AP Physics 1 Summer Assignment

Welcome to AP Physics 1! This is a college level physics course that is fun, interesting and challenging on a level you've not yet experienced. There is a three-fold purpose for being in my class. You are taking this class to learn to THINK, learn to REASON, and learn to PERSEVERE. If you can do these three things by the end of my class you will be able to deal with difficult things that you deal with, especially the AP Test.

By THINK, I mean that you will be able to think logically. You will be able to start with fact and observation after which you will apply valid relationships that lead to a conclusion on the cause of a physical phenomenon. In this class I rarely expect you to know the correct answer immediately. Instead, you are going to learn the correct way to approach a problem that guarantees that you get the right answer. While this may seem scientific, I assure you this is a crucial skill for the sake of your entire life.

By REASON, I mean that you will be able to convey clear and coherent answers that explain your thinking process to convince a reasonably minded person of your answer. This will take a lot of practice, but by the end of this course you will have a clear structure ingrained in your mind that will never leave you regardless of the field or career path that you choose in the future.

By PERSEVERE, I mean that this class will be hard. If you have a class harder than mine at Eastwood Academy, please let me know. I do not make my class hard on purpose, but in order to learn to think and reason you will experience difficult challenges that make you want to quit. If you don't want this, then maybe don't take my class. However, you cannot avoid difficult challenges in life. They will come, I promise. Therefore, it is vital that you practice a crucial skill to overcome challenges – keep going! If you can keep going, or what I call persevere, then you will find yourself overcoming significantly more challenges and living a much more successful and productive life. But don't forget that you can't always do it alone. Sometimes persevering means getting overcoming fears of seeming dumb and asking for help even when you don't want to. For some of you, this will be your biggest challenge. Remember you are in school! If you knew everything you wouldn't be here.

I have some good news for you! This Summer Assignment is one of the easiest things you'll do for my class. This assignment is to ensure that we all have the necessary prerequisite math and science skills in order to have a successful start. Most of the content in this packet is review, but even the new things will be relatively simple. If you find yourself struggling with any of these then it is time that you begin practicing your perseverance. You will find attached lecture videos that may help you comprehend some of these ideas if you don't know them already. Please feel free to reach out for help if you need additional help. My email address is alex.gary@houstonisd.org. I will respond to emails on a weekly basis. Additionally, all lecture videos can be found in a Google Drive Folder at the link below.

https://drive.google.com/drive/folders/1YgeMF8YWIoZbd_5fuGRaa_pOGUESXi1R?usp=sharing

Lastly, THIS ASSIGNMENT IS DUE ON THE FIRST DAY OF SCHOOL. Show every step of work. This packet will count as your first test grade. This assignment is designed to take two weeks to complete when working about 30 minutes a day. And of course, DO NOT WAIT UNTIL THE LAST MINUTE TO START THIS ASSIGNMENT.

I look forward to having you in my class next year. Please feel free to reach out with any questions.

Have a blessed day,

Mr. Gary

PART 1: Significant Figures, Scientific Notation, Dimensional Analysis, and Uncertainty

First, let's discuss something that you have heard of before. In biology and chemistry, you should have heard of significant figures and scientific notation. You have also heard of dimensional analysis, just maybe by a new name. You have heard this as unit analysis or unit conversion. Then we will come to uncertainty, which means exactly opposite of what you think it does. This part will be new to you. We will discuss each of these in their own sections.

Section 1: Significant Figures

The use of significant figures is crucial for any science class. In math, we simply round problems wherever the question tells us to, but in science we can't pick this at random. Instead, we must round based on the precision of our measurement. Significant Figures force us to think of the number of places that we measure and therefore report our data to that many places to clearly communicate what we measured. I will give you some examples of significant figures below but use the video below if you need a refresher.

Video: shorturl.at/klvJ7

Examples of Significant Figures

123	3 sig figs	0.010	2 sig figs
1001	4 sig figs	1010.	4 sig figs
1010	3 sig figs	0.00000001	1 sig fig

These might be confusing as some of them look so similar, yet they have a different number of significant figures. Fortunately, we can simplify this into three rules.

Rule 1: Beginning zeros never count, so only ever start counting with the first non-zero number. (See 0.00000001)

Rule 2: Concerning ending zeros.

a. If there is a decimal, ending zeros count. (See 0.010 and 1010.)
b. If there is no decimal, ending zeros do not count. (See 1010)

Rule 3: All numbers between beginning and ending zeros count as significant, even new zeros.

So how do we combine these numbers? Well it depends.

If we multiply or divide, we simply limit our answer to the smaller number of significant figures.

Example:

3.900 • 140 = 546 but we must write **550** (since we are limited to 2 significant figures)

If we add or subtract, we don't care about significant figures! Instead, we limit our answer to the least precise measurement.

Example:

3.25 + 104 = 107.25 but we must write **107** (since 104 is only precise to the ones place)

Section 1 Problems: Try the following examples below. Show all of your work and then circle your rounded answer to the correct number of significant figures.

Simply write the number of significant figures besides each number.

1) 60, 000

2) 9.8

3) 1000.56

4) 0.0000000000667

5) 0.050020

6) 8990000000

7) Add 12.02 ft and 10.1 ft.

8) Multiply 12.02 ft and 10.1 ft.

9) Divide 16.5 kg by 0.27 kg.

10) Subtract 0.27 kg from 16.5 kg.

Section 2: Scientific Notation

Following our use of Significant Figures we can go directly into Scientific Notation. In physics and all the natural sciences, it is common to come across very large and very small numbers. These help us write these very large and very small numbers in a very compact way, and they help use clearly see what the significant digits are. Numbers in scientific notation only show the significant figures while not showing the beginning and ending zeros.

Example of Scientific Notation:

12000 can be written as 1.2×10^4

4012000 can be written as 4.012×10^6

300000000 can be written as 3×10^8

0.000000001203 can be written as 1.203×10^{-9}

Often multiple numbers in a problem contain scientific notation and will need to be reduced by hand. Before you practice, remember the rules for exponents.

1. When numbers are multiplied together, you *add the exponents* and *multiply the bases*.

2. When numbers are divided, you *subtract the exponents* and *divide the bases*.

3. When an exponent is raised to another exponent, you *multiply the exponent*.

Section 2 Problems: Using the three rules from above, simplify the following numbers in proper scientific notation.

1) 7,640,000 kg

2) 8327.2 s

3) 0.0000000003 m

4) 0.0093 km/s

5) $(3 \times 10^6) \bullet (2 \times 10^4)$

6) $(1.2 \times 10^4) / (6 \times 10^{-2})$

7) $(4 \times 10^8) \bullet (5 \times 10^{-3})$

8) $(7 \times 10^3)^2$

9) $(8 \times 10^3) / (2 \times 10^5)$

10) $(2 \times 10^{-3})^3$

Section 3: Dimensional Analysis

We need to now remember how to do unit conversion. All the unit prefixes that we care about will be on the prefix table below. Kilo- has been completed as an example. Use the link below for a refresher.

Video: shorturl.at/hsAFO

Prefix	Power	Symbol
Giga-		
Mega-		
Kilo-	10^3	k
Centi-		
Milli-		
Micro-		
Nano-		
Pico-		

Not only is it important know what prefixes are, it is also vital to remember that the prefix is really abbreviated scientific notation. Recall that you can't add different prefixes together. You must get them to be the exact same unit before doing that. We will call this unit the BASE unit, or the unit without the prefix. Here are two simple things to remember.

1. To go from the base unit to a prefix unit, divide by the power in the table above.

2. To go from a prefix unit to the base unit, multiply by the power in the table above.

For example, if we want to convert 1500 meters into kilometers, we will divide by the number 10^3 and get a value of 1.5 km. If we want to undo that and go back to meters, which is the base unit, we will multiply by the number 10^3 and get 1500 meters again.

Section 3 Problems: Convert the following numbers into the specified unit. Use scientific notation for very large and very small numbers when necessary. If a unit is on the denominator, reverse the steps above. If they are raised to a power, repeat the step the same number of times as the power.

1. 24 g = _____ kg
2. 94.1 MHz = _____ Hz
3. 6 Gb = _____ kb
4. 640 nm = _____ m
5. 3.2 m^2 = _____ cm^2
6. 40 mm^3 = _____ m^3
7. 1 g/cm^3 = _____ kg/m^3
8. 20 m/s = _____ km/hr

PART 2: Geometry

Calculate the area of the following shapes. It may be necessary to break up the figure into common shapes. Show all your work and use this equation sheet to help.

Rectangle
$A = bh$

Triangle
$A = \frac{1}{2}bh$

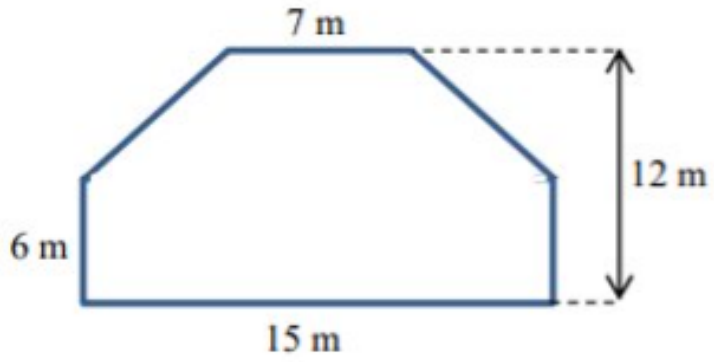
Circle
$A = \pi r^2$
$C = 2\pi r$

Rectangular solid
$V = \ell wh$

Cylinder
$V = \pi r^2 \ell$
$S = 2\pi r\ell + 2\pi r^2$

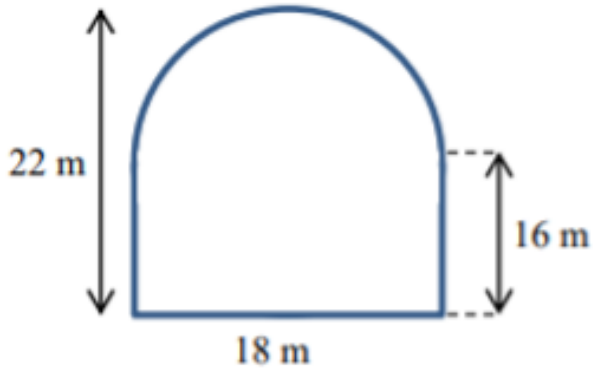
Sphere
$V = \frac{4}{3}\pi r^3$
$S = 4\pi r^2$

1.



Area = _____

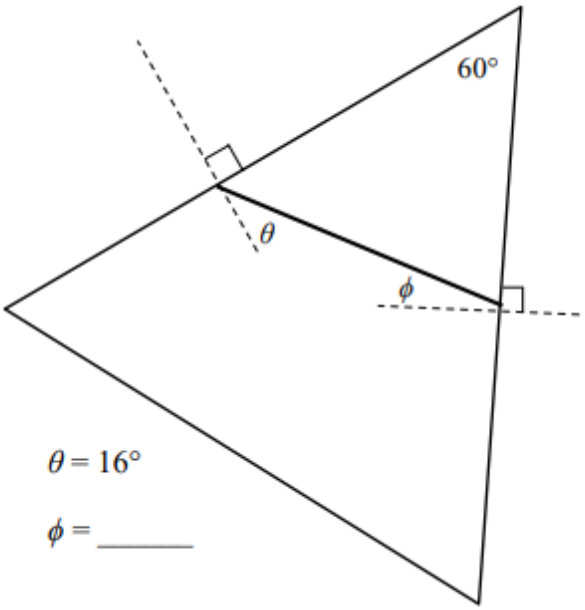
2.



Area = _____

Calculate the unknown values for questions 3-6.

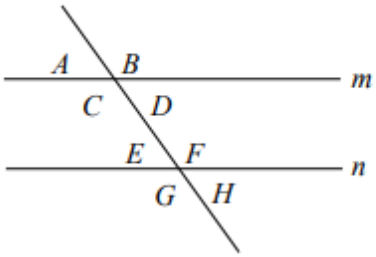
3.



$\theta = 16°$

$\phi =$ _____

4.

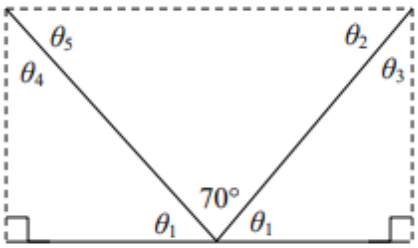


Lines m and n are parallel.

$A = 75°$ $B =$ _____ $C =$ _____ $D =$ _____

$E =$ _____ $F =$ _____ $G =$ _____ $H =$ _____

5.



$\theta_1 =$ _____

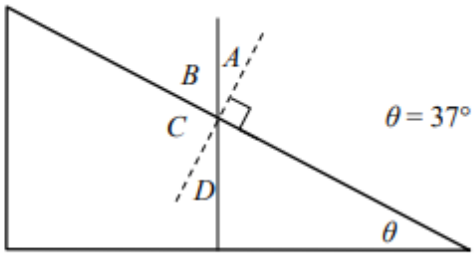
$\theta_2 =$ _____

$\theta_3 =$ _____

$\theta_4 =$ _____

$\theta_5 =$ _____

6.



$A =$ _____ $B =$ _____

$C =$ _____ $D =$ _____

PART 3: Trigonometry

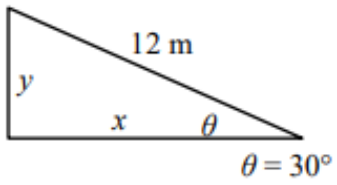
Write the formulas for each of the following trigonometric functions. Remember SOHCAHTOA!

$\sin\theta =$ $\cos\theta =$ $\tan\theta =$

Calculate the following unknowns using trigonometry. Use a calculator but show all your work. Please include appropriate units with all answers. (Watch the unit prefixes!) See the video link below for review.

Video 1: shorturl.at/oxSZ1 Video 2: shorturl.at/hmq06

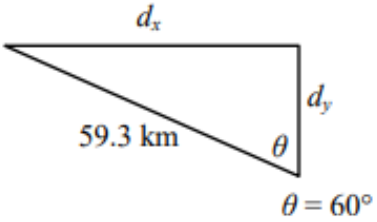
1.



$y =$ _____

$x =$ _____

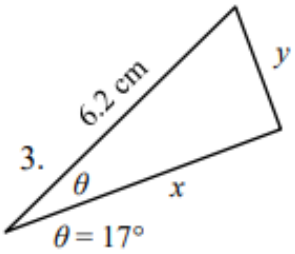
2.



$d_x =$ _____

$d_y =$ _____

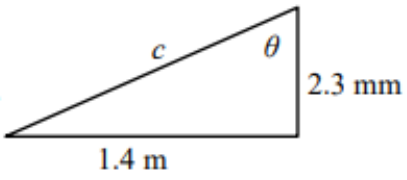
3.



$x =$ _____

$y =$ _____

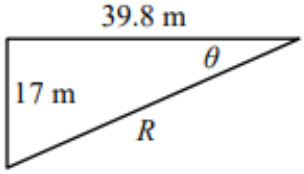
4.



$c =$ _____

$\theta =$ _____

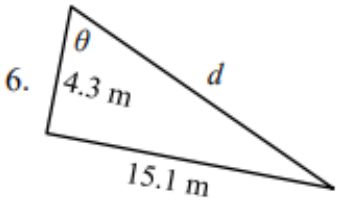
5.



$R =$ _____

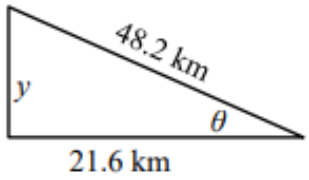
$\theta =$ _____

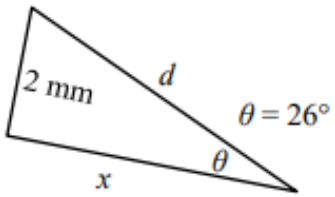
6.

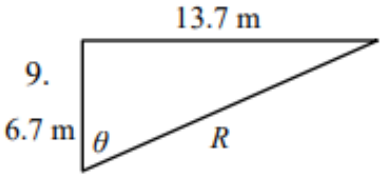


$d =$ _____

$\theta =$ _____

7. 

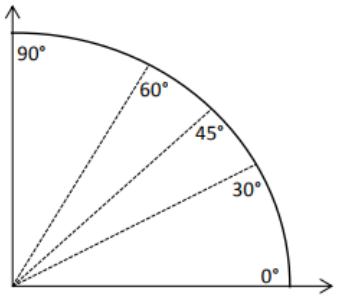
8. 

9. 

$y =$ _____ $x =$ _____ $R =$ _____

$\theta =$ _____ $d =$ _____ $\theta =$ _____

You will need to be familiar with trigonometric values for a few common angles. Memorizing this unit circle diagram in degrees or the chart below will be very beneficial for next year in both physics and pre-calculus. How the diagram works is the cosine of the angle is the x-coordinate and the sine of the angle is the y-coordinate for the ordered pair. Write the ordered pair (in fraction form) for each of the angles shown in the table below.



θ	$\cos\theta$	$\sin\theta$
0°		
30°		
45°		
60°		
90°		

10. At what angle is sine at a maximum?

11. At what angle is sine at a minimum?

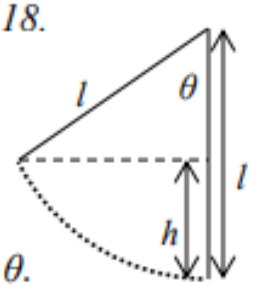
12. At what angle is cosine at a minimum?

13. At what angle are the sine and cosine equivalent?

15. As the angel increases in the first quadrant, what happens to the cosine of the angle?

16. As the angle increases in the first quadrant, what happens to the sine of the angle?

Use the figure below to answer problems 17 and 18.



17. Find an expression for h in terms of l and θ.

18. What is the value of h if $l = 6$ m and $\theta = 40°$?

PART 4: Basic Algebra

Algebra is a big part of a college-level algebra-based physics class like AP Physics 1. We will do algebra regularly and interpret the relationships that they represent. In here, math means something! Since we are dealing with relationships, we will not deal with numbers as often in order to help us visualize these connections. So, without a calculator, solve for the unknowns below. Don't get confused with the letters, think of them as numbers and algebraically rearrange for the chosen variable. Use the lesson below if you need help.

Video: shorturl.at/ikP28

1. $U_g = mgh$; solve for h

2. $F = k\frac{q_1 q_2}{r^2}$; solve for q_2

3. $P = \frac{\Delta W}{\Delta t}$; solve for Δt

4. $R = \rho\frac{l}{a}$; solve for ρ

5. $a_c = \frac{v^2}{r}$; solve for v

6. ${v_f}^2 = {v_i}^2 - 2a(x_f - x_i)$; solve for x_i

7. $qV = \frac{1}{2}mv^2$; solve for v

8. $n_1 \sin\theta_1 = n_2 \sin\theta_2$; solve for θ_2

9. $y_f = y_i + v_i t + \frac{1}{2}at^2$; solve for a

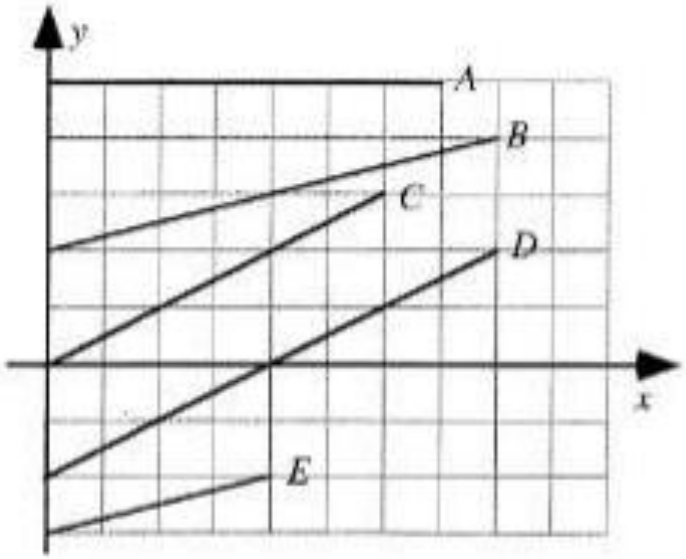
10. $T = 2\pi\sqrt{\frac{m}{k}}$; solve for k

PART 5: Graphing

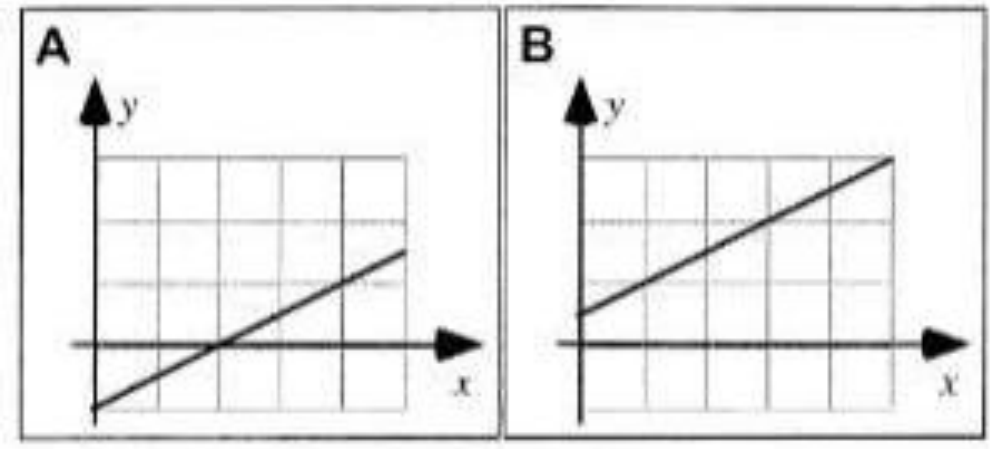
Another way to show relationships between variables is by graphing data obtained from an experiment. Based on the shape of the graph we may be able to use it to determine the mathematical relationship. The graphs we will see in AP Physics 1 are simple, but the detail we use to describe and interpret them is a little more complex. To be successful, we need to be able to distinguish between a few terms. See the lesson video below.

Video: shorturl.at/acPY7

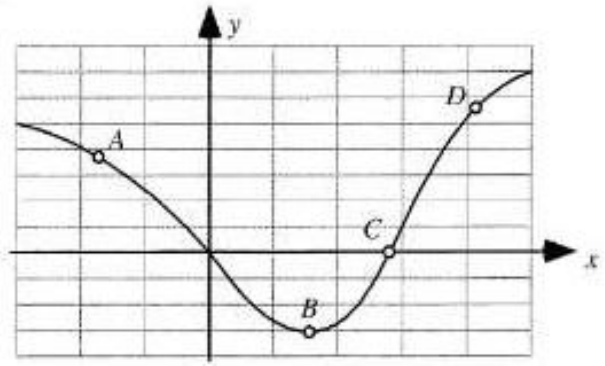
1. Rank the slopes of the lines in the graph below. If any are equal, clearly state so. Explain your reasoning.



2. In the graph below, is the slope greater in case A, greater in case B, or the same in both cases? Explain why.



3. Four points are labeled on the graph below. Rank the slopes of the graph at the labeled points. Explain you reasoning.



In AP Physics 1 we will learn to linearize functions. To begin the year, you need to know what certain functions look like. Using resources at your disposal, create a quick graph of each of the following functions.

Linear $y = kx$ Inverse $y = {}^{k}/_{x}$ Inverse Square $y = {}^{k}/_{x^2}$ Power $y = kx^2$

PART 6: Scalars & Vectors

Not only do numbers in AP Physics 1 mean something but certain types of numbers imply different things. In short, there are two types of numbers with units. We will get more into units in a bit. For now, watch the following two videos. For each video, summarize the content Mr. Khan is presenting in at least 5 sentences.

Video 1: https://www.khanacademy.org/science/ap-physics-1/ap-one-dimensional-motion/ap-physics-foundations/v/introduction-to-vectors-and-scalars

Write your five-sentence summary in the space below.

Video 2: https://www.khanacademy.org/science/ap-physics-1/ap-two-dimensional-motion/analyzing-vectors-using-trigonometry-ap/v/visualizing-vectors-in-2-dimensions

Write your five-sentence summary in the space below.

Important final question: What is magnitude? (For instance: If a problem says “Find the magnitude of the force?” how could you reword what is it asking you to find?)

PART 7: Units, Variables, & Tools

Now that we have discussed types of units, let talk about the various quantities that we will need unit for as well as their variables and tools. There are two types of physics units. There are fundamental units and abbreviated (or short) units. Short units are made up of fundamental units. When possible, just write the short units instead of the fundamental units. You likely understand most of these words, but if you want to discuss this topic more, check out the links below for a video lesson. **These units must be memorized! Use the Quizizz link below for practice.**

Video Lesson: shorturl.at/iuwJ0

Quizizz: https://quizizz.com/join?gc=28260666

Next, using the resources at your disposal, fill in the columns for each of the following physics quantities. If a Short Units column is blocked out, that means there are no short units for the quantity.

Quantity	Variable	Vector (Yes or No)	Units	Short Units	Tool(s)
Distance					
Displacement					
Time					
Speed					
Velocity					
Acceleration					
Force					
Inertial mass					
Gravitational mass					
Energy (all types)					
Work					
Momentum					
Impulse					
Frequency					
Power					
Current					
Voltage					
Resistance					