Student: _____

Ocean City High School
AP PHYSICS 1
Summer Assignment 2021

Course:	**AP Physics 1**	Teacher:	Mr. Tapp
Email:	itapp@ocsdnj.org	Due Date:	Pt.1/2: August 27th, 2021

Standards	NJCCCS: 5.1.12.A.2, 5.1.12.B.2, 5.1.12.D.2
Topic	Mathematical Review/Skills specific to success in AP Physics
Purpose	Part 1: Provide a mathematics of physics overview that will help students to brush up on the essential mathematical skills and concepts utilized throughout the course. Part 2: Introduction to life as an AP science student including skills specific to AP Physics
Approximate Time on Task	**#1/2**: 5-10 hrs
Suggested Timeline	Work on a few sections each week over the course of the summer
How It Will Be Assessed	Pt1: timely completion and Rubric Pt2: timely completion and Rubric
How to Submit the Assignment	Please scan the Summer Assignment and send it to my email at itapp@ocsdnj.org.

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

Dear AP Physicist,

Hello and welcome to the AP Physics 1 course. AP Physics 1 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 1 course emphasizes the co-development of these skills, which will enhance students' investigative abilities. In short, this year, you will be responsible for constructing/deepening physics knowledge through inquiry, cultivating critical thinking, reasoning skills, and a deep understanding of ideas in physics.

This summer assignment is broken into two parts. Part One serves to review the mathematical knowledge necessary to be successful in this course. Part Two is designed to introduce the special skills required to be an AP Physics student. 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. In this assignment, I am looking to see where you currently are before walking in on day one. This is my first impression of you, so give me an honest effort. Any mistakes you make will be worked on throughout the year.

Sincerely,

Mr. Tapp

Part 1: Mathematics of AP Physics &
Part 2: AP Physics Skills   0.5-1 hour/week

General Instructions
Make sure to read all directions throughout the attached assignment packet. Do not copy work from another student for your own integrity and for your own benefit because all AP Physics students will take a quiz with problems similar to (if not exactly like) those found on this assignment the first week of school.

Format of Submitted Work - *Important*
Show <u>ALL WORK</u>—for each assignment, start on a fresh page and label section. 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 of Part 2 must be TYPED== and attached to this packet when submitted.

Questions?
If you have difficulty, please do not hesitate to email me at itapp@ocsdnj.org . Over the summer, I will check my email somewhat infrequently (~1 per week).

DUE: August 27, 2021

> *"I think we should teach them [the people] wonders and that the purpose of knowledge is to appreciate wonders even more."*
> — **Richard P. Feynman**

Contents

Part 1: Mathematics Review

Section 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:			
$E = \dfrac{F}{q}$	1. Solve for q. _____	$a = (v_f - v_o)/t$	5. Solve for v_f _____
$mgh = \dfrac{1}{2}mv^2$	2. Solve for v. _____	$T = 2\pi\sqrt{\dfrac{m}{k}}$	6. Solve for k. _____
$k = \dfrac{1}{2\pi\varepsilon_0}$	3. Solve for ε_0. _____	$F = G\dfrac{m_1 m_2}{r^2}$	7. Solve for r. _____
$v = \sqrt{2a\Delta x}$	4. Solve for Δx. _____	$\dfrac{1}{f} = \dfrac{1}{d_o} + \dfrac{1}{d_f}$	8. Solve for d_f _____

Section 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.

<div align="center">Numerically solve for the variable specified:</div>

1. Find: v_f $$v_f = v_o + at$$ Given that: • $v_o = 0$ • $t = 5$ • $a = 2$ $v_f =$ _____	2. Find: v_o $$x_f = x_o + v_o t + \frac{1}{2}at^2$$ Given that: • $x_o = 0, x_f = -6$ • $t = 2$ • $a = 3$ $v_o =$ _____	3. Find: μ $$f = \mu N$$ Given that: • $f = mg\,\sin\,sin\,\theta$ • $N = mg\,\cos\,cos\,\theta$ • $\theta = 30^o$ μ = _____
4. Find: ρ_1 $$\rho_1 V_1 g = \rho_2 V_2 g$$ Given that: • $V = A * h$ • $A_1 = A_2$ • $h_1 = 2h_2$ • $\rho_2 = 10$ ρ = _____	5. Find: t $$x_{f1} = 8 - 2t$$ $$x_{f2} = -1 + \frac{1}{2}t$$ Given that: • $x_{f1} = x_{f2}$ $t =$ _____	6. Find: T, a_1 $$a_1 = \frac{T}{3m}$$ $$a_2 = \frac{mg-T}{m}$$ Given that: • $a_1 = a_2$ • $m = 5$ • $g = 10$ T= _____
7. Find: P $$P = IV \qquad I = \frac{V}{R}$$ Given that: • $V = 3$ • $R = 2$ P = _____		$a_1 =$ _____

Section 3: Geometric Diagrams

In this class you will find yourself analyzing many physical scenarios and diagrams. Utilize basic geometry to answer the following questions. *Note: if you have not had geometry yet please do your best on these specific situations - will be reviewed early in year*

The radius of a circle is 4.2 cm.

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

1=_____

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

2=_____

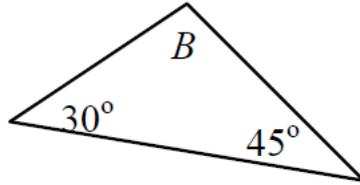3. Determine the *area* in **square centimeters**.

3=_____

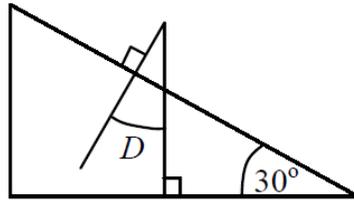4. Determine the *area* in **square meters**. (*hint: convert first!*)

4=_____

5. What is the value of angle B?

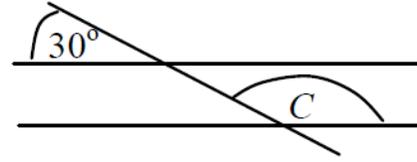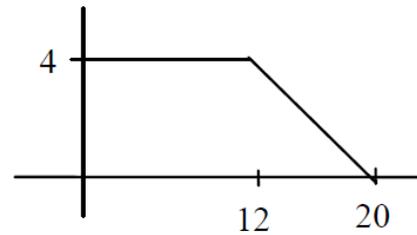5=_____

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=_____

## Section 4: Proportional Reasoning

In this class you will find yourself interpreting relationships between variables as expressed in mathematical equations. Practice thinking about proportional relationships below.

Consider $z = \dfrac{x}{y}$, $\qquad c = ab$, $\qquad l = m - n$, $\qquad r = \dfrac{s^2}{t^2}$.

1) As x increases and y stays constant, z _____.

2) As y increases and x stays constant, z _____.

3) As x increases and z stays constant, y _____.

4) As a increases and c stays constant, b _____.

5) As c increases and b stays constant, a _____.

6) As b increases and a stays constant, c _____.

7) If s is tripled and t stays constant, r is multiplied by _____.

8) If *t* is doubled and *s* stays constant, *r* is multiplied by _____

Section 5: Trigonometry

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. They are also important to understand vector quantities in physics. *Note: if you have not had trigonometry yet please do your best on these specific situations - will be reviewed early in year*

$$\sin A = \frac{opp}{hyp} \qquad \cos A = \frac{adj}{hyp} \qquad \tan A = \frac{opp}{adj}$$
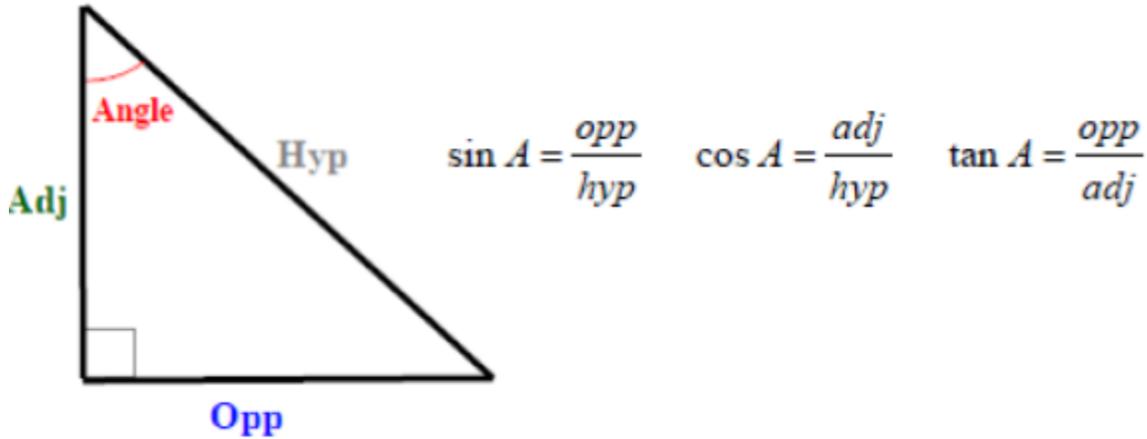
In this class, we will concern ourselves with the top three trigonometric functions. This activity will have you practice **using your calculator** to compute the following common values you will need often for this class. Note: Doing the function to the -1 power is an inverse function (usually the 2nd key above the standard function on a calculator) and finds an unknown angle using the ratio of sides

1.	$\sin\left(30^o\right) =$	2.	$\cos\left(30^o\right) =$	3.	$\tan\left(45^o\right) =$
4.	$\sin\left(0^o\right) =$	5.	$\cos\left(0^o\right) =$	6.	$\tan\left(0^o\right) =$
7.	$\sin^{-1}(3/5) =$ °	8.	$\sin^{-1}(4/5) =$ °	9.	$\tan^{-1}(1) =$ °

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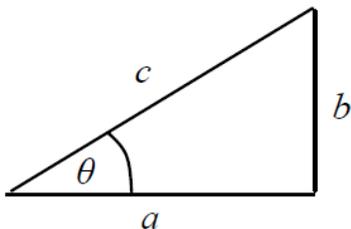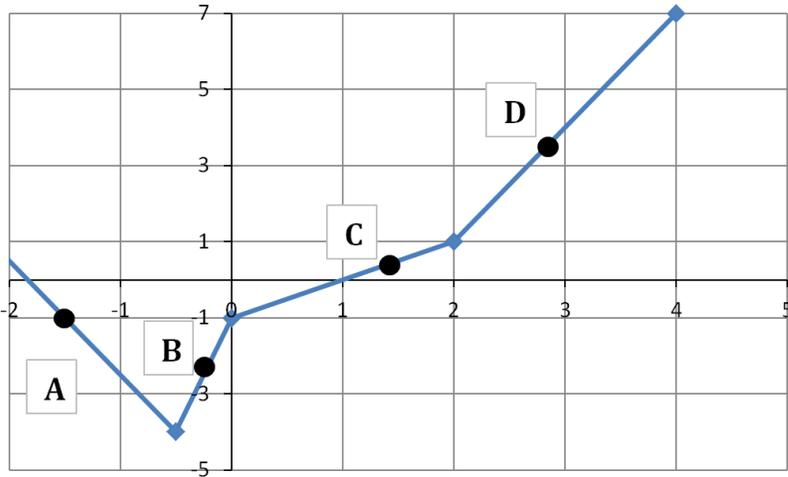

   a. *Given*: a=25.0, c=30.0 Determine b and θ = _____

   b. *Given*: a = 230 , b = 160 Determine c and θ = _____

   c. *Given*: θ = 45.0° , a = 12.0 Determine b and c = _____

   d. *Given*: b =63.0 , c = 105 Determine a and θ = _____

Section 6: Graphing

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

_____ _____ _____ _____

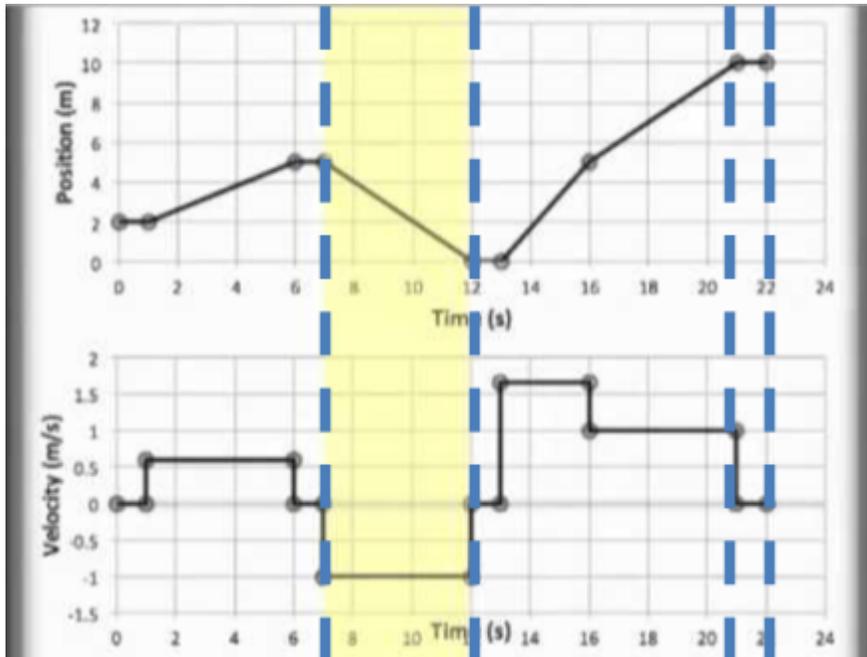Smallest   Largest
Slope   Slope

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:
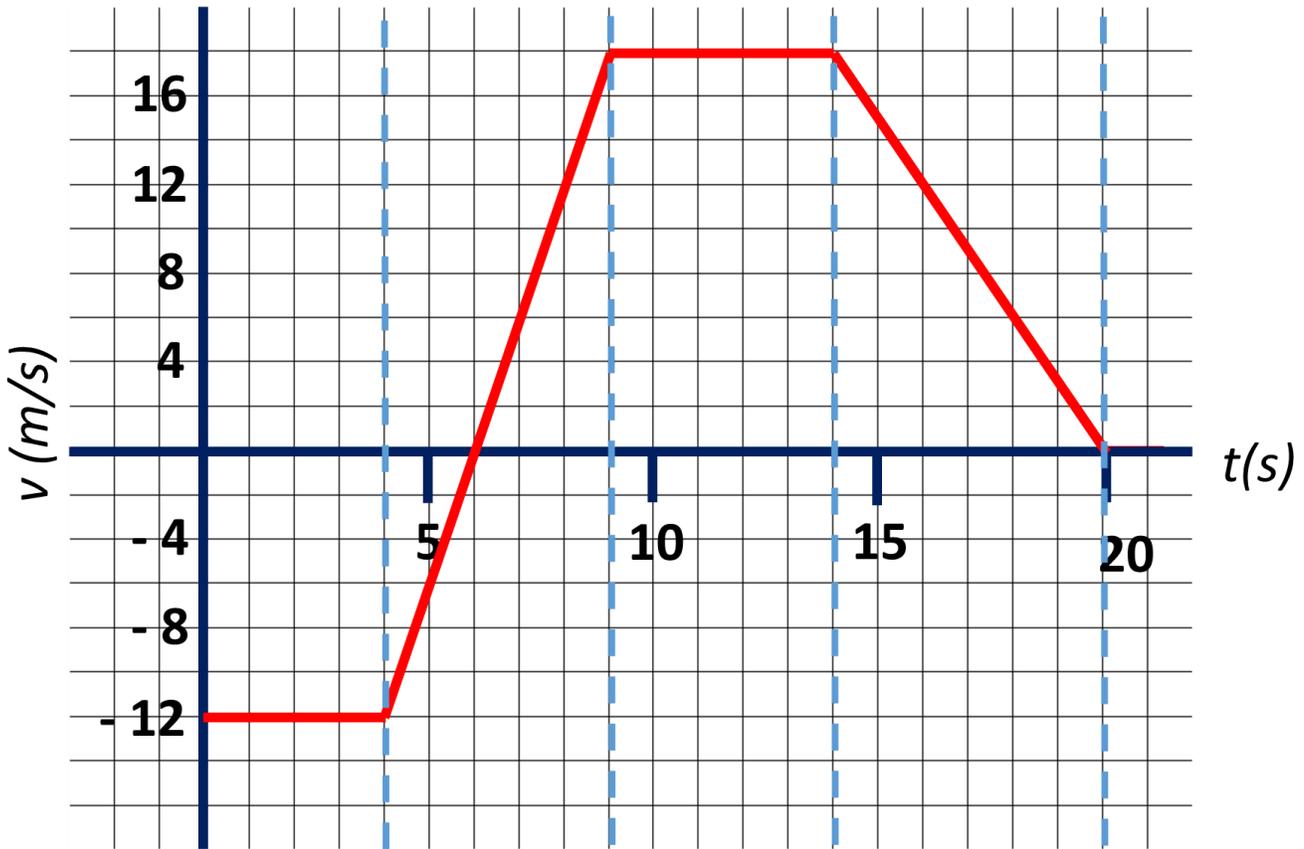
0-4s: _____4-9s: _____9-13s: _____ 13-18s: _____
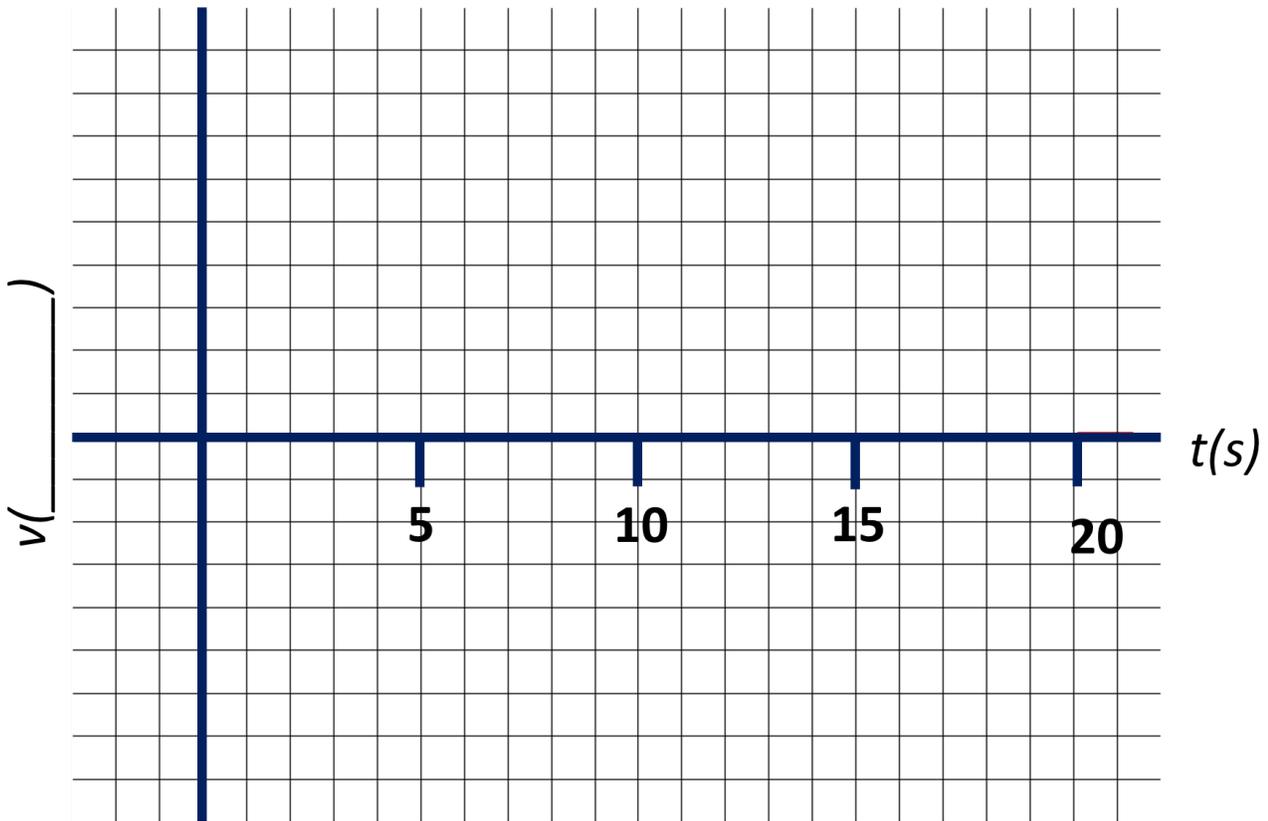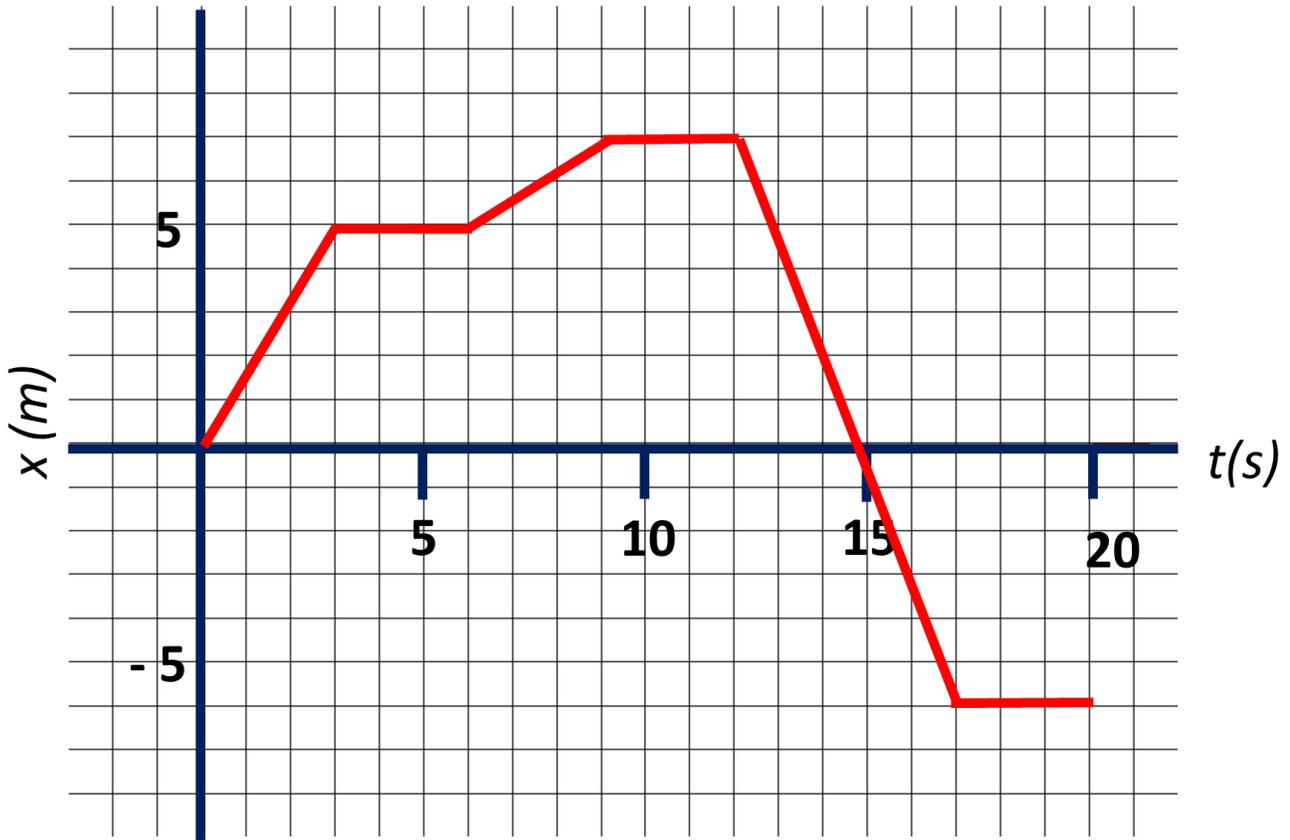
      b.   Graph Set 2:
            i.   (To be completed on your own)

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 graph.

Graph Set 1
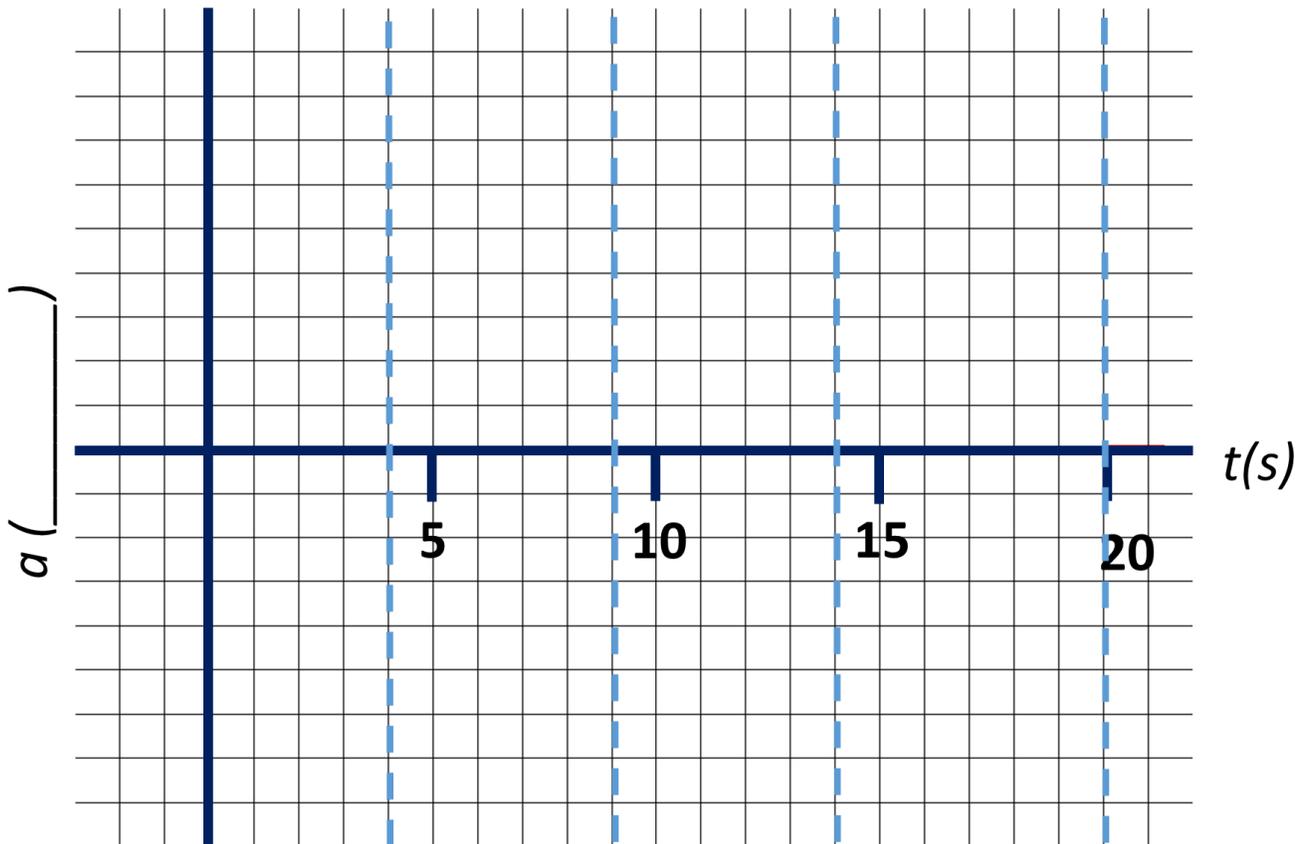
Activity 3: At an internship at a civil engineering contracting firm your project was to study different materials' response to various loads. Suppose you recorded the following data for one end-loaded cantilever beam. Answer the following questions below:

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. IV: _____DV: _____

2. Plot the graph of this data in the space provided - you must utilize at least 75% of the available space by scaling your axes properly:

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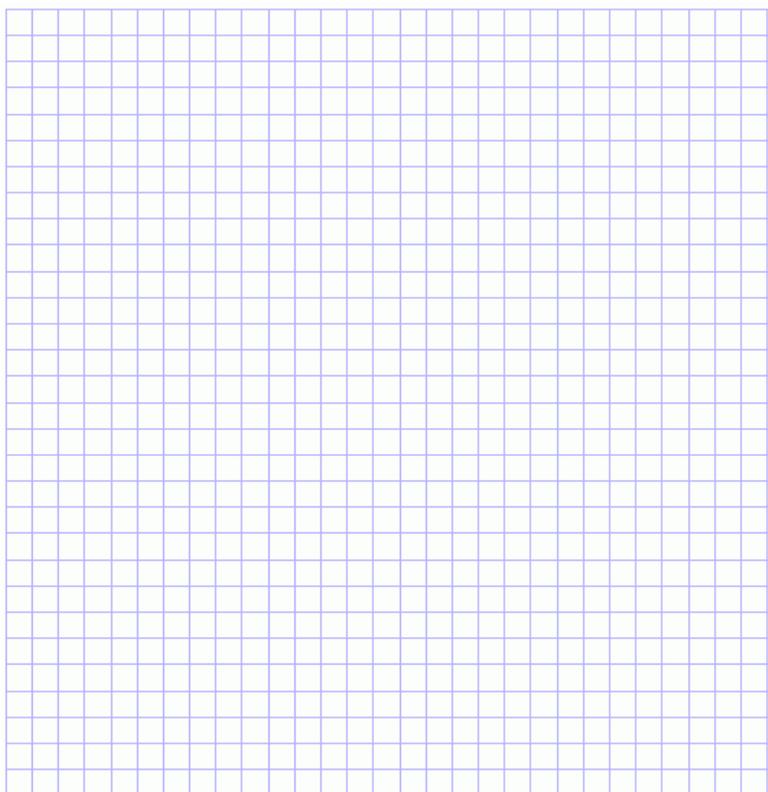
Applied Load (kg)	Beam Deflection (mm)
0.00	0
0.05	3
0.10	6.5
0.15	9
0.20	13
0.25	16
0.30	20

3. What type of function (linear/quadratic/exponential) best fits this data? =_____
   _https://www.thephysicsaviary.com/Physics/Programs/Tools/HelpWithGraphTypes/index.html

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 4: In this graphing activity, you will need to practice plotting the data in a computer based program. We often utilize the online graphing calculator desmos for this in class, but further instructions will be given for that program in class. For this graph use the following site, but keep in mind you can't save your graph to come back to later. https://www.thephysicsaviary.com/Physics/Programs/Tools/Graphing/

Rosie and Bryn are taking measurements of a toy car traveling across the classroom. Rosie calls out each one second interval. Bryn records the location of the car as Rosie 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** (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.

3. What type of function (linear/squared/square root/inverse/quadratic) best fits this data? https://www.thephysicsaviary.com/Physics/Programs/Tools/HelpWithGraphTypes/index.html

_____

4. **Use the program to add a best fit line to the data** the equation of the data is given in the top right corner of the graph - write the equation here, but first translate the x and y placeholder variable into your x and y axis quantities (you should not have a y = equation if you do this correctly!)

5. Is the distance traveled greater between:
    a. 0 and 1 seconds   or   b. 3 and 4 seconds
How can you tell? _____

_____

6. Is the slope of the curve greater between:
    a. 1 and 2 seconds   or   b. 3 and 4 seconds
How can you tell? _____

_____

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

Part 2: AP Physics Skills

Section 1: Writing Prompt - 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.

Case A

Case B
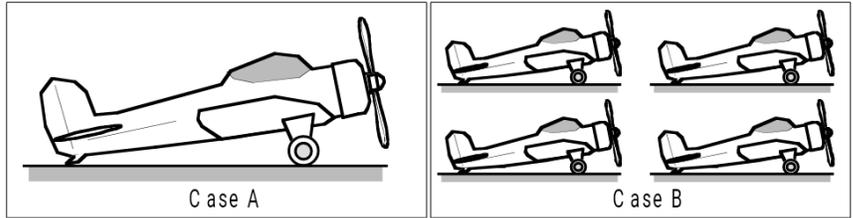
a) The amount of paint required to paint the planes is directly proportional to the surface area. Will the amount of paint required for the single plane in Case A be *greater than, less than,* or *equal to* the total amount of paint required for all four planes in Case B? **Explain your reasoning thoroughly** 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.
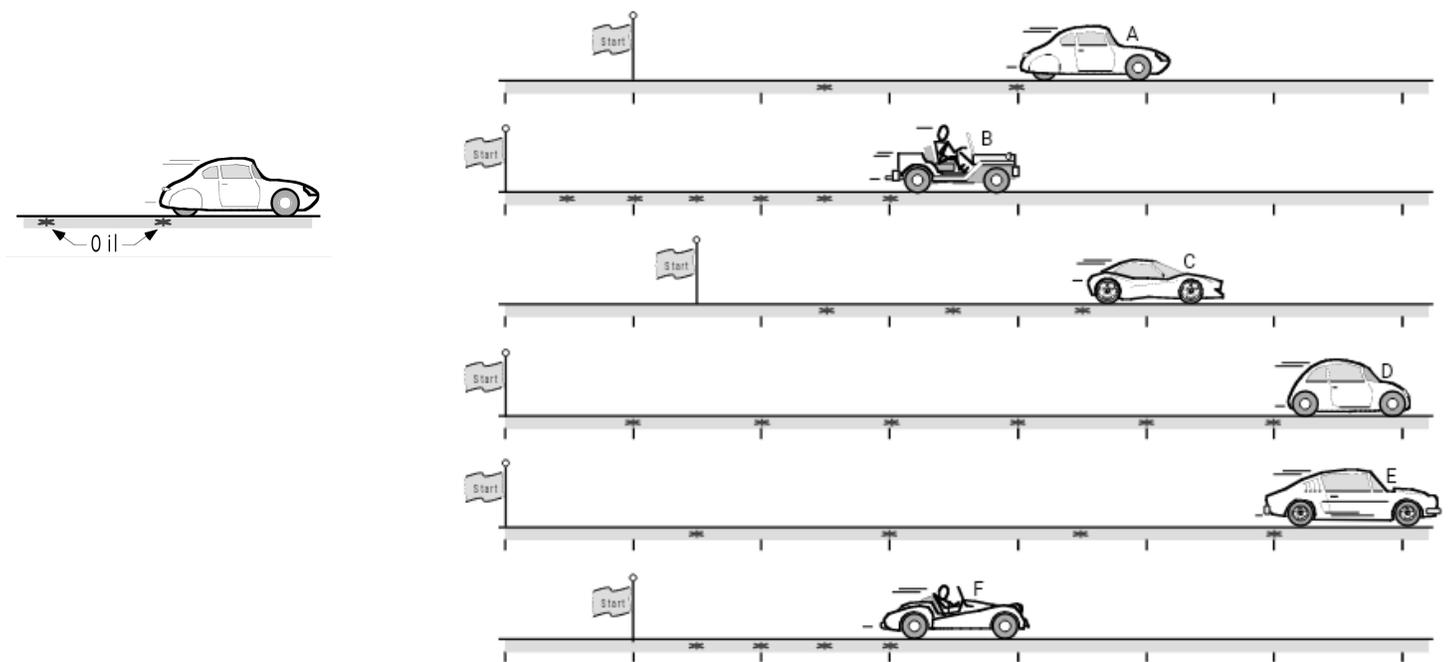
Section 2: Writing Prompt - The Process of Learning Physics

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

<u>Article 1:</u> 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

<u>Article 2:</u> Students can select one of the following articles about motivation and learning OR chose 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/
https://docs.google.com/document/d/1daLX83eOdi2BUvnHhp3ODC9noCdlRk5OIgvhFWqdMjo/edit?usp=sharing

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

<u>Prompt:</u> Write a short essay 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.

Total Points: _____/ 70 pts
Formative

Name:

PART 1 - Mathematics Review   **_____/ 45 pts**

    Section 1: Solving symbolically   _____/ 4 pts

    Section 2: Algebraic Manipulation   _____/ 7 pts

    Section 3: Geometric Diagrams   _____/ 4pts

    Section 4: Proportional Reasoning   _____/ 4pts

    Section 5: Trigonometry   _____/ 6 pts

    Section 6: Graphing   _____/ 20pts

        Activity 1   _____/ 2 pts

        Activity 2   _____/ 4 pts

        Activity 3   _____/ 6 pts

        Activity 4   _____/ 8 pts

PART 2 - AP Physics Skills   **_____/ 25 pts**

    Section 1: Writing Prompt - Reasoning   _____/ 10 pts

        Activity 1   _____/ 5 pts

        Activity 2   _____/ 5 pts

    Section 2: The Process of Learning Physics   _____/ 15 pts