Student: _____

Ocean City High School
AP PHYSICS 2
Summer Assignment 2022

Course:	AP Physics 2	Teacher:	Mr. Uhrich
Email:	duhrich@ocsdnj.org	Due Date:	**September 1, 2022** **First Day for <u>TEACHERS</u>** **(via shared documents)**

Standards	NJCCCS: 5.1.12.A.2, 5.1.12.B.2, 5.1.12.D.2
Topic	Math Review and Skill Development
Purpose	Part 2: 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 3: Introduction to life as an AP science student including skills specific to AP Physics
Text/Novel(s) & Brief Description	This packet and internet resources (if needed) Mr. Uhrich's Summer Assignment Website: **https://sites.google.com/ocsdnj.org/ochs-apphysics1-2/home**
Approximate Time on Task	**#1** : 20 minutes ; **#2/3**: 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 Pt2: timely completion and follow up assessment within first week Pt3: timely completion and utilized as base for first lessons of year

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

Dear AP Physicist,

Hello and welcome to the AP Physics 2 course. AP Physics 2 is an algebra-based physics course that will be a rigorous and eye-opening introduction into exploring many phenomena not studied in traditional first year Physics programs. These areas will build upon your current understanding of forces and energy in new contexts and may even challenge your current understanding of how the world works. Success in this course will require the co-development of science 'practice' skills along with deepening your physics content knowledge. The AP Physics 2 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 three parts. Part One is your opportunity to introduce yourself to me. Part Two serves to review the mathematical knowledge necessary to be successful in this course. Part Three 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.

Sincerely,

Mr. Uhrich

Part 1: Introduce Yourself   20 minutes

Go to this Google Form https://forms.gle/Ze37MCBkrvNT4DJ96. Complete and submit the form by typing your answers to the prompts. Keep in mind that this is a professional communication with your teacher so you should pay attention to spelling and grammar as you craft your responses. If you had me in the past, you still have to complete this part of the summer assignment.

Join my REMIND for the course: @OCAP2-2022   https://www.remind.com/join/ocap2-2022

Part 2: Mathematics of AP Physics &
Part 3: 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. Use a math book or the internet for reference https://sites.google.com/ocsdnj.org/ochs-apphysics1-2/home if needed.

Format of Submitted Work - <mark>*Important*</mark>
You will create and share a google doc and/or pdf files hosted in your google drive with the following naming convention. YOUR NAME - Pt2 or YOUR NAME - Pt3. You can scan your work with a free smartphone pdf scanning app or type your work out. Multiple shared documents are fine - simply label them appropriately. Go to the share button and add my email address duhrich@ocsdnj.org

Questions?
If you have difficulty, please do not hesitate to message me on Remind or email me at duhrich@ocsdnj.org or refer to the resources posted on this website https://sites.google.com/ocsdnj.org/ochs-apphysics1-2/home. Please note that over the summer, I will check my email and Remind app somewhat infrequently (~1 per week).

DUE: September 1, 2022

> *"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 2: 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.

Numerically solve for the variable specified:		
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= _____

Don't forget to submit your work via a google doc shared with my email duhrich@ocsdnj.org

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=_____

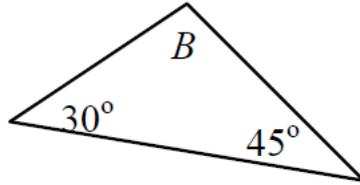2. Determine the *circumference* in **meters**.

2=_____

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

3=_____

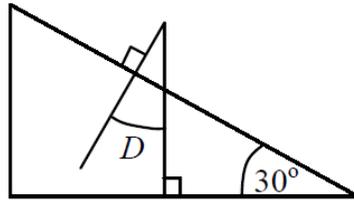4. Determine the *area* in **square meters**. (*hint: convert first!*)
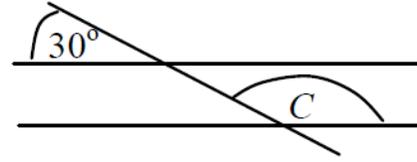
4=_____

5. What is the value of angle B?
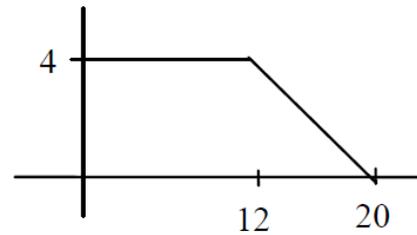

5=_____

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: Graphing

Below is from the **AP Physics 1 and 2 Lab Investigations: Student Guide to Data Analysis**

Graphs

Graphs are often an excellent way to present or to analyze data. When making graphs, there are a few guidelines you should follow to make them as clear as possible:

▸ Each axis should be labeled with the variable that is plotted and its units.

▸ Each axis should include a reasonable number of labeled tick marks at even intervals. Having too many tick marks will make the graph crowded and hard to read. Having too few will make the value of data points difficult to determine.

▸ Typically, graphs should be labeled with a meaningful title or caption.

Independent and Dependent Variables

When you graph data, you most often choose to plot an independent variable versus a dependent variable. The independent variable is plotted on the *x*-axis, and the dependent variable is plotted on the *y*-axis.

An **independent variable** is a variable that stands alone and isn't changed by the other variables you are trying to measure. For example, time is often an independent variable: in kinematics, distance, velocity, and acceleration are dependent on time, but do not affect time.

A **dependent variable** is something that depends on other variables. For example, in constant acceleration motion, position of a body will change with time, so the position of the body is dependent on time, and is a dependent variable.

Graphing Data as a Straight Line

When you make a plot on *x-y* axes, a straight line is the simplest relationship that data can have. Graphing data points as a straight line is useful because you can easily see where data points belong on the line. A line makes the relationships of the data easy to understand.

You can represent data as a straight line on a graph as long as you can identify its slope, m, and its *y*-intercept, b, in a linear equation: $y = mx + b$. The slope is a measure of how y varies with changes in x: $m = \Delta y / \Delta x$. The *y*-intercept is where the line crosses the *y*-axis (where $x = 0$).

The general equation of a **linear function** is $y = mx + b$, where m is slope and b is the *y*-intercept. For example, a linear function in physics is the time dependence of the velocity of an object undergoing constant acceleration, $v = v_0 + at$, where the acceleration, a, is the slope and the initial velocity, v_0, is the *y*-intercept.

Situation to Analyze:

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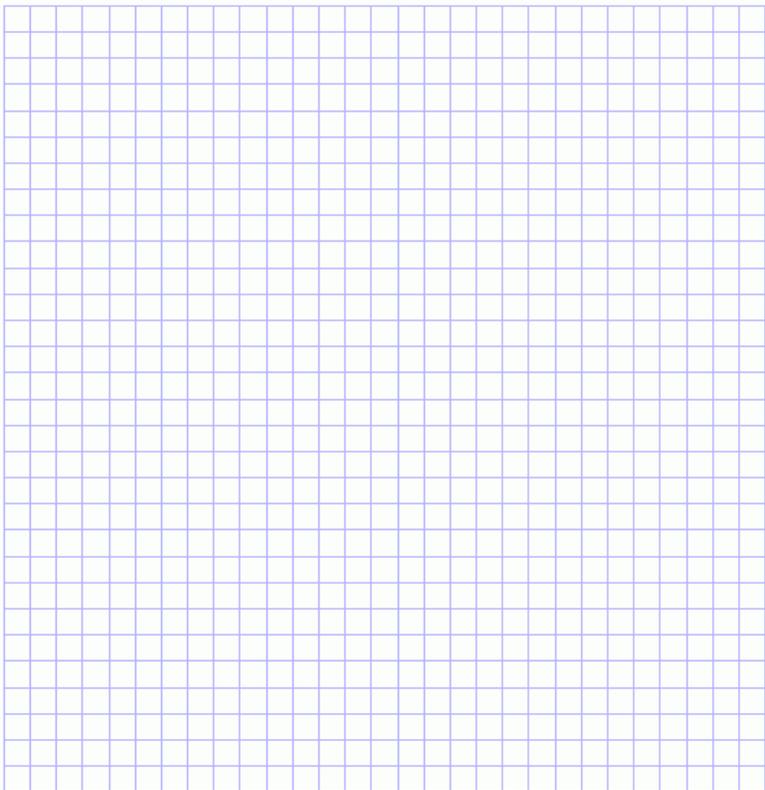
| Applied Load (kg)	Beam Deflection (mm)
0.00	0
0.05	3
0.10	6.5
0.15	9
0.20	13
0.25	16
0.30	20

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?

Part 3: 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
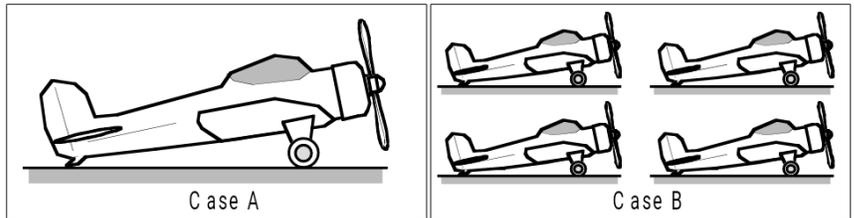
a) The amount of paint required to paint the planes is directly proportional to the surface area. Will the amount of paint required for the single plane in Case A be *greater than, less than,* or *equal to* the total amount of paint required for all four planes in Case B? **Explain your reasoning thoroughly** in your google doc.

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** in your google doc..

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** in your google doc..
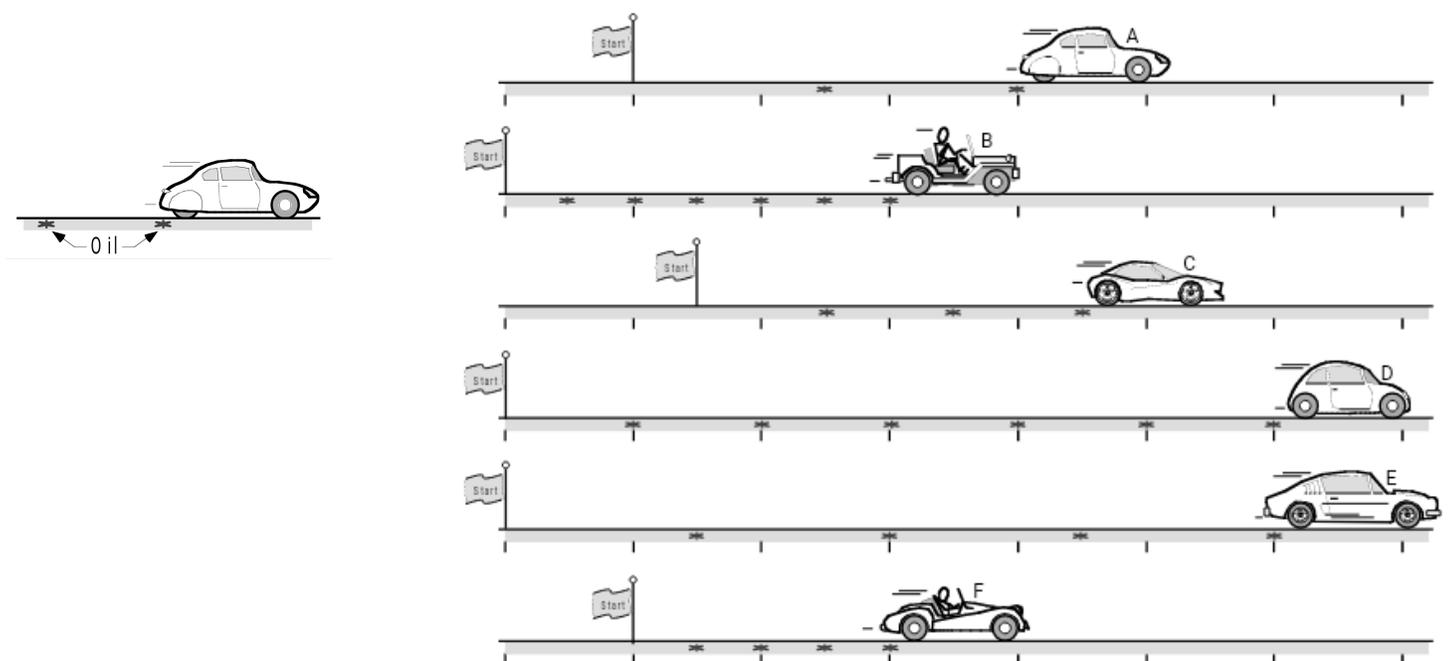
Section 2: Writing Prompt - The Process of Learning Physics

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/Video 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
https://www.nytimes.com/2011/09/18/magazine/what-if-the-secret-to-success-is-failure.html

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

Surbhi Sachdev: The Power of a Growth Mindset | TED Talk
https://www.ted.com/talks/surbhi_sachdev_the_power_of_a_growth_mindset

The power of believing that you can improve | Carol Dweck | TED Talk
https://www.youtube.com/watch?v=_X0mgOOSpLU

<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.

<div style="border: 1px solid black; padding: 10px; display: inline-block;">

Total Points: _____/ 40 pts

</div>

Name:

PART 1 - Introduce Yourself   **_____/ 2 pts**

PART 2 - Mathematics Review   **_____/ 18 pts**

    Section 1: Solving symbolically   _____/ 2 pts

    Section 2: Algebraic Manipulation   _____/ 2 pts

    Section 3: Geometric Diagrams   _____/ 2pts

    Section 4: Proportional Reasoning   _____/ 2pts

    Section 5: Graphing   _____/ 10pts

PART 3 - AP Physics Skills   **_____/ 20 pts**

    Section 1: Writing Prompt - Reasoning   _____/ 10 pts

        Activity 1   _____/ 5 pts

        Activity 2   _____/ 5 pts

    Section 2: The Process of Learning Physics   _____/ 10 pts

Don't forget to submit your work via a google doc shared with my email duhrich@ocsdnj.org   Page 10 of 10