LPS AP Physics 1
Summer Assignment 2022

"Physics was prose: elegant gymnastics for the mind, mirror of creation, the key to man's dominion over the planet."

--- Primo Levi, "The Periodic Table"

"In physics you do not go around making trouble for yourself – nature does it for you."

--- Frank Wilczek

***This summer assignment was adapted from: https://www.ccboe.com/schools/northpoint/images/pdfs/Summer_Assignments/AP-Physics-1-Summer-Assignment.pdf ***

Welcome to AP Physics I!

AP Physics I is an algebra-based physics course which will enhance your problem-solving skills and introduce you to the most fundamental science. Physics is the science of energy and its scope is broad – from fundamental forces and particles to the universe as a whole.

Math skills – particularly conversions, scientific notation, algebra, and knowing how to interpret graphical representations of the relationship between variables – are essential for your success in this course.

The goal of this summer assignment is to help you review the prerequisite knowledge necessary to be successful in this course. You may use your previous coursework, the internet and other resources to refresh your memory to help with this, and **I'll be available to answer any questions via email or we can meet at school.**

Details

I suggest that you spread this assignment out throughout the summer, completing maybe an hour or so each week. SHOW ALL WORK for full credit – **this summer assignment will count as your first TEST GRADE of the year** (but you can get help from me / the internet / textbooks if you need it)!

Summer Assignment Table of Contents

Part 1: Mathematics Review

During class and on the AP exam, many problems will be worked with variables only. Solve for the variable indicated. Don't let the variables confuse you – we'll 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:

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

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

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:

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

Take the square root of both sides:

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

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

AP PHYSICS SUMMER ASSIGNMENT

$mgh = \frac{1}{2}mv^2$	1. Solve for v. _____	$a = (v_f - v_o)/t$	7. Solve for v_f. _____
$pV = nRT$	2. Solve for T. _____	$T = 2\pi\sqrt{\frac{l}{g}}$	8. Solve for g. _____
$x = x_0 + v_0t + \frac{1}{2}at^2$	3. Solve for t. _____	$sin\,\theta_c = \frac{n_1}{n_2}$	9. Solve for θ_c. _____
$B = \frac{\mu_o}{2\pi}\frac{I}{r}$	4. Solve for r. _____	$F = G\frac{m_1m_2}{r^2}$	10. Solve for r. _____
$v = \sqrt{2a\Delta x}$	5. Solve for Δx. _____	$I = \frac{\varepsilon - IR_2}{R_1}$	11. Solve for I. _____
$a = (v_f - v_o)/t$	6. Solve for t. _____	$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_f}$	12. Solve for d_f. _____

SHOW WORK BELOW / ON THE PREVIOUS PAGE or attach another piece of paper.

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:

- $v_o = 0$
- $t = 4$
- $a = 3.2$

=_____

2. Find: v_o

$x_f = x_o + v_o t + \frac{1}{2}at^2$

Given that:

- $x_o = 0, x_f = 25$
- $t = 2$
- $a = 10$

= _____

3. Find: μ

$f = \mu N$

Given that:

- $f = mg\sin\theta$
- $N = mg\cos\theta$
- $\theta = 30^o$

= _____

4. Find: ρ_1

$\rho_1 V_1 g = \rho_2 V_2 g$

Given that:

- $V = A * h$
- $A_1 = A_2$
- $h_1 = 2h_2$
- $\rho_2 = 10$

= _____

5. Find: t

$x_{f1} = 5 - 2t$

$x_{f2} = -1 + \frac{1}{2}t$

Given that:

- $x_{f1} = x_{f2}$

= _____

6. Find: T, a_1

$a_1 = \frac{T}{3m}$

$a_2 = \frac{mg - T}{m}$

Given that:

- $a_1 = a_2$
- $m = 5$
- $g = 10$

= _____

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. I recommend using the conversion method we learned in chemistry for problems 5 – 12... look out especially for the squares and cubes!

Simplify the expressions of units:			
1. $\frac{\frac{m}{s}}{s}$	2. $\frac{\frac{kg*m}{s}}{\frac{m}{s^2}}$	3. $\frac{kg*m}{s^2} * s$	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?

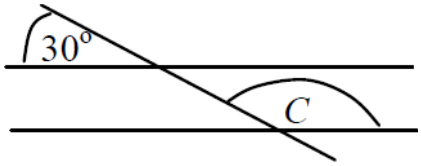
Part 4: Geometry Review

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

1. Write expressions for Sin, cos, and tan below:

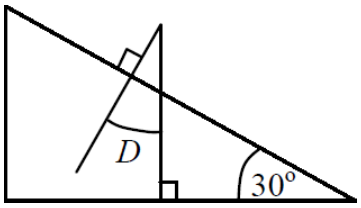
2. The radius of a circle is 5.5 cm. Determine the *area* in square meters.

3. The two horizontal lines are parallel.



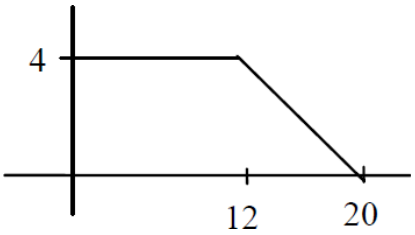
What is the value of angle C?

4. How large is angle D?

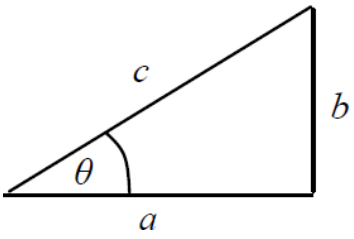


5. The radius of a circle is 5.5 cm. Determine the *circumference* in meters.

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 θ

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

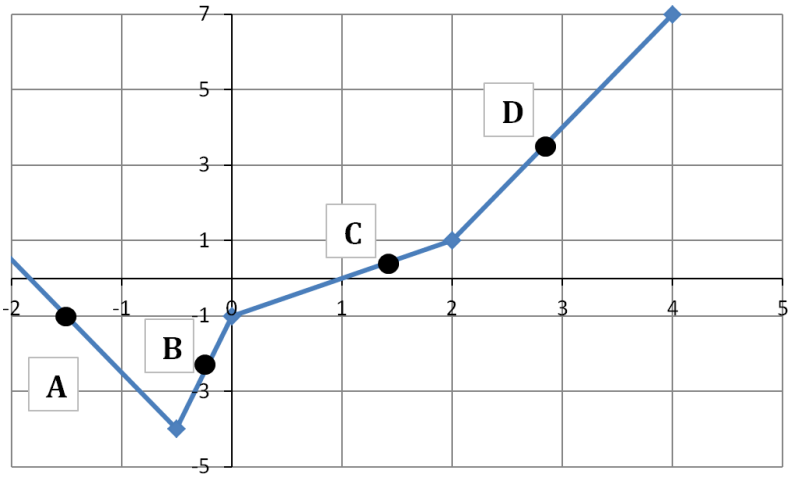
c. *Given*: b = 17.8, θ=65° Determine a and c.

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

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

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.

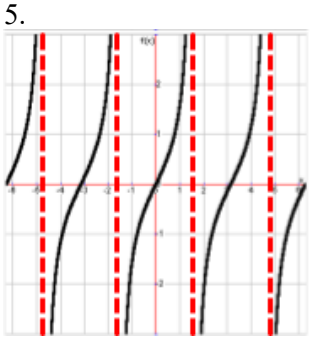
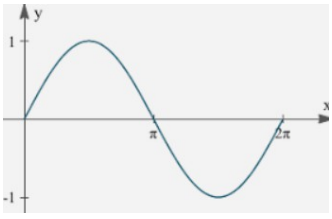
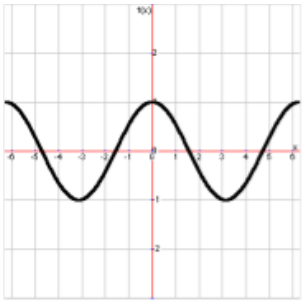
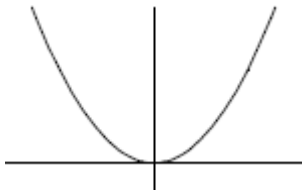


Smallest Slope

Largest Slope

Explain:

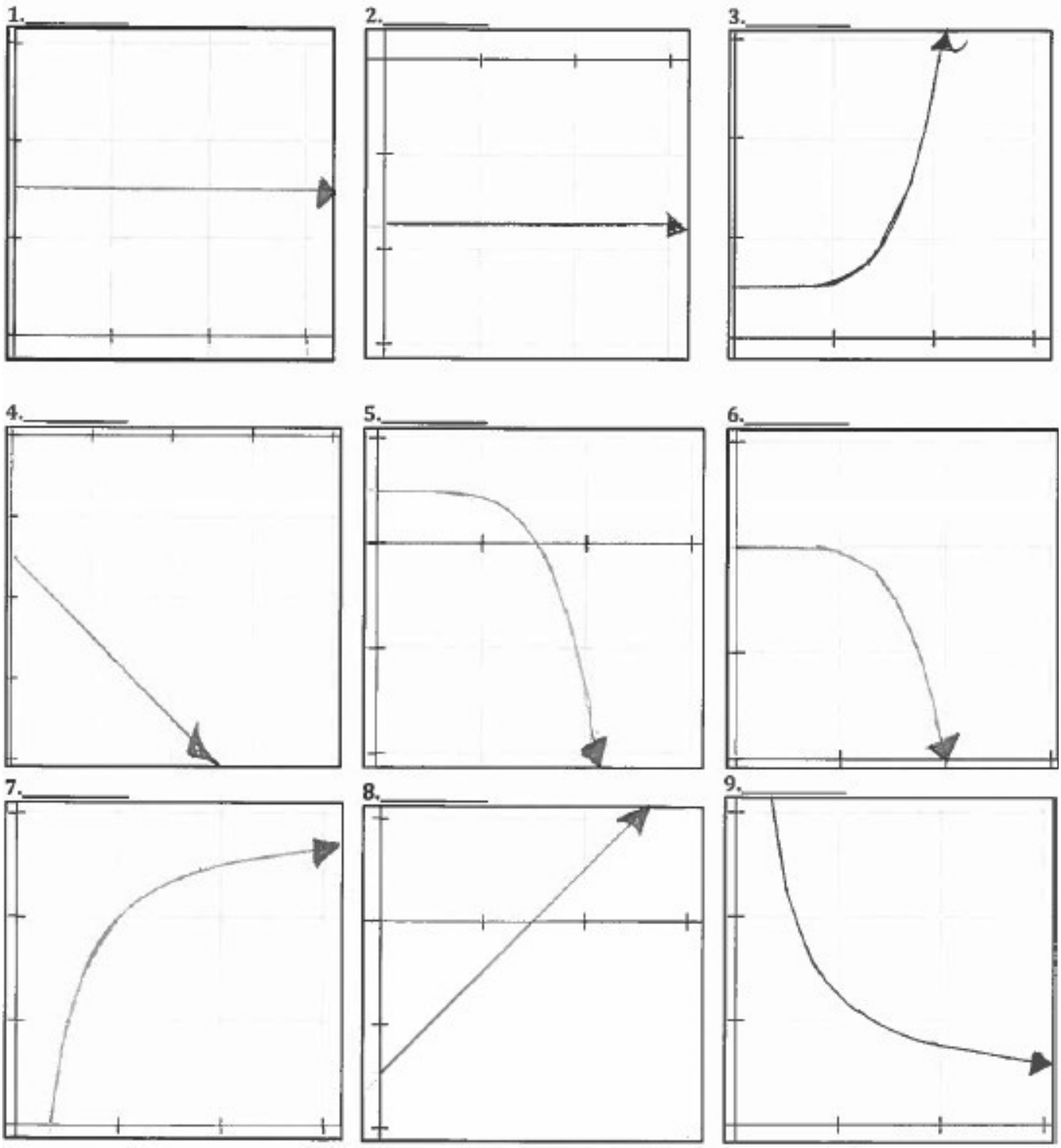
Activity 2:
First row: Sketch a graph corresponding to each given equation, labeling all variables.
Second row: Below each graph, correctly write the equation of the function that corresponds each graph.

1. **y = mx + b**	2. **y = -x (y = negative x)**	3. **y is directly proportional to x**	4. **y = 1/x (inversely proportional)**
5.  **y =**	6.  **y =**	7.  **y =**	8.  **y =**

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



Writing Prompt 1: Outlining Your Goals (How Can Physics Serve You?)

"*Uncommon knowledge for uncommon people*" - Alex Mills' physics class motto

Physics can be hard sometimes, but learning it is an incredibly rewarding process that will strengthen your math, logic and problem-solving skills as well as teach you about how the universe works at the most fundamental level. My favorite thing about physics is that you'll sometimes look at a problem and have NO IDEA what the solution is and you might not even immediately know any of the steps to getting there, either... all you know is where you can start, and you've got to use the tools/equations/concepts you learned in class to go step by step and figure it out from there. Oftentimes people are surprised by the extent to which they need to think critically in this class, as physics problems are completely different from most things they've had to do in other courses (and from the more formulaic problems we had in chemistry). This has lead to some tears, but also to a lot of elation!

Because this aspect of physics is difficult and unique, I'd like you to consider how physics can help you achieve your goals and outline your motivations for taking it.
This will help me tailor the class serve your goals in the best possible way, and it can also serve as a reminder for why you embarked on this journey if you ever find yourself frustrated when trying to solve a problem (although usually the rush of eventually getting it will make up for any frustration!)

I'd like you to type at least 1 double-spaced page on the following and have it ready to submit to Google Classroom on the first day of school:

- *Why did you decide to take physics?*
- *What do you find most intriguing about learning physics? / What are you most excited about?*
- *What do you find most intimidating about learning physics? / What are you most worried about?*
- *How can learning physics help you achieve your personal/academic/professional goals?*
- *What do you want to get out of this class?*
- *How can I best be of service to you?*
- *In order to succeed in and enjoy physics, **the most important thing is learning to love the challenge** of not knowing and then figuring out. If you've chosen to take this class, you likely already do love things like this.*
  - *If so, what makes you love a challenge?*
  - *If not, how do you plan to handle the challenge?*
  - *And regardless, how can you help yourself love the challenge even more?*

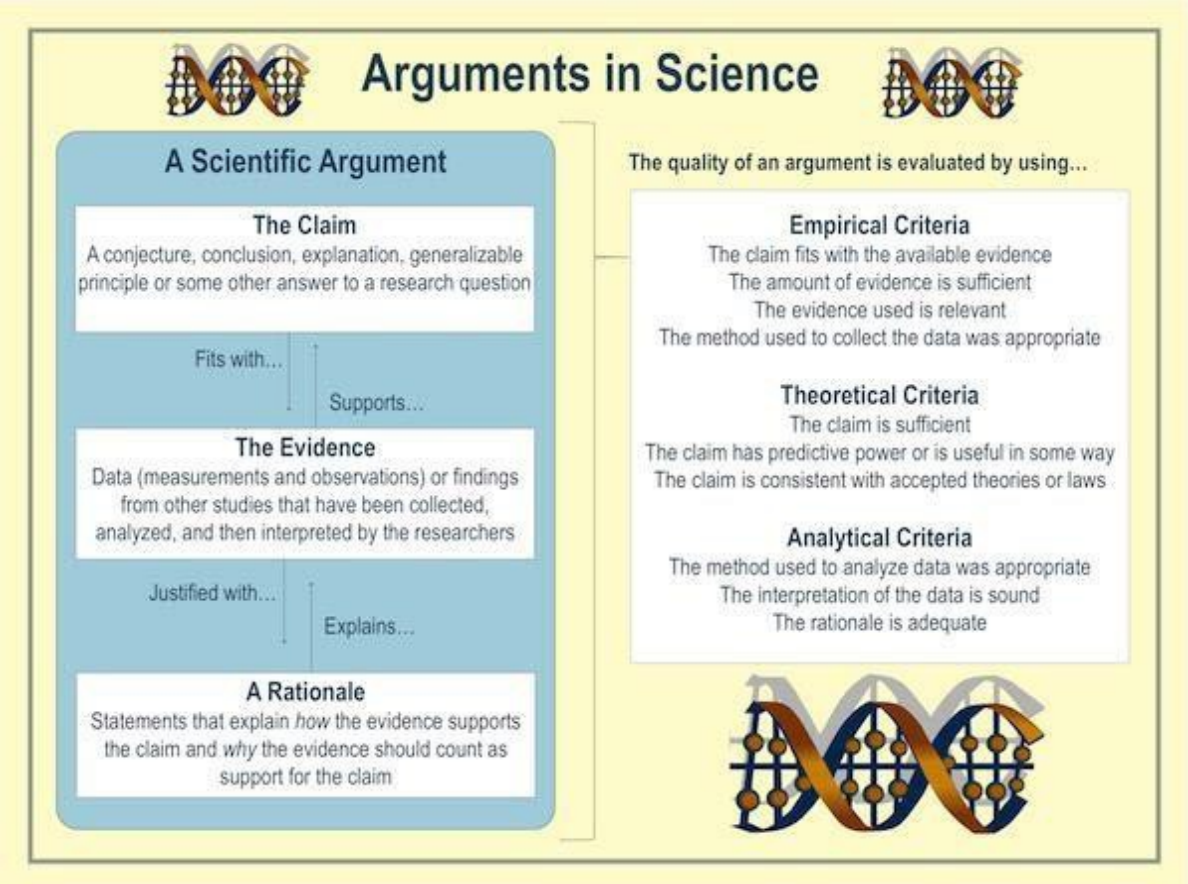
Writing Prompt 2: Scientific Argumentation

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:

4.1. The first element is the **claim.** A claim provides an explanation for why or how something happens in a laboratory investigation.
4.2. The second component is the **evidence**, which supports the claim and consists of the analysis of the data collected during the investigation.
4.3. 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.



http://adi.lsi.fsu.edu/instructional-model

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 and on the AP Exam. 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 (typed or hand-written).*

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	Example: **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 travels? 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! The effort 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. I can't wait to get started!