Name:

AP Physics I Summer Assignment 2023
ENGINEERING CTE

Overview

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

Hello and welcome to the AP Physics I course. AP Physics I is an 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 I course emphasizes the co-development of these skills, which will enhance students' investigative abilities. In short, 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.

The goal of this summer assignment is to help you review the prerequisite knowledge necessary to be successful in this course. You will benefit from completing this assignment with your own work. You may use your previous coursework, the internet and other resources to refresh your memory.

Class Textbook
Physics by Cutnell & Johnson, 10th Edition, AP Edition

Suggested Time
You may have summer plans and other summer assignments so this assignment was designed so that you spend approximately **one hour per week** on each of the activities. You'll notice on the top right hand corner each week's worth of work is labeled. Some activities may take shorter/longer depending on your familiarity of the topic.

Structure your time wisely over the summer so that you can manage the workload for this assignment and any others you may have. This year you have approximately 11 weeks of summer and there are 10 weeks of summer content in this packet. This adds up to approximately 10 hours of work this summer.

Materials Required for this Packet
Calculator, Computer with a Word Processing program, internet access and/or Microsoft Excel. If you do not own a copy of Microsoft Excel, you can access the online version from your school account.

Materials Required for Class in September
Pencil pouch (optional), ≥ 3 inch Binder, 5 Binder Dividers, Scientific or Graphing Calculator, Loose Leaf Paper, Pencils/Pens, and Two 8.5" x 11" Folders to stay in classroom (optional).

Format of Submitted Work - *Important*
Show ALL WORK—for each week's assignment, start on a fresh page and label the week. Include your last name on the top of each page. Each problem should be clearly labeled and work should be easy to follow. Writing prompts must be TYPED and attached to this packet when submitted. The summer assignment will be put in the gradebook as three sections: Math Review, Graphing Review, and Writing Prompts, so please keep your work organized!

Questions?
Over the summer, I will be out of state on occasion, but I will check my work email periodically. Please allow some time for me to get back to you. My school email is: sellis@ccboe.com.

Contents

Overview 1
Mathematics Review 3
Part 1: Solving Symbolically 3
Part 2: Algebraic Manipulation 4
Part 3: Geometry Review 5
Part 4: Trigonometry Review 6
Part 5: Reasoning 8
Graphing Review 9
Writing Prompt 1: The Process of Learning Physics 16
Writing Prompt 2: Scientific Argumentation 17
Writing Prompt 3: Experimental Design FRQ 19

Mathematics Review

Week 1: 6/11 – 6/17

Part 1: Solving Symbolically

During class and on the AP exam, problems will be worked *with variables only*. Solve for the variable indicated on a separate sheet of paper. Write your final answers on this page. These are basic algebraic manipulations. Don't let the different equations and variables confuse you; we will develop these mathematical relationships in class.

Manipulate/**rearrange** these equations algebraically as though they were numbers. When solving for the variable indicated, you are isolating that variable to one side. 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:

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

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

Symbolically solve for the variable specified:			
$mgh = \frac{1}{2}mv^2$	1. Solve for *v*. _____	${v_f}^2 = {v_o}^2 + 2a\Delta x$	7. Solve for v_o. _____
$pV = nRT$	2. Solve for *T*. _____	$T = 2\pi\sqrt{\frac{l}{g}}$	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 θ_c. _____
$B = \frac{\mu_o}{2\pi}\frac{I}{r}$	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 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. _____

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. **Remember to solve these problems symbolically;** variables cancel which is the only way that you will get to some of these answers**.**

Numerically solve for the variable specified:

1. Find: v_f

$v_f = v_o + at$

Given that:
- $v_o = 4$
- $t = 16$
- $a = 5$

v_f=_____

2. Find: v_o

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

Given that:
- $x_o = 0, x_f = -12$
- $t = 8$
- $a = 3$

v_o= _____

3. Find: μ

$f = \mu N$

Given that:
- $f = mg\sin\theta$
- $N = mg\cos\theta$
- $\theta = 55^o$

μ = _____

4. Find: ρ_1

$\rho_1 V_1 g = \rho_2 V_2 g$

Given that:
- $V = A * h$
- $A_1 = A_2$
- $h_1 = 2h_2$
- $\rho_2 = 17$

ρ = _____

5. Find: t

$x_{f1} = 8 - 2t$

$x_{f2} = -6 + \frac{1}{3}t$

Given that:
- $x_{f1} = x_{f2}$

t = _____

6. Find: T, a_1

$a_1 = \frac{T}{2m}$

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

Given that:
- $a_1 = a_2$
- $m = 7$
- $g = 10$

T= _____

a_1= _____

7. Find: P

$P = IV$ $\quad I = \frac{V}{R}$

Given that:
- $V = 3$
- $R = 4$

P = _____

Part 3: Geometry Review

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

The radius of a circle is 7.5 cm.

1. Determine the *circumference* in **centimeters**.

1=_____

2. Determine the *circumference* in **meters**.

2=_____

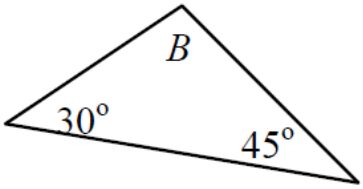
3. Determine the *area* in **square centimeters**.

3=_____

4. Determine the *area* in **square meters**.

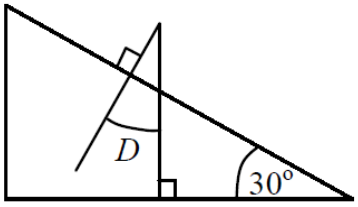
4=_____

5. What is the value of angle B?



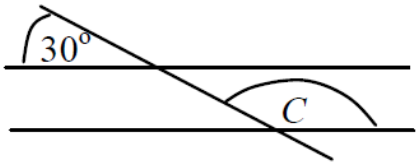
5=_____

6. How large is angle D?



6=_____

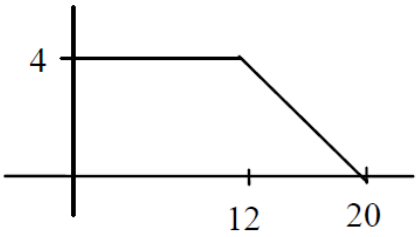
7. The two horizontal lines are parallel.



What is the value of angle C?

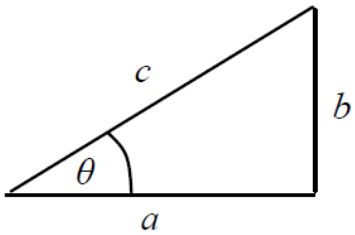
7=_____

8. Determine the area under the graph below.



8=_____

9. Use the following triangle to answer the questions to the right:



a. *Given*: a=25.0, c=35.0 Determine b and θ = _____

b. *Given*: a = 240 , b = 120 Determine c and θ = _____

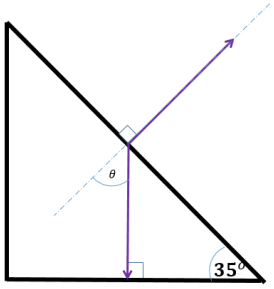
c. *Given*: θ = 35.0° , a = 15.0 Determine b and c = _____

d. *Given*: b =65.0 , c = 120 Determine a and θ = _____

e. *Given*: b = 14.6, θ=70° Determine a and c = _____

10. Find angle theta:

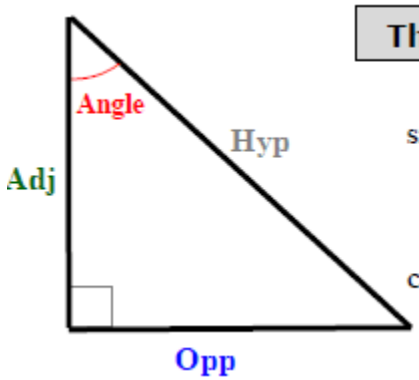
10=_____



Week 4: 7/2 – 7/8

Part 4: Trigonometry Review

The trigonometric functions are functions whose input is an angle and output is a ratio of specific side lengths of a triangle. These functions are used to relate the angles of a triangle to the lengths of its sides. Trig functions are important in the study of triangles and modeling periodic phenomena such as pendulums, springs, etc.



The Six Trigonometric Functions

$$\sin A = \frac{opp}{hyp} \quad \cos A = \frac{adj}{hyp} \quad \tan A = \frac{opp}{adj}$$

$$\csc A = \frac{hyp}{opp} \quad \sec A = \frac{hyp}{adj} \quad \cot A = \frac{adj}{opp}$$

Activity 1: In this class, we will concern ourselves with the top three trigonometric functions. Although you would have already needed to use these for last week's activity, this activity will have you practice **using your calculator** to compute the following common values you will need often for this class. *Do not forget to switch your calculator from degrees to radians mode for the last two rows!*

1.	$\sin(30^o) =$	*2.*	$\cos(30^o) =$	*3.*	$\tan(45^o) =$
4.	$\sin(0^o) =$	*5.*	$\cos(0^o) =$	*6.*	$\tan(0^o) =$
7.	$\sin^{-1}(3/5) =$ o	*8.*	$\cos^{-1}(4/5) =$ o	*9.*	$\tan^{-1}(1) =$ o
10.	$\sin(0\ rad) =$	*11.*	$\cos(0\ rad) =$	*12.*	$\tan(0\ rad) =$

Activity 2: There are 2π radians in a full circle. There are 360^o in a full circle. Convert the following values from degrees to radians. **Hint:**

$$\square\ ^o\ x \left[\frac{2\pi\ radians}{360^o}\right] = \square\ radians$$

$$\square\ radians\ x \left[\frac{360^o}{2\pi\ radians}\right] = \square\ ^o$$

13.	Describe what a *radian is:*	*14.*	$60^o\ to\ rad$	*15.*	$45^o\ to\ rad$
16.	2.94 rad to deg	*17.*	8.26 rad to deg	*18.*	6.83 rad to deg

Activity 3: Answer the following questions.

19. A wheel turns for one complete rotation. By how many **degrees** did the wheel turn?

_____

20. A wheel turns for one complete rotation. By how many **radians** did the wheel turn?

_____

21. A wheel turns at a constant rate of four rotations per minute. By how many **degrees** did the wheel turn in *one minute*?

_____

22. A wheel turns at a constant rate of two rotations per minute. By how many **radians** did the wheel turn in *five minutes*?

_____

23. A wheel turns at a constant rate of three rotations per minute. By how many **degrees** did the wheel turn in *40 seconds*?

_____

24. A wheel turns at a constant rate of five rotations per minute. By how many **degrees** did the wheel turn in *3 seconds*?

_____

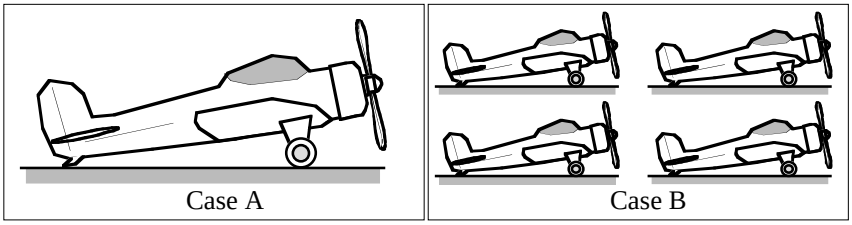
All responses should be typed, double-spaced and attached to this packet when submitted.

Week 5: 7/9 – 7/15

Part 5: 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.) **The goal here is to practice being clear in your reasoning. You will be graded on your clarity of writing and the level of detail in your thought process.** 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.

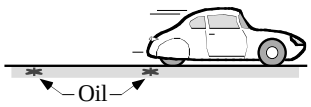


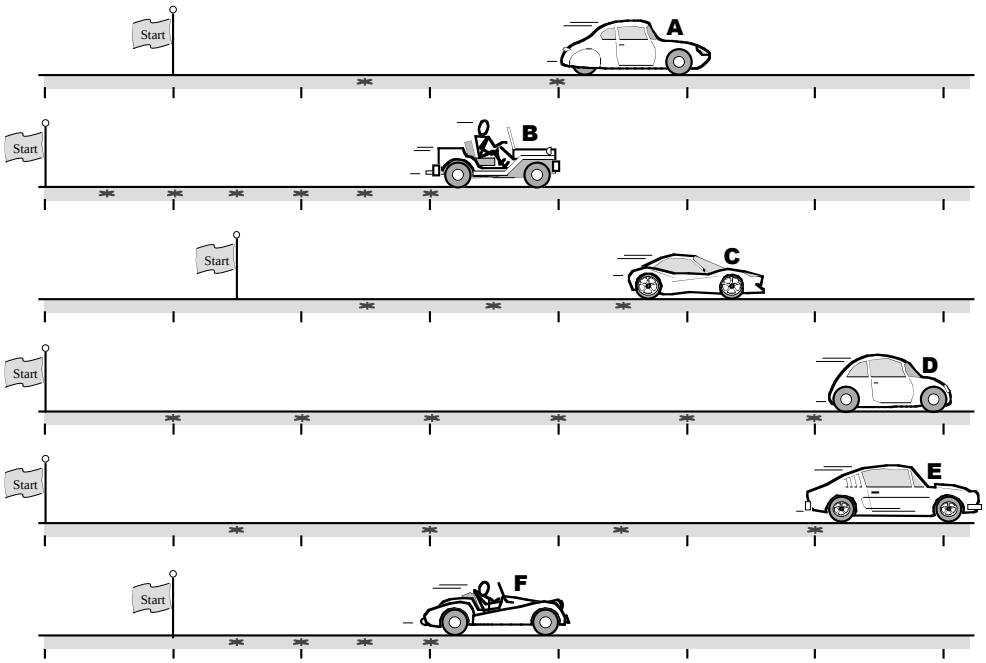
a) The amount of paint required to paint the planes is directly proportional to the surface area. Will the amount of paint required for the single plane in Case A be *greater than, less than,* or *equal to* the total amount of paint required for all four planes in Case B? **Explain your reasoning thoroughly**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

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 thoroughly** typed on a separate sheet.

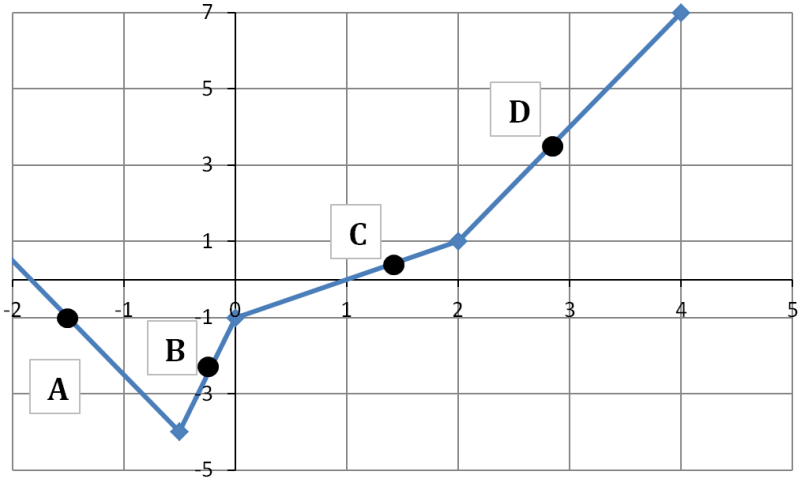




GRAPHING REVIEW

Week 6: 7/16 – 7/22

Activity 1: Four points are labeled on the following graph. Rank the magnitude (value only, not whether it is + or -) of the slopes of the curve at each of the labeled points. **Then, explain your reasoning.**



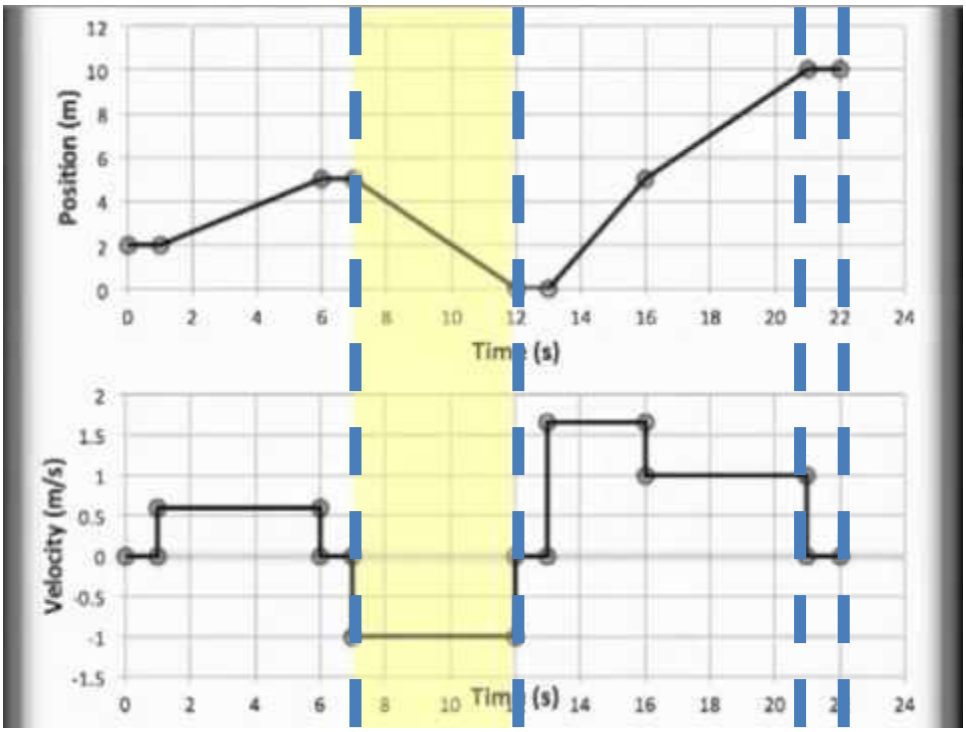
_____ _____ _____ _____

Smallest Slope — Largest Slope

Explain:

Activity 2: Interpreting and translating between different types of graphs is an important skill to master in the first unit of study. In the image below, the second graph is made by plotting the slope of the first graph at each time interval.

Example Graph:



- *Notice how the slope of the first graph between 7 and 12 seconds is –1 m/s.*
- *Notice how on the second graph, -1 m/s is plotted over the interval 7 to 12 s.*
- *Don't worry about the units or what these quantities mean just yet – just be attentive to how the second graph is just the slope of the first graph.*

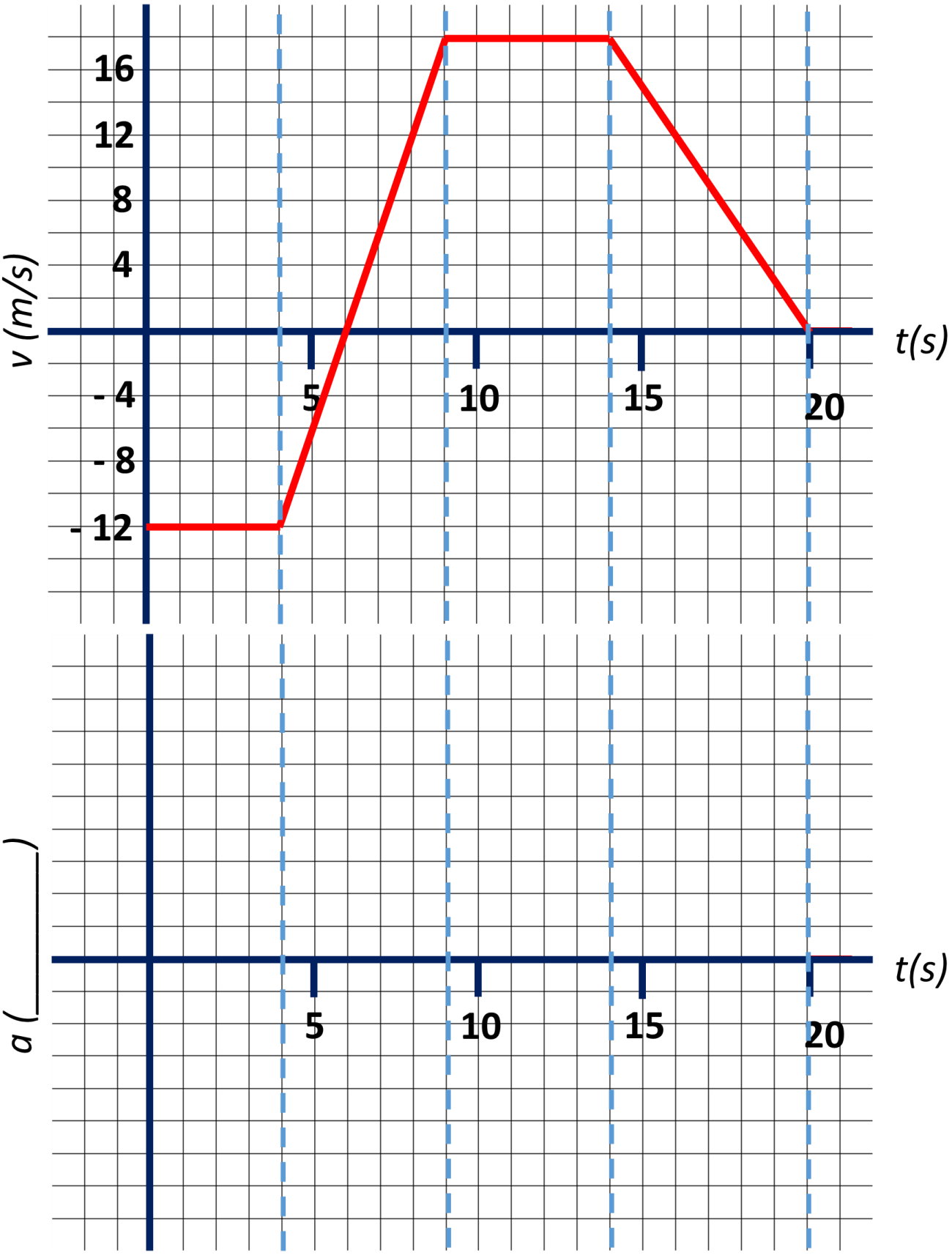
For this activity, study the graph sets on the next two pages. For each graph set, complete the following steps:

I. **Step 1** - Determine the slope of the first graph between:
   a. Graph Set 1:
      i. 0-4s: _____
      ii. 4-9s: _____
      iii. 9-13s: _____
      iv. 13-18s: _____
   b. Graph Set 2:
      i. (To be completed on your own)

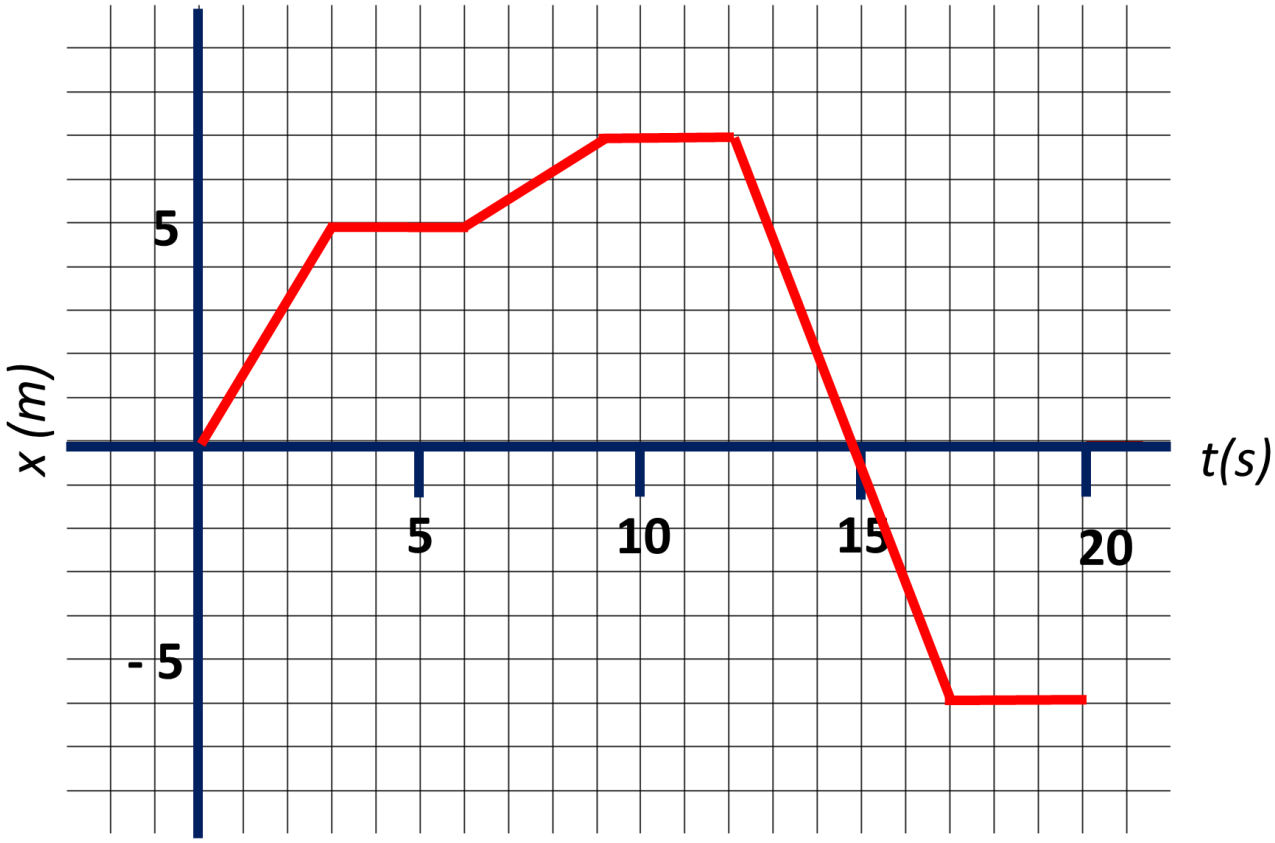
II. **Step 2 -** Plot these values in the second graph provided, where the slope will be the values plotted on the y-axis and time will be plotted on the x-axis. Do not forget to include a scale on the second graphs.

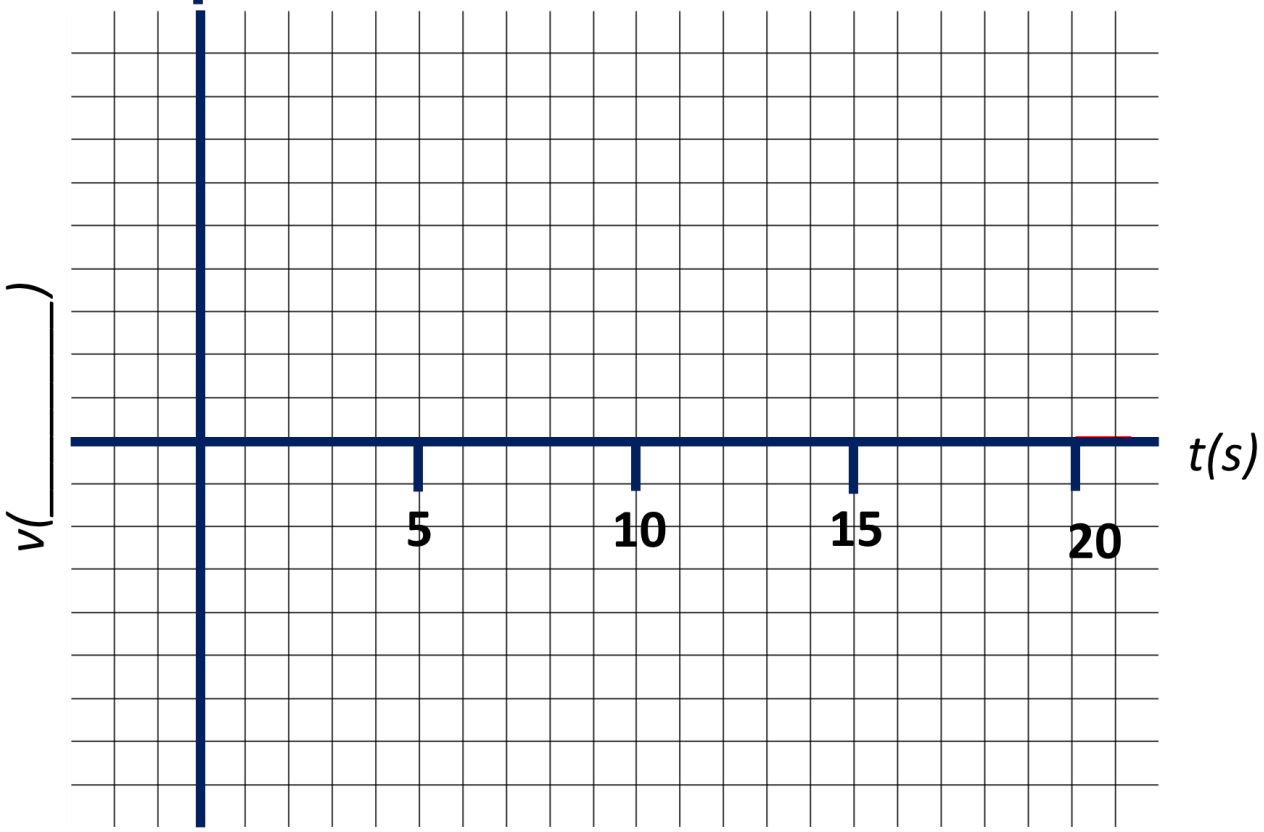
III. **Bonus Points:** Determine the units of the slope and write in the units on the y-axis of the second graph for each set.

Graph Set 1



Graph Set 2: No lines to guide you, but you can do it!

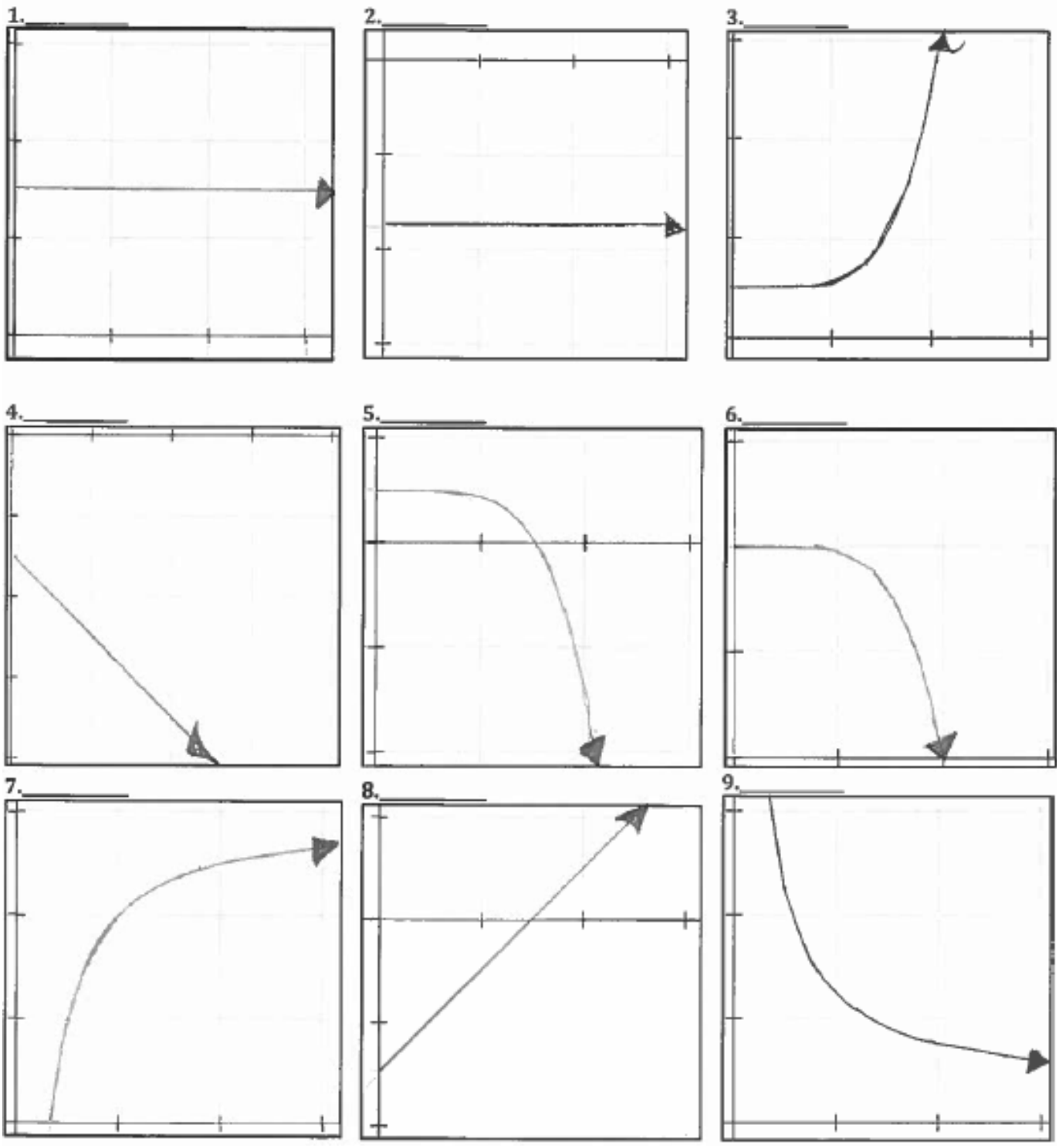

5
- 5
x (m)
5
10
15
20
t(s)


v(
)
5
10
15
20
t(s)

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 or not at all.*

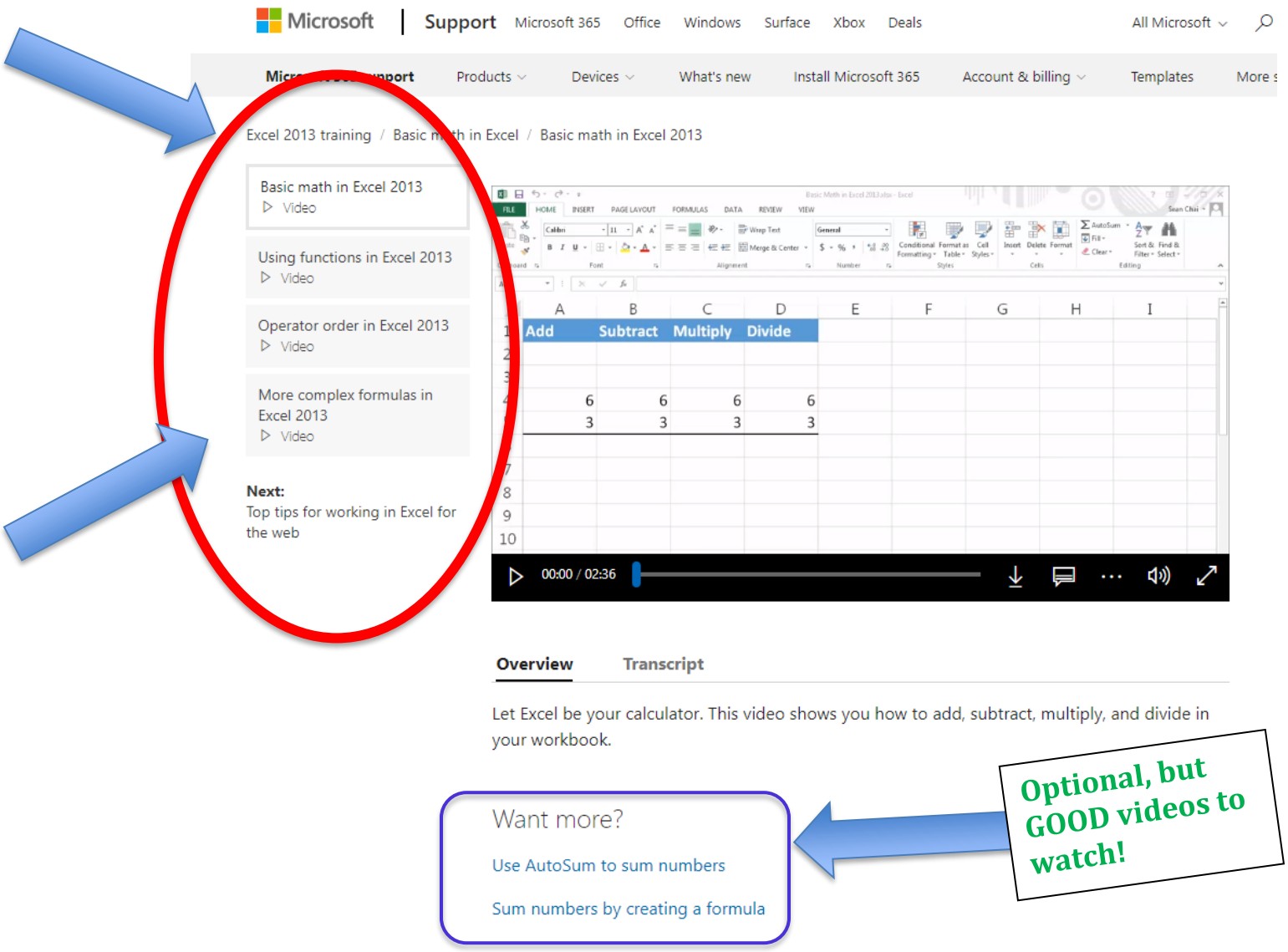
Word Bank

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



Activity 4: Introduction to Excel

- **First**, you'll watch some tutorials on using Excel to do basic numerical calculations. This will be an important skill to have for Engineering Fundamentals, as you will take a lot of data throughout the year and will need to process that data in a timely fashion. Excel can help you do that!
    - **Go to https://support.microsoft.com/en-us/office/video-basic-math-in-excel-2013-e05703f5-7150-44c1-8a52-307738266821**
    - **There are 4 videos there for you to watch:**

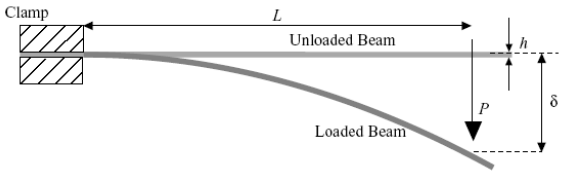


- **Next,** you'll watch these tutorials on how to create a scatter plot graph in Excel. This will be a ***super important skill for you to learn for this coming school year.*** You will be expected to create formal graphs in Excel throughout AP Physics 1/Engineering Fundamentals. In addition, you will be expected to choose the correct trendline that corresponds to the best R^2 value. *You will also be asked to do this for Activity 6.*
    - **https://www.youtube.com/watch?v=gBbGBrHTMrM**
    - **https://www.youtube.com/watch?v=xPllgp12uY4**

- **Last,** some questions to research and answer:
    - What does the R^2 value mean with my trendline?
    - How do I plot a quadratic curve on Excel?
    - How can I switch my x and y axis data? (Let's say Excel puts your independent data on the incorrect axis – how can you put it on the correct axis?)
    - What did you learn from the first set of tutorials (at least 2 things)?
    - What did you learn from the second set of tutorials (at least 2 things)?

Week 7: 7/23 – 7/29

Activity 5: 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:

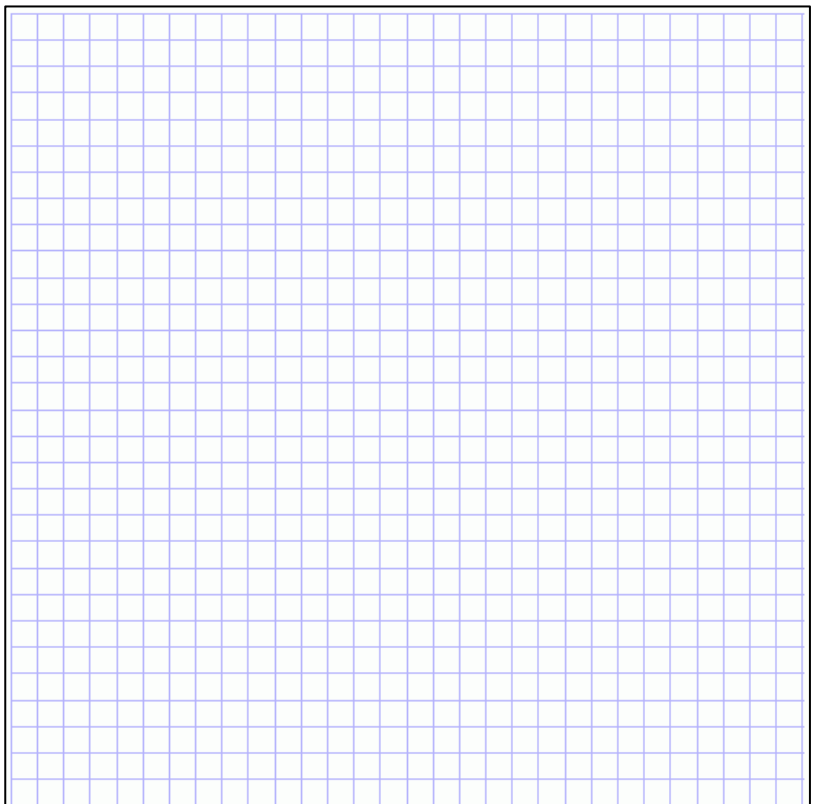


1. When scientists plot experimental data using *x*- and *y*- axes, the independent variable (the '*cause*') is assigned to the x-axis and the dependent variable (the '*effect*') is assigned to the y-axis.

   ➔ In this scenario, identify the independent and the dependent variable *and* **<u>label the axes</u>** below appropriately. IV: _____DV: _____

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

   ➔ <u>GRAPH TITLE:</u>_____



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

3. What type of function (linear/quadratic/exponential) best fits this data? =_____

4. What is the value of the elongation of a beam with a 0.13kg load applied? How can you tell?

   _____

   _____

5. What would the estimated elongation of a beam with a 0.50kg load applied? How can you tell?

   _____

   _____

Activity 6: In this graphing activity, you will need to practice plotting the data in Excel. If you do not have Excel at home, you can complete this on the school computers before your assignment is completed. You can also log into your Microsoft 360 Office account to access Excel Online from home.

Rayshell and Hannah are taking measurements of a toy car traveling across the classroom. Rayshell calls out each one second interval. Hannah records the location of the car as Rayshell calls out each time interval.

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

1. What is the dependent variable (your y-axis variable) in this experiment?

   _____

   What is the independent variable (your x-axis variable) in this experiment?

   _____

2. **Plot the data to the side in Excel** (No points awarded for graphs done by hand). Use the internet for assistance if you have never done this before. Make sure that your axes are labeled with units and your graph has a title (Y-axis label vs. X-axis label) Ensure that you are making a Scatter Plot of these values. <u>DO NOT USE EXCEL ONLINE TO DO THIS.</u> It is not as user-friendly as the actual program downloaded to your computer, so please use the actual program to do your work.

3. What type of function (linear/quadratic/exponential) best fits this data?

   _____

4. **Use Excel** to calculate and display the equation for the best-fit function.

5. **Use Excel** to calculate and display the correlation coefficient R^2. The correlation coefficient (R^2) gives you information about how 'good' your selected best-fit function is. R^2 values greater than 0.99 are indicative of a true fit. Is your selected best-fit function a good fit?

   _____

6. Is the distance traveled greater between:
   a. 0 and 1 seconds or
   b. 3 and 4 seconds

   How can you tell? _____

   _____

7. Is the slope of the curve greater between:
   a. 1 and 2 seconds or
   b. 3 and 4 seconds

   How can you tell? _____

   _____

8. **Print out** your graph with all of the information from questions 2, 4 and 5 displayed for full credit for this section.

All responses should be typed, double-spaced and attached to this packet when submitted.

Writing Prompt 1: The Process of Learning Physics

Week 8: 7/30 – 8/5

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 relevant select 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/dan_pink_on_motivation?language=en

Why Failure Is Good for Success
Pauline Estrem—Source: Success
https://www.success.com/why-failure-is-good-for-success/

Prompt: Write a short essay (at least 1.5 pages double spaced) reflecting on the ideas in the two pieces you've read. Respond to each of the following bullets in your essay:

- What you think is the message of David Hammer's paper and who is the intended audience?
- How does the second article you read relate to the Hammer paper? What can you synthesize from both pieces?
- Describe a time you had difficulty in learning a concept or a subject. Describe the steps **you** used to overcome that difficulty.
- What are some telltale signs that you are having difficulty learning a concept and what strategies can **you** use to make sure you do not fall behind? Use your past experiences and the articles you've read to answer this question.
- 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

Week 9: 8/6– 8/12

Introduction

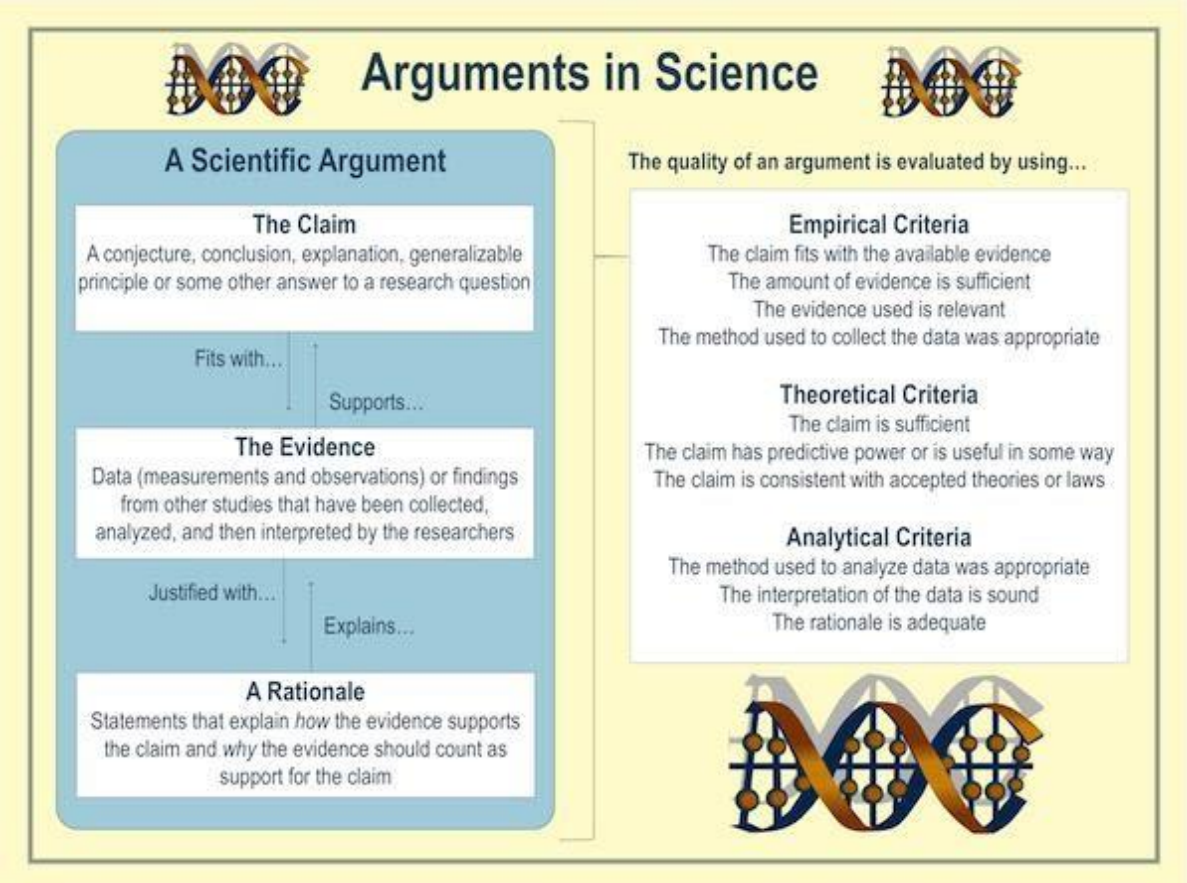
Scientific Argumentation is a key element of the AP Physics 1 Curriculum. One of the objectives of the curriculum is that *"the student can work with scientific explanations and theories."* More specifically this science practice includes the following:

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.



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

All responses should be typed, double-spaced 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.*

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. *Example question*: What causes leaves to change colors in the fall?

1. 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. You are not being graded on if your claim is correct. You are being graded on if your claim is testable. *Example claim*: Temperature may cause leaves to change color.

2. 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 actually a good football team, **and** they go to the playoffs, **then** they will win that game.
… **and** (…)	:Describe experiment to be conducted	
… **then** (…)	:Identify specific hypothetical results	

3. Identify necessary materials and their quantities for your experiment.

4. 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? *Be specific* and discuss how the instruments will be used to collect data.

5. 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?

6. 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 or determined.*** 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 determination of acceleration (the rate of change of speed), we would calculate a value that is larger than the true value. *This is the level of detail that I expect here.*

7. 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? How certain are you that your data is valid? ***Hint: Uncertainties have to do with the quality of instruments that you use and your method of data collection.*** How can you be sure that your measured values are accurate and/or precise?

    a. *Accuracy is the degree of closeness to a true or known value (example: acceleration due to gravity = 9.81m/s^2). Precision is the degree to which an instrument or process will repeat the same value.*

8. Multiple Representations—draw a sketch of your setup and/or your equipment. Include any relevant diagrams. Ensure that all representations are clearly labeled. *You should have multiple diagrams.*

All responses should be typed, double-spaced and attached to this packet when submitted.

Writing Prompt 3: Experimental Design FRQ

Week 10: 8/13– 8/19

Introduction: The AP Physics 1 Exam is divided into two sections, the Multiple Choice Question (MCQ) section and the Free Response Question (FRQ) section. The AP Physics 1 exam differs from the past AP Physics exams as they have moved away from simple problem solving ('plug and chug') questions. The new test format has questions that focus deeply on conceptual understanding and the FRQ section requires students to be able to explain their reasoning clearly and correctly. This is the reason behind the many writing portions of this assignment! In class, we will talk at length about the different types of FRQ questions and the strategies behind each type of question. However, in this activity you will practice developing a paragraph length response to a given prompt.

Background Information: *1D Kinematics* is the first unit that we will study in AP Physics 1. Kinematics is the study of motion. The first few terms that we will learn about in this unit are as follows:

- Motion: A change in an object's position relative to a given observe during a certain change in time.
- Linear Motion: A model of motion that assumes that an object, considered as a point-like object, moves along a straight line.
- Time, t: The reading on a clock or some time-reading instrument at an instant.
- Time Interval, Δt: The difference between two times.
- Position, x : Location with respect to a particular coordinate system (Usually x- or y-)
- Distance: "how much ground an object has covered"
- Speed: Distance covered in a time interval (distance/time)

Prompt: You have spent all of your allowance on a battery-powered car that is advertised to travel at a constant speed for a money-back guarantee. Because you are a discerning consumer, you want to test this claim to ensure that you have spent your money wisely.

Design an experiment to determine whether the car travels at a constant speed. You have markers, a whiteboard surface, a meter stick, a stopwatch, beanbags, and a measuring tape.

a) Describe your experiment. In this description answer the following two questions as well: What quantities do you need to measure? How will you use the equipment available to measure those quantities?
b) How you can organize and present your data to draw a conclusion? What results would support the claim that the car travels at a constant speed?
c) What experimental uncertainties exist in your data collection? Identify two things you can do to minimize the impact of these uncertainties on your data.
d) Identify at least two assumptions you are making in your experimental method. Identify how these assumptions may specifically increase or decrease your calculated value (speed). Explain how.

Rest up and get ready for school!

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 that you will look back to this class with huge sense of satisfaction! I know I can't wait to get started… Let's learn some SCIENCE!!!

AP Physics I Engineering Summer Assignment 2023

Total Points: _____/ 90 pts

Name:

Mathematics Review **_____/ 34 pts**

Part 1: Solving symbolically _____/ 6 pts
Part 2: Algebraic Manipulation _____/ 4 pts
Part 3: Geometry Review _____/ 7 pts
Part 4: Trigonometry Review _____/ 12 pts
Part 5: Reasoning _____/ 5 pts
Activity 1 _____/ 2.5 pts
Activity 2 _____/ 2.5 pts

Graphing Review **_____/ 25 pts**

Activity 1 _____/ 1 pts
Activity 2 _____/ 2 pts
Activity 3 _____/ 2 pts
Activity 4 _____/ 5 pts
Activity 5 _____/ 5 pts
Activity 6 _____/ 10 pts

Writing Prompt 1: The Process of Learning Physics **_____/ 7 pts**
Writing Prompt 2: Scientific Argumentation **_____/ 12 pts**
Writing Prompt 3: Experimental FRQ **_____/ 12 pts**

Writing Prompt 2: Scientific Argumentation Rubric

1. Transform your question into a claim _____/ 1 pts

2. Devise a testable hypothesis statement. _____/ 3 pts

Scientific Ability	Missing (0)	Basic (0.5)	Developing (1)	Proficient (1.5)
Is able to identify the hypothesis to be tested	No mention is made of a hypothesis.	An attempt is made to identify the hypothesis to be tested but is described in a confusing manner.	The hypothesis to be tested is described but there are minor omission or vague details.	The hypothesis is clearly stated.
Is able to make a reasonable prediction based on a hypothesis.	No prediction is made. The experiment is not treated as a testing experiment.	A prediction is made but it is identical to the hypothesis, OR prediction is made based on a source unrelated to hypothesis being rested or is completely inconsistent with hypothesis being tested, OR Prediction is unrelated to the context of the designed experiment.	Prediction follows from hypothesis but is flawed because: *relevant experimental assumptions are not considered and/or *prediction is incomplete or somewhat inconsistent with hypothesis and/or *prediction is somewhat inconsistent with the experiment	A prediction is made that: *follows from hypothesis *is distinct from the hypothesis *accurately describes the expected outcome of the designed experiment *incorporates relevant assumptions if needed

3. Identify necessary materials for your experiment. _____/ 1 pts

4. Specify how materials will be used for data collection. _____/ 1 pts

5. Identify how collected data will be analyzed. _____/ 1.5 pts

Scientific Ability	Missing (0)	Basic (0.5)	Developing (1)	Proficient (1.5)
Is able to identify specifically how the collected data will be interpreted.	No attempt is made to identify data interpretation methods.	An attempt is made to identify data interpretation methods however, methods described are incorrect.	Sufficient interpretation methods are correctly identified.	Sufficient interpretation methods are correctly identified and data organization methods are clearly described.

6. Discuss assumptions in procedure _____/ 1.5 pts

Scientific Ability	Missing (0)	Basic (0.5)	Developing (1)	Proficient (1.5)
Is able to identify the assumptions made in making the prediction	No attempt is made to identify any assumptions.	An attempt is made to identify assumptions, but the assumptions are irrelevant or are confused with the hypothesis.	Relevant assumptions are identified but are not significant for making the prediction.	Sufficient assumptions are correctly identified, and are significant for the prediction that is made.
+1 Point for identifying how assumption may specifically alter your prediction (will it increase or decrease predicted value)				

7. Discuss uncertainty inherent in data collection _____/ 1.5 pts

Scientific Ability	Missing (0)	Basic (0.5)	Developing (1)	Proficient (1.5)
Is able to identify the uncertainty inherent in data collection.	No attempt is made to identify any uncertainty.	An attempt is made to identify uncertainties, but the uncertainties are irrelevant or are confused with the assumptions.	Relevant uncertainties are identified but are not significant for the experiment. OR Uncertainties are not distinct from assumptions.	Sufficient uncertainties are correctly identified, and are significant for the experiment.

8. **Multiple** Representations _____/ 1.5 pts

- A sketch of the experimental setup is included
- **&** All relevant diagrams are included

Sub-Total Points: ____/ 12 pts