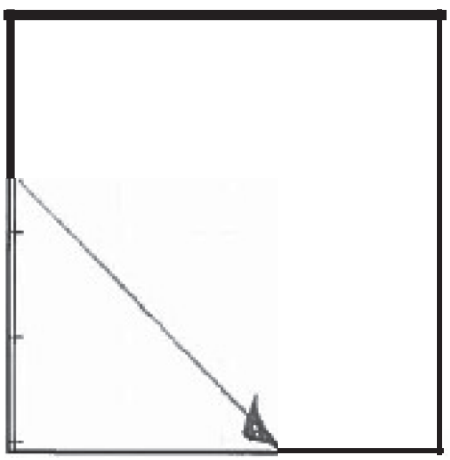

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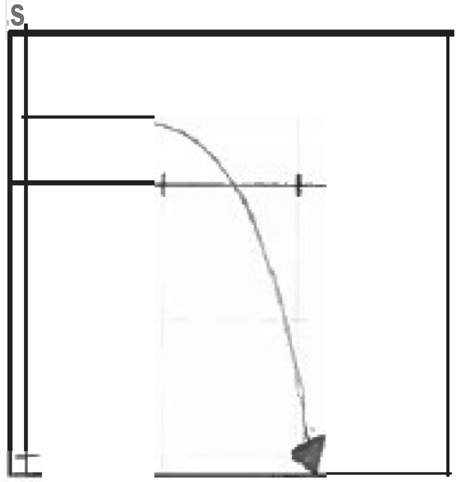

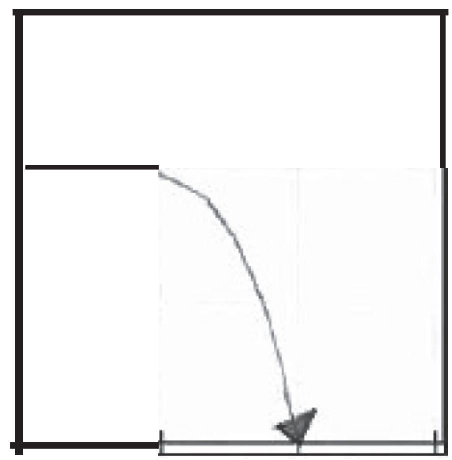

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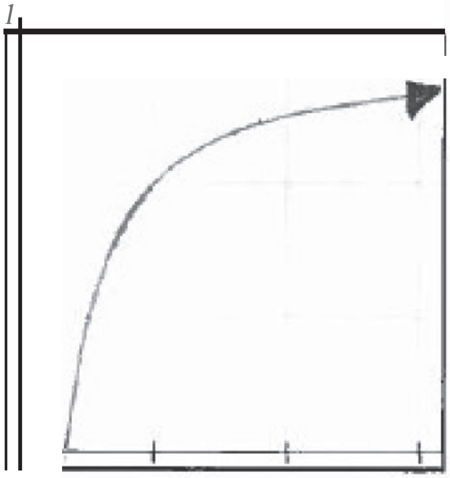

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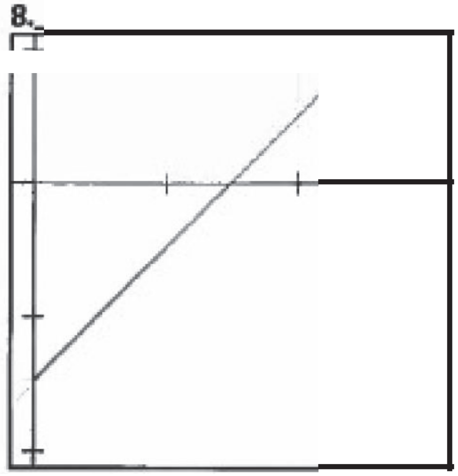
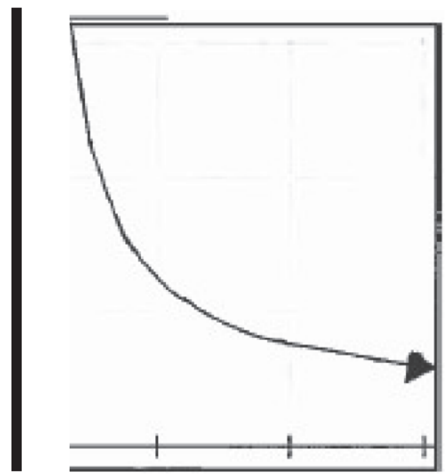
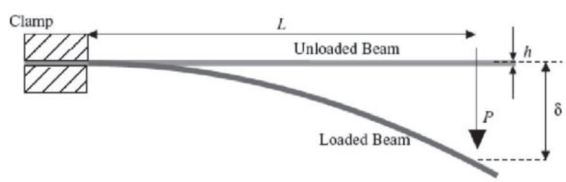




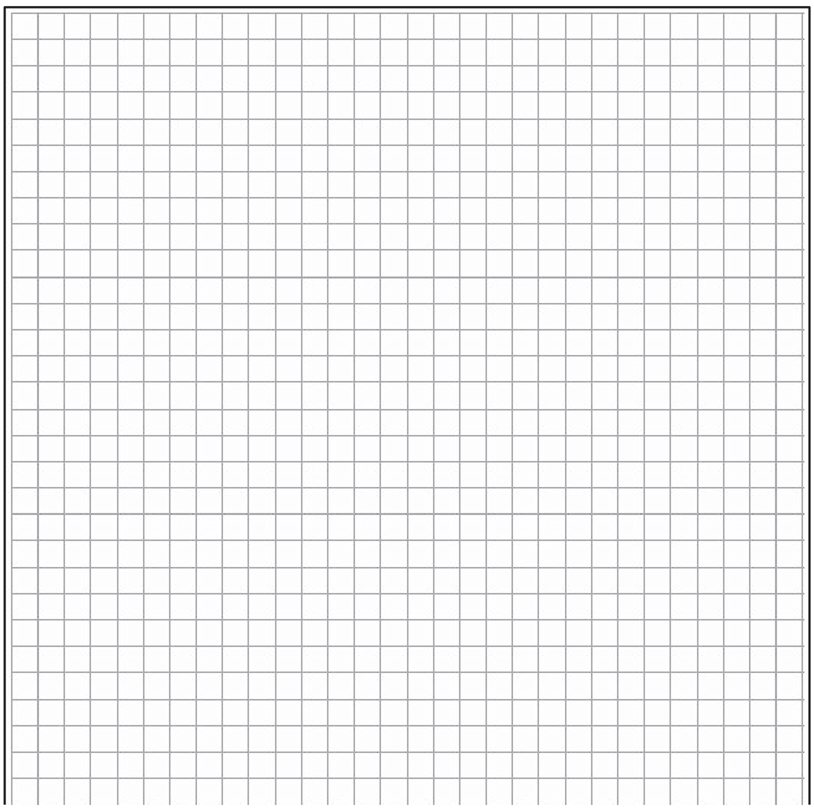
Activity 4: At an internship at a civil engineering contracting firm your project was to study different materials' response to various loads. Suppose you recorded the following data for one end-loaded cantilever beam. Answer the following questions below:



1. When scientists plot experimental data using *x- and y-* axes, the independent variable (the *'cause')* is assigned to the x-axis and the dependent variable (the *'effect')* is assigned to the y-axis. In this scenario, identify the independent and the dependent variable and label the axes below appropriately.

2. Plot the graph of this data in the space provided:

GRAPH TITLE:



Applied Load (kg)	Beam Deflection (mm)
0.00	0
0.05	3
0.10	6.5
0.15	9
0.20	13
0.25	16
0.30	20

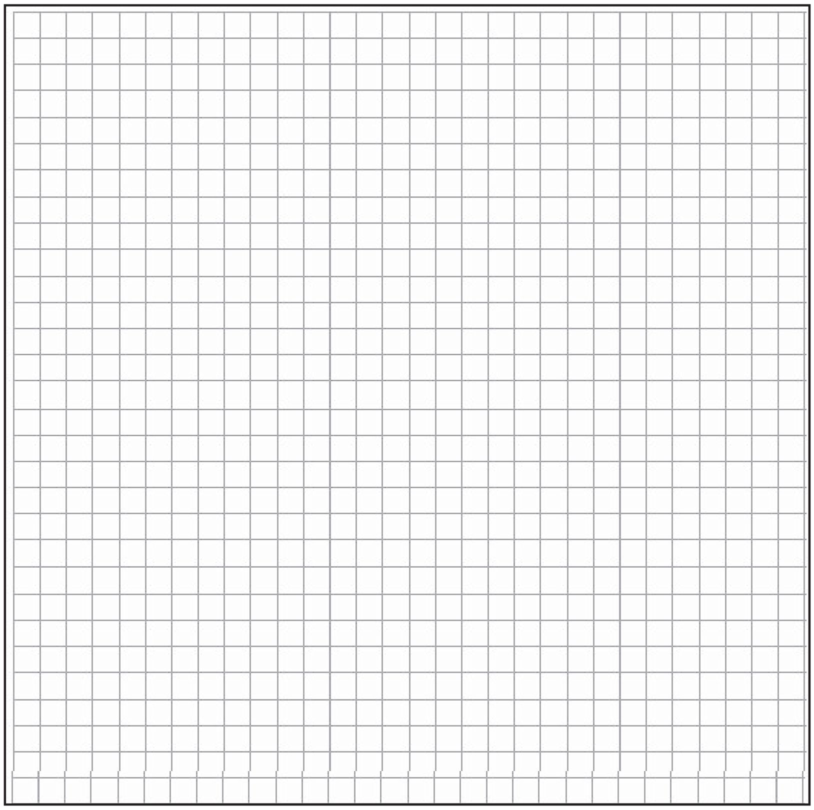
2. Graph the data in Excel *in addition* to graphing it by hand above; attach your Excel graph to this packet. Excel can help you determine the following: What type of function (linear/quadratic/exponential) best fits this data? What is the equation of this best-fit function? What is the correlation coefficient?

3. What is the value of the elongation of a beam with a 0.13kg load applied?

4. What would the estimated elongation of a beam with a 0.50kg load applied?

Activity 5: Evan and Anna are taking measurements of a toy car traveling across the classroom. Evan calls out each one second interval. Anna records the location of the car as Evan calls out each time interval. Plot their data below:

GRAPH TITLE:



Time(s)	Distance (m)
1	3
2	15
3	25
4	49
5	76
6	108
7	150
8	195

5. Graph the data in Excel *in addition* to graphing it by hand above; attach your Excel graph to this packet. Excel can help you determine the following: What type of function (linear/quadratic/exponential) best fits this data? What is the equation of this best-fit function? What is the correlation coefficient?

6. Is the distance traveled greater between 0 and 1 seconds or 3 and 4 seconds?

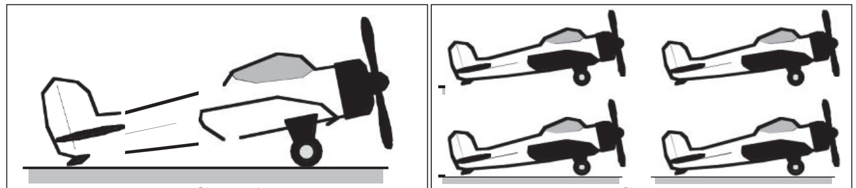
7. Is the slope of the curve greater between seconds one and two or three and four?

All responses should be clearly hand-written or typed and attached to this packet when submitted.

Part 6: Reasoning

In each content topic you will be expected to explain your reasoning behind your problem-solving strategy. Often this will require a coherent written paragraph explanation along with multiple representations (diagrams, graphs, bar charts, sketches, mathematical statements, etc.) Practice this skill with the following tasks:

Activity 1: A woodworker has made four small airplanes and one large airplane. All airplanes are exactly the same shape, and all are made from the same kind of wood. The larger plane is twice as large in every dimension as one of the smaller planes. The planes are to be painted and then shipped as gifts.



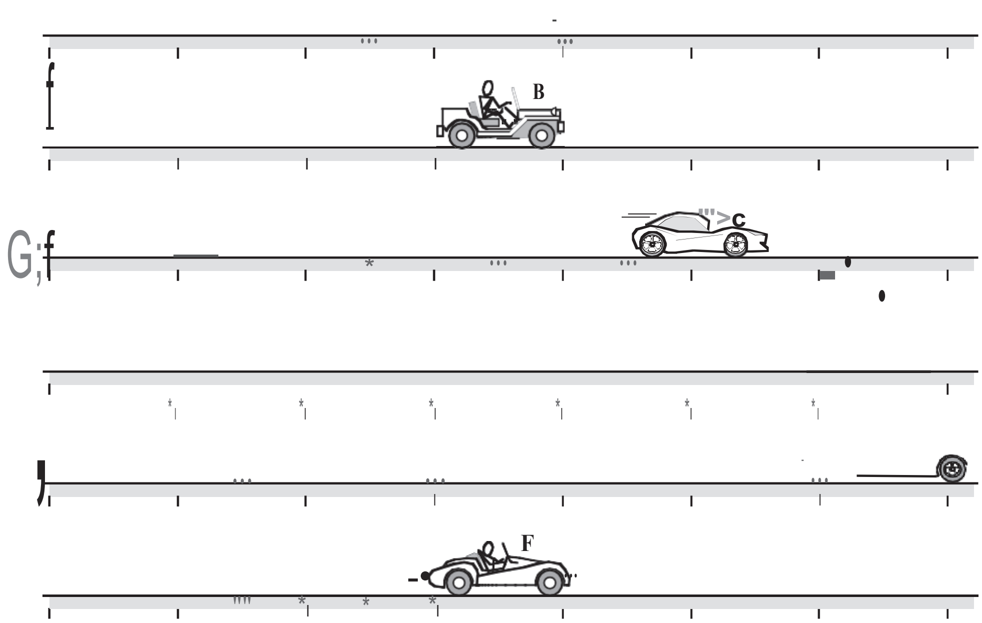
Case A   Case B

a) The amount of paint required to paint the planes is directly proportional to the surface area. Will the amount of paint required for the single plane in Case *A* be *greater than, less than,* or *equal to* the total amount of paint required for all four planes in Case B? Explain your reasoning on a separate sheet.

b) The shipping cost for the planes is proportional to the weight. Will the weight of the single plane in Case A be *greater than, less than,* or *equal to* the total weight of all four planes in Case B? Explain your reasoning.

Activity 2: An index is a number that helps people compare things. *Miles per gallon* is an index of how well a car uses gas, *batting average* is an index of how well a baseball player hits. Your task is to come up with a *fastness index* for cars with dripping oil. You see a bunch of cars, and you need to come up with one number to stand for each car's fastness. There is no watch or clock to tell you how long each car has been going. However, all the cars drip oil once a second. (They are not very good cars!) You can look at the oil drops to help figure out how long a car has been traveling. Each car from the same company will have the same fastness index.

You have to decide which cars are from the same company. Explain your reasoning.



All responses should be clearly hand-written or typed and attached to this packet when submitted.

Part 7: Scalars and Vectors Preview

Hooray for the Internet! Watch the following two videos. For each video, summarize the content Mr. Khan is presenting in three sentences. Then, write at least one question per video on something you didn't understand or on a possible extension of the elementary concepts he presents here.

http:// www.khanacademy.org/ science/ physics/ v/introduction-to-vectors-and-scalars

Summary1

http://www.khanacademy.org/science/physics/v/visualizing-vectors-in-2-dimensions

Summary2

All responses should be clearly hand-written or typed and attached to this packet when submitted.

Writing Prompt 1: The Process of Learning Physics

After reading articles on motivation and learning physics, write a short essay reflecting on two articles and your learning style. Physical copies of these papers can be found attached to this assignment OR students may search for them online.

Article 1: David Hammer published his paper, *Two Approaches to Learning Physics,* in The Physics Teacher in December of 1989. Please read the paper. Some of the physics concepts might not make sense yet, that is expected- we are going to learn these concepts this year.

Two Approaches to Learning Physics
David Hammer
http://dhammer.phy.tufts.edu/home/publications_files/twoapproaches.pdf

Article 2: Students can select one of the following articles about motivation and learning OR choose a relevant article/paper /resource of interest. Note: students may select relevant TED talks, books, presentations.

Why do People Learn Faster?
Jonah Lehrer- Source : Wired
http://www.wired.com/2011/10/why-do-some-people-learn-faster-2/

What if the Secret to Success is Failure?
Paul Tough- Source: NYT
http://www.nytimes.com/2011/09/18/magazine/what-if-the-secret-to-success-is-failure.html?_r=0

The Surprising Science of Motivation
Daniel Pink- Source : TED Talks
http://www.ted.com/talks/danpinkonmotivation?language=en

Prompt : Write a short essay (at least 1.5 pages double spaced) reflecting on the ideas in the two pieces you've read. You should respond to the following **in** your essay:

- What you think is the message of David Hammer's paper. Who is Hammer's intended audience?
- What is the purpose of Hammer's study?
- How does the second article you read relate to the Hammer paper? What can you synthesize from both pieces?
- What is learning? Describe your approach to learning. Discuss the strengths and weaknesses of this approach.
- Identify how your current beliefs about physics and learning may affect the way you approach this course. You may include your initial impressions, questions or concerns here.

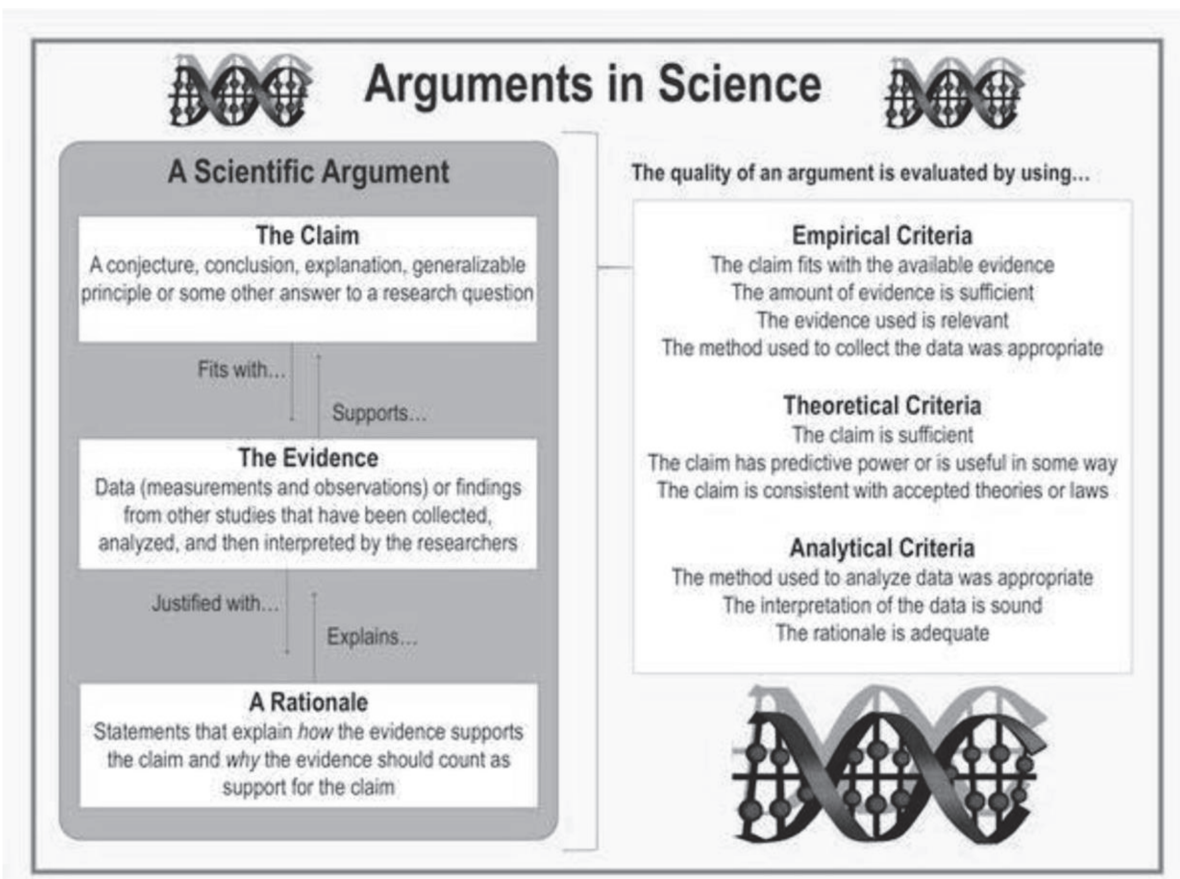
Writing Prompt 2: Scientific Argumentation

Introduction
Scientific Argumentation is a key element of the AP Physics 1 curriculum. One of the objectives of the curriculum is that *"the student can work with scientific explanations and theories."* More specifically this science practice includes the following:

6.1 The student can justify claims with evidence.
6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices.
6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced.
6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models.

Scientific Argumentation Process
The process of scientific argumentation involves three components:

1. The first element is the **claim.** *A* claim provides an explanation for why or how something happens in a laboratory investigation.
2. The second component is the **evidence,** which supports the claim and consists of the analysis of the data collected during the investigation.
3. The third component consists of **questioning,** in which students examine and defend one another's claims. The claims in this step are presented with a rationale of how the evidence supports the claim and why the evidence should count as support for the claim.



All responses should be clearly hand-written or typed and attached to this packet when submitted.

Assignment

You will design a *hypothetical* experiment to test a claim. This means you will **not** have to actually implement this experiment. The goal of this activity is to give you some practice in the procedure of designing an experiment to test a claim-something you will be expected to do often in this course. As this maybe your first time formally engaging in this practice, you will follow the outline below, responding to these questions on a *separate sheet of paper.*

1. Select a topic of interest and formulate a question. Consider a topic that interests you. Think about a scientific question that you might want to know the answer to. This does **not** have to be an entirely new question, unasked by scientists-it just has to relate to a scientific topic that interests you.

2. Transform your question into a claim. After you have a question that you would like to study, use your background knowledge to make a claim that you would like to investigate through experimentation.

3. Devise a testable hypothesis statement. A useful testable hypothesis is a specific statement which provides information about the predicted results of your experiment. We will use the if-, and-, then- format for hypothesis statements. See the format below:

If(...)	:Describe claim to be tested	Exam ple: If the Ravens are the most skilled football team in the NFL, **and** they engage in a game against the Bengals, **then** the Ravens will win.
... **and(...)**	:Describe experiment to be conducted	
... **then(...)**	:Identify specific hypothetical results	

4. Identify necessary materials for your experiment.

5. Specify how materials will be used for data collection. For instance, a ruler can measure length yes, but in your experiment will it measure the distance an object trave ls ? How long an object is? A location? Discuss how the instruments will be used to collect data.

6. Identify how collected data will be analyzed. You will want to discuss how you will organize and interpret the data you collect. Will you gather your information into a table? How will you analyze it? Will you make a graph to see a trend?

7. Discuss assumptions in procedure-specify how they may affect your interpretation of the data you collect. An assumption is an accepted truth that has not been proven. What assumptions are you making in your experiment? If these assumptions actually had an effect on your results, how would they skew your data? *For example:* In introductory physics classes, a common assumption made about falling objects is that air resistance has a negligible effect on changing how an object falls. However, if we neglected to include air resistance calculations in our calculations for acceleration (the rate of change of speed), we would calculate a value that larger than the true value.

8. Discuss uncertainty inherent in data collection-specify how experimental errors may affect your interpretation of the data you collect. Consider the equipment that you are using. What sorts of errors are associated with the precision of your instrument or the method of data collection?

9. Multiple Representations-draw a sketch of your setup and/or your equipment. Include any relevant diagrams. Ensure that all representations are clearly labeled.

Rest up and get ready for school!

Congratulations! You're finished!
Think about it as an investment with a guaranteed return.