## AP Physics 1 - Summer Assignment

## This assignment is due on the first day of school. You must show all your work in all problems.

AP physics is a science course that will demand an exceptional knowledge of algebra-based mathematics, trigonometry, and geometry. It will sometimes feel as if you are in another math class that consists of only word problems. Because much of physics requires application of algebraic mathematics, it is strongly recommended that students have a solid foundation before entering this class to be successful.

## Google Classroom:

Join the summer assignment google classroom using the code: $q 2 w g p a 6$. I will post some reference videos and course materials for you to review as well as some recommended due dates so you do not save the entire assignment for the last day of summer. You can also send me questions and I will reply back to you as I am able.

## Things to know about AP Physics:

1. Ignore your grade. If you focus on the content, do your work on time, ask questions as often as needed, you will do well.
2. Conceptual knowledge is more important than the math. We will cover concept after concept and to truly do well in the class, you need to be ready to apply that knowledge in different ways as the question being asked will always be different than you expect.
a. This means you need to be involved in the course and study regularly. If you do so, you can build upon your knowledge and gain a deeper understanding of the concepts. Topics covered at the beginning of the year will continue to be used throughout the course.
3. Outside resources are your friend. When told to read a chapter of the book, or watch a video, you need to do it. I will provide numerous resources for you so if one is not making sense, try another one. Take notes while reading or watching videos to review later. Study the diagrams, graphs, and equations as well.
a. When you are in college, taking effective notes is the key to success. Every course and every teacher is different so find a method that works best for you.
b. Find your own resources! The internet is full of information and you can find dozens of people all explaining the same topic. If you do find something especially useful, send it to me and I can share it with the rest of the class.
4. Do not spend an exceptionally long time on one problem. The AP test is timed as well as the exams in class. If you get stuck on a problem, skip it. Often time future problems may provide hints or reminders on how to solve your problem.
5. Work together as a class. Help each other out, bounce ideas off each other, problem solve together. Find a study group, share quizlets, share videos with each other. Use class time effectively. Socializing with your friends may be fun, but you will have more work to do later.
6. Do not cram. This is not a memory based course. You will need to be able to pull multiple topics together to solve one problem. Keeping up with the material and constantly using it helps keep everything fresh and easy to recall. Learn how to solve a problem and not just memorize the steps from one example.

## Significant Figures

Always use the correct number of significant figures in your answers, whether it is scientific notation or regular notation.

## Significant Figures Rules:

$\underline{\text { Bold\&underline }}=$ significant figure
Strikethrough $=$ not significant

1. Non-zero digits are always significant Eg. $\mathbf{3 2 2 . 7}$
2. Zeroes between non-zero numbers are significant. Eg. 302.07
3. Zeroes at the beginning of a number are never significant. Eg. 0.0032
4. Zeroes at the end of a number are significant IF there is a decimal point.

Eg. 320. is significant, but $32 \theta$ is not. Also $0.003 \underline{\mathbf{0 0 0}}$ or $32 \underline{\mathbf{0}} \mathbf{0}$ are significant.

## Addition/Subtraction Rule:

Answer should be rounded to the value place of the number who's last sig fig is in the highest value place.
$35.4 \underline{8}+2 . \underline{4}=37.88$ which would round to $37 . \underline{9}$
The last digit of the $1^{\text {st }}$ number (8) is in the $100^{\text {th }}$ place while the last digit of the $2^{\text {nd }}$ number (4) is in the $10^{\text {th }}$ place. Since the $10^{\text {th }}$ place is the higher place value, we round to the $10^{\text {th }}$ place.
$4,3 \underline{\mathbf{3}} 0-210 . \underline{\mathbf{5}}=4,119.5$ which would round to $4,1 \underline{\mathbf{2}} 0$
The last digit of the $1^{\text {st }}$ number (3) is in the 10 's place while the last digit of the $2^{\text {nd }}$ number (5) is in the $10^{\text {th }}$ place. Since the 10 's place is the higher place value, we round to the 10 's place.

Multiplication/Division Rule:
Answer should be rounded so that it has the same total number of significant figures as the number with the least total number of significant figures.
$\underline{\mathbf{2 0 . 8 2}} * 0.0 \underline{\mathbf{4 2}}=0.87444$ which would round to $0 . \underline{\mathbf{8 7}}$
The first number has 4 total sig figs while the second number only has 2 total sig figs. Since the least total number of sig figs is 2 , we round to the first two significant digits.
$\underline{\mathbf{7 , 8 9 0}}$. $\underline{\mathbf{8 . 6 4 8 6}}=912.28638$ which would round to $\underline{\mathbf{9 1 2} .3}$
The first number has 4 total sig figs (since there is a decimal) while the $2^{\text {nd }}$ number has 5 total sig figs. Since the least total number of sig figs is 4 , we round to the first 4 significant digits.

## Metric Measurements and Conversions

You should be comfortable using and converting the following metric prefixes. Using proper symbols for units, variables, prefixes, etc is important as the wrong symbol could change the entire meaning. These symbols are CaSe SeNsItIvE, capital and lower case letters mean different things.

Complete the following table:

| Metric Prefix | Symbol | Power |
| :---: | :---: | :---: |
| Tera- |  |  |
| Giga- |  |  |
| Mega- |  |  |
| Kilo- | k | $10^{3}$ |
| Base Unit | ----- | $10^{0}$ |
| Centi- |  |  |
| Milli- |  |  |
| Micro- |  |  |
| Nano- |  |  |
| Pico- | p | $10^{-12}$ |

## Significant Figures, Metric Conversions, and Scientific Notation

1. Round each of the following numbers to four significant figures. Write the answer in decimal form AND scientific notation.
a. 300.235800
b. 456,500
c. $5,799.823$
d. 0.006580221
2. Complete the following calculations. Round all answers to the correct number of sig figs.
a. $1.24056+75.80$
b. $37.05-75$
c. $890,000 * 112.3$
d. $78,132 / 2.50$
3. Convert the following units. Solve each problem using dimensional analysis showing all your work. Every number every time must have a unit and the answer must be expressed with proper significant figures.
a. Convert $4,200 \mathrm{mg}$ to kg

$$
4,200 \mathrm{mg} \cdot \frac{10^{-3} \mathrm{~g}}{1 \mathrm{mg}} \cdot \frac{1 \mathrm{~kg}}{10^{3} \mathrm{~g}}=0.0042 \mathrm{~kg}
$$

b. 50.0 m to mm
c. 25 cL to kL
d. 0.00332 Mg to kg
e. 457.3 nm to m
f. $39.2 \mathrm{~m} / \mathrm{s}$ to miles per hour

## Graphing and Data Analysis

You must be able to create scatterplot graphs from data, draw a best-fit-line, and find the equation for that line.

When making graphs, take full use of the graph's axes, but do not extend beyond the given space. All axes should be labeled with titles and appropriate units. Graph titles are in the form " $y$ versus x" (ex. Mass versus volume = mass on $y$-axis and vol ume on x -axis)

1. Create a distance versus time graph of the following data.

| Distance (m) | Time (s) |
| :---: | :---: |
| 0.0 | 0.0 |
| 3.6 | 1.0 |
| 7.1 | 2.0 |
| 11.1 | 3.0 |
| 14.6 | 4.0 |
| 18.2 | 5.0 |


2. Add a best-fit-line using a straight edge.
3. Find the equation of the best-fit-line. Express in $y=m x+b$ form with " $d$ " (distance) and " $t$ " (time) substituted for the appropriate x or y variables.
4. Use your best-fit-line to calculate how long it takes to travel exactly 15.5 meters.
5. Find the area under the curve between 2 and 4 seconds.

## Functions and Relationships

You must be familiar with common functions and their associated proportions and graphs as covered in algebra II. Much of physics is analyzing graphs or equations to understand how variables relate to each other. You need to know how to express functions as a proportion and written out in words.

## Linear:

Proportion: $y \propto x$
Written: $\mathbf{y}$ is linearly proportional to $\mathbf{x}$


## Quadratic:

Proportion: $y \propto x^{2}$
Written: $\mathbf{y}$ is proportional to $\mathbf{x}^{\mathbf{2}}$


Inverse:
Proportion: $y \propto \frac{1}{x}$ OR $y \propto x^{-1}$
Written: $\mathbf{y}$ is inversely proportional to $\mathbf{x}$


Square Root:
Proportion: $y \propto \sqrt{x}$ OR $y \propto x^{1 / 2}$ OR $y^{2} \propto x$
Written: $\mathbf{y}$ is proportional to the square root of $\mathbf{x}$


## Algebra

You need to be very comfortable solving and manipulating algebraic expressions. While you will have to calculate values using the equations, much of the math we use in this class involves combining equations together and solving for new expressions.

Solve the following problems for the variable. List all possible answers and round all answers $\mathbf{3}$ digits. Use DNE if a real answer does not exist. You must show all your work.

1. $2 x+5=7$
2. $5 x-12=6-x$
3. $\frac{3 x}{4}+3=6 x$
4. $7-\frac{3}{x}=5$
5. $\frac{18}{x}+12=9 x-\frac{6}{x}$
6. $x^{2}-17=8$
7. $(5 x-4)(x+1)=0$
8. $(4 x+7)(2 x+3)=-26$
9. $2 x=\frac{6 x}{5 x^{2}-8}$
10. $2 x^{2}=5 x+17$
11. 


12.

13.

14.

15.


Solve the following system of equations for $x$ and $y$
16. $y=5 x+3$

$$
y=8 x-3
$$

17. $4 x-9 y=8$
$9 y+3 x=-15$
18. $3 x=8-12 y$
$-2 y-6 x=7$
19. $\frac{9}{x}+6 y=-2$

$$
x=0.4 y-4
$$

Solve the following equations in terms of the given variable. Simplify as much as possible.
20. Solve for a: $a b+c d=e$
21. Solve for $\mathrm{y}: \frac{x y}{z}=w$
22. Solve for $\mathrm{p}: f t=\frac{g}{p^{2}}+s$
23. Solve for $\mathrm{r}: ~ w(r+y)=x r-t$
24. Solve for $\mathrm{n}: a n^{2}=n g^{2}+n p$

The following are actual physics equations we will be working with throughout the course. Solve each equation and express your answer in the correct units. Round each answer to the correct number of significant figures.
25. $K=\frac{1}{2} m v^{2}$

$$
K=\frac{1}{2} \cdot 210 \mathrm{~kg} \cdot(10.5 \mathrm{~m} / \mathrm{s})^{2} \quad K=
$$

26. $F=G \frac{m_{1} m_{2}}{r^{2}}$

$$
F=\left(6.67 \times 10^{-11} \frac{\mathrm{~N} \cdot \mathrm{~m}^{2}}{\mathrm{~kg}^{2}}\right) \cdot \frac{\left(5.64 \times 10^{24} \mathrm{~kg}\right)\left(1.99 \times 10^{31} \mathrm{~kg}\right)}{\left(1.51 \times 10^{5} \mathrm{~m}\right)^{2}} \quad F=
$$

27. $\frac{1}{R_{p}}=\frac{1}{R_{1}}+\frac{1}{R_{2}}+\cdots$

$$
\frac{1}{R_{p}}=\frac{1}{24 \Omega}+\frac{1}{18 \Omega} \quad R_{p}=
$$

28. $\tau=r F \sin \theta$

$$
\tau=1.4 \mathrm{~m} \cdot 28 \mathrm{~N} \cdot \sin 47^{\circ} \quad \tau=
$$

29. $T=2 \pi \sqrt{\frac{l}{g}}$

$$
T=2 \pi \sqrt{\frac{0.344 \mathrm{~m}}{9.8 \mathrm{~m} / \mathrm{s}^{2}}}
$$

$$
T=
$$

Solve the following physics equations for the variable indicated.
30. $K=\frac{1}{2} k x^{2}$ $x=$
31. $T_{p}=2 \pi \sqrt{\frac{\ell}{g}}$
$g=$
32. $F_{g}=G \frac{m_{1} m_{2}}{r^{2}}$
$r=$
33. $m g h_{0}=\frac{1}{2} m v_{f}^{2}$
$v_{f}=$
34. $p V=n R T$
$T=$
35. $W=F d \cos \theta$
$\theta=$
36. $v_{f}^{2}=v_{0}^{2}-2 a\left(x_{f}-x_{0}\right) \quad x_{0}=$
37. $x_{f}=x_{0}+v_{0} t+\frac{1}{2} a t^{2} \quad t=$
38. $a_{c}=\frac{v^{2}}{r} \quad v=$
39. $F=k \frac{q_{1} q_{2}}{r^{2}}$
$q_{2}=$
40. $F t=m v_{f}-m v_{0}$
$v_{f}=$

