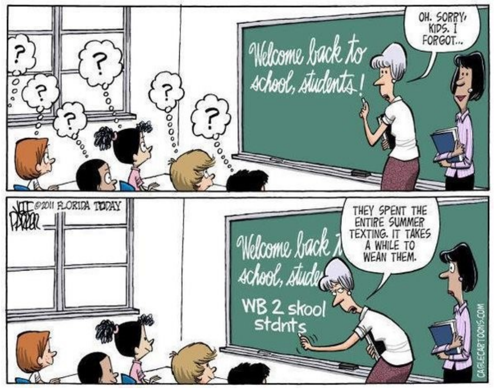
AP Physics 1
Prerequisite Practice Assessment



Name: ____ Period: __________

Welcome to AP Physics 1! I congratulate all of you for choosing to undertake this challenging course. While very rewarding, the subject can be very demanding in terms of analytical reasoning and problem-solving. And just like a great author must have a mastery of grammar to create a masterpiece, a physicist, or physics student, must be able to the tools of mathematics to create. Even conceptual understanding of physics is enhanced when you can appreciate, visualize, and manipulate the variables behind the relationships.

The following pages represent the prerequisite material you should have learned in your math and science classes. Not only is it a good way to jump-start your brain after summer break, but it can also help you identify areas where you are weak and might need to review. Remember: AP Physics 1 is a college-level course, meaning you must take ownership and responsibility of your learning and progress.

THE BASICS

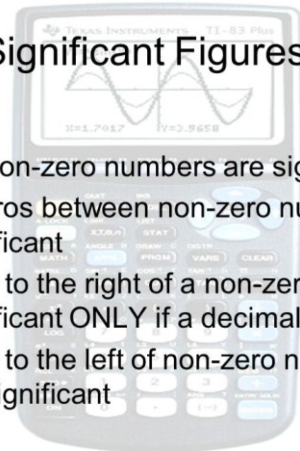
I. Significant Figures

Not all measurements are created equal. For example, using an old wooden meter stick and your eye gives a very different level of uncertainty in measuring distance than using a laser. When manipulating data, your results are only as good as your weakest link, or measurement, and your answer(s) must represent that.

In addition, not all zeros are created equal. Some are actual numbers, while others are merely placeholders.

The following is summary of the four general rule involving significant figures.

Significant Figures



- Rules
- 1. ALL non-zero numbers are significant
- 2. All zeros between non-zero numbers are significant
- 3. Zeros to the right of a non-zero number are significant ONLY if a decimal is used
- 4. Zeros to the left of non-zero numbers are not significant

1. Indicate how many significant figures there are in each of the following measured values.

246.32	____________	1.008	____________	700000	____________
107.854	____________	0.00340	____________	350.670	____________
100.3	____________	14.600	____________	1.0000	____________
0.678	____________	0.0001	____________	320001	____________

2. Calculate the answers to the appropriate number of significant figures.

32.567	246.24	658.0
135.0	238.278	23.5478
+ 1.4567	+ 98.3	+ 1345.29

3. Calculate the answers to the appropriate number of significant figures.

a) 23.7 x 3.8	=	____________	e) 43.678 x 64.1	=	____________
b) 45.76 x 0.25	=	____________	f) 1.678 / 0.42	=	____________
c) 81.04 x 0.010	=	____________	g) 28.367 / 3.74	=	____________
d) 6.47 x 64.5	=	____________	h) 4278 / 1.006	=	____________

<u>II. Scientific Notation</u>

The discipline of physics studies the entire universe and everything within it! That means our scope can range from galactic distances to the size of subatomic particles. Scientific notation allows us to represent very large or very small numbers in a less cumbersome fashion. For example, the Andromeda Galaxy (the closest one to our Milky Way Galaxy) contains at least 200,000,000,000 stars. On the other hand, the weight of an alpha particle, which is emitted in the radioactive decay of Plutonium-239, is 0.000,000,000,000,000,000,000,000,006,645 kilograms.

As you can see, it could get tedious writing out those numbers repeatedly. So, a system was developed to help represent these numbers in a way that was easy to read and understand: Scientific Notation. Numbers are written in the product form, or power of ten form, as shown

$$a.bc\ldots \times 10^n$$

where the argument (a.bc…) obeys the rules of significant figures.

This should be review for you. Re-awaken your brain cells and try the following:

Convert the following numbers into scientific notation:

1) 3,400 ________________________________

2) 0.000023 ________________________________

3) 101,000 ________________________________

4) 0.010 ________________________________

5) 45.01 ________________________________

6) 1,000,000 ________________________________

7) 0.00671 ________________________________

8) 4.50 ________________________________

Convert the following numbers into standard notation:

9) 2.30×10^{4} ______________________________

10) 1.76×10^{-3} ______________________________

11) 1.901×10^{-7} ______________________________

12) 8.65×10^{-1} ______________________________

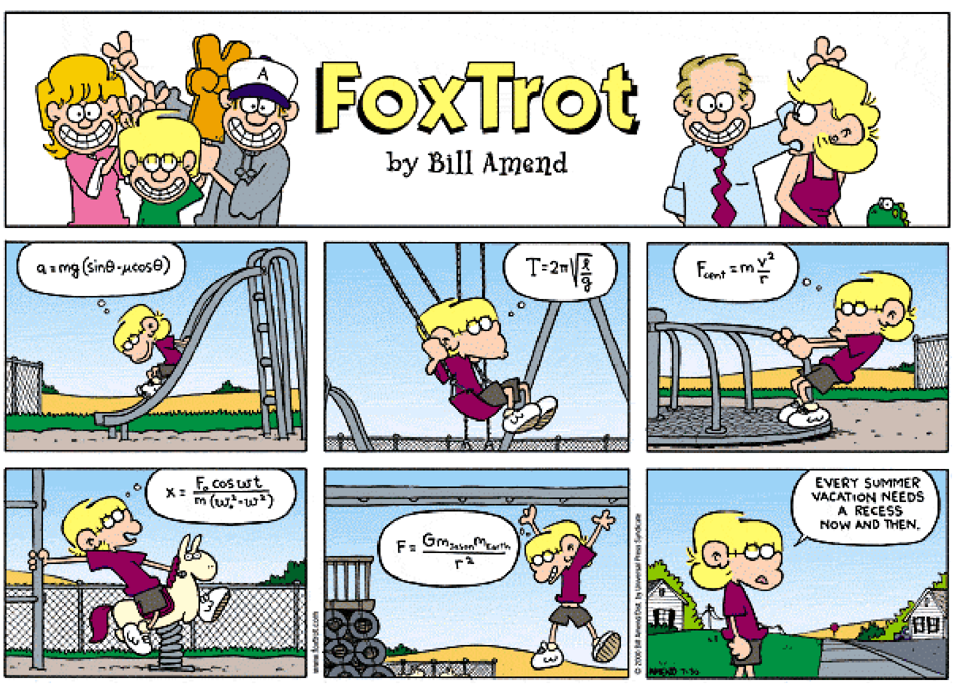
13) 9.11×10^{3} ______________________________

14) 5.40×10^{1} ______________________________

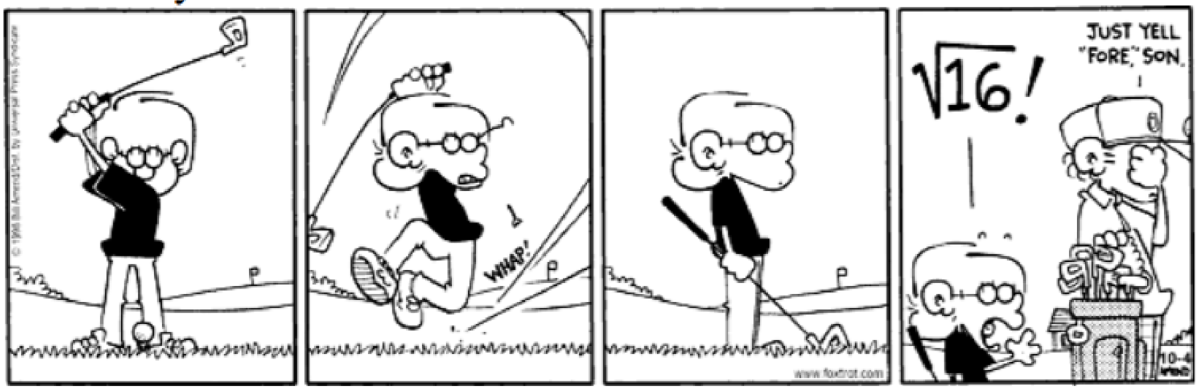
15) 1.76×10^{0} ______________________________

16) 7.4×10^{-5} ______________________________

The wok on the following pages is based on the math prerequisites for AP Physics 1 and it is assumed you can work these problems without guidance. Therefore, a minimum of review, if any, is offered with each section. These problems represent an overview of what you will be expected to do, but it is certainly not all-inclusive.



1. AP Physics – math review



PART I. SOLVING EQUATIONS

Solve the following equations for the quantity indicated.

1. $y = \frac{1}{2}at^2$ Solve for t

2. $x = v_o t + \frac{1}{2}at^2$ Solve for v_o

3. $v = \sqrt{2ax}$ Solve for x

4. $a = \frac{v_f - v_o}{t}$ Solve for t

5. $a = \frac{v_f - v_o}{t}$ Solve for v_f

6. $F = k\dfrac{m_1 m_2}{r^2}$ Solve for r

7. $F = k\dfrac{m_1 m_2}{r^2}$ Solve for m_2

8. $T = 2\pi\sqrt{\dfrac{L}{g}}$ Solve for L

9. $T = 2\pi\sqrt{\dfrac{L}{g}}$ Solve for g

10. $\dfrac{1}{f} = \dfrac{1}{d_o} + \dfrac{1}{d_i}$ Solve for d_i

11. $qV = \dfrac{1}{2}mv^2$ Solve for v (not V and v are not the same quantity)

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In each case make the specified variable the subject of the formula:

a) $h = c + d + 2e,\quad e$ b) $S = 2\pi r^2 + 2\pi rh,\quad h$

c) $Q = \sqrt{\dfrac{c+d}{c-d}},\quad c$ d) $\dfrac{x+y}{3} = \dfrac{x-y}{7} + 2,\quad x$

PART II. SCIENTIFIC NOTATION

The following are ordinary physics problems. Write the answer in scientific notation and simplify the units.

1. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}\,\text{kg}}{2.0\times10^{3}\,\text{kg/s}^2}} =$

2. $K = \dfrac{1}{2}\left(6.6\times10^{2}\ \text{kg}\right)\left(2.11\times10^{4}\ \text{m/s}\right)^2 =$

3. $F = 9x10^{-9}\,\dfrac{\text{N}\cdot\text{m}^2}{\text{C}^2}\left(\dfrac{(3.2x10^{-9}\,\text{C})(9.6x10^{-9}\,\text{C})}{(0.32\ \text{m})^2}\right) =$

4. $\dfrac{1}{R_p} = \dfrac{1}{4.5\times10^{2}\ \Omega} + \dfrac{1}{9.4\times10^{2}\ \Omega}$ $R_p =$

5. $e = \dfrac{\left(1.7\times10^{3}\ \text{J}\right)\text{-}\left(3.3\times10^{2}\ \text{J}\right)}{\left(1.7\times10^{3}\ \text{J}\right)} =$

6. $(1.33)\sin 25.0^{\circ} = (1.50)\sin\theta$ $\theta =$

7. $K_{max} = (6.63\times10^{-34}\ \text{J}\cdot\text{s})(7.09\times10^{14}\ \text{s}^{-1}) - (2.17\times10^{-19}\ \text{J}) =$

8. $\gamma = \dfrac{1}{\sqrt{1 - \dfrac{2.25\times10^{8}\ \text{m/s}}{3.00\times10^{8}\ \text{m/s}}}} =$

PART III. FACTOR-LABEL METHOD FOR CONVERTING UNITS

A very useful method of converting one unit to an equivalent unit is called the **factor-label method** of unit conversion. You may be given the speed of an object as 25 **km/h** and wish to express it in **m/s.** To make this conversion, you must change **km** to **m** and **h** to **s** by multiplying by a series of factors so that the units you do not want will cancel out and the units you want will remain. Conversion: 1000 **m** = 1 **km** and 3600 **s** = 1 ***h***,

$$\left(\frac{25\ \text{km}}{\text{h}}\right)\left(\frac{1000\ \text{m}}{1\ \text{km}}\right)\left(\frac{1\ \text{h}}{3600\ \text{s}}\right) =$$

What is the conversion factor to convert km/h to m/s?

What is the conversion factor to convert m/s to km/h?

Carry out the following conversions using the factor-label method. Show all your work!

1. How many seconds are in a year?

2. Convert 28 km to cm.

3. Convert 45 kg to mg.

4. Convert 85 cm/min to m/s.

5. Convert the speed of light, $3x10^8$ m/s, to km/day.

6. Convert 823 nm to m

7. $8.8x10^{-8}$ m to mm

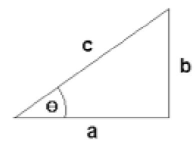
8. $1.5x10^{11}$ m to μm

9. 7.6 m^2 to cm^2

10. 8.5 cm^3 to m^3

PART IV. TRIGONOMETRY AND BASIC GEOMETRY

Solve for all sides and all angles for the following triangles. Show all your work.



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

Your calculator must be in **degree** mode! **Show all your work.**

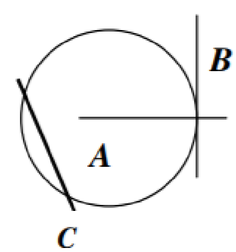
1. $\theta = 55^{\circ}$ and $c = 32$ m, solve for a and b

2. $\theta = 45^{\circ}$ and $a = 15$ m/s, solve for b and c.

3. $b = 17.8$ m and $\theta = 65^{\circ}$, solve for a and c.

4. Line ***B*** touches the circle at a single point. Line ***A*** extends through the center of the circle.

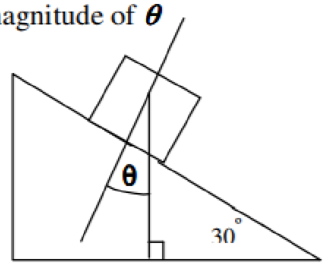
What is line ***B*** in reference to the circle?



How large is the angle between lines ***A*** and ***B***?

What is line ***C*?**

5. Write down the magnitude of $\boldsymbol{\theta}$

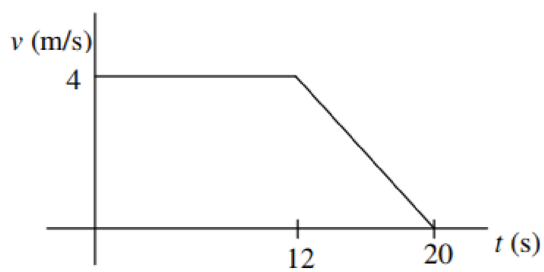


6. The radius of a circle is 5.5 cm,

a. What is the circumference in <u>meters</u>?

b. What is its area in <u>square meters</u>?

7. What is the area under the curve below? Show your work and include the appropriate units.



PART V. GRAPHING TECHNIQUES

Graph the following sets of data using proper graphing techniques.
The first column refers to the *y*-axis and the second column to the *x*-axis

1. Plot a graph for the following data recorded for an object falling from rest:

Velocity (ft/s)	**Time** (s)
32	1
63	2
97	3
129	4
159	5
192	6
225	7

a. What kind of curve did you obtain?

b. What is the relationship between the variables?

c. What do you expect the velocity to be after 4.5 s?

d. How much time is required for the object to attain a speed of 100 ft/s?

2. Plot a graph showing the relationship between frequency and wavelength of electromagnetic waves:

Frequency (kHz)	**Wavelength** (m)
150	2000
200	1500
300	1000
500	600
600	500
900	333

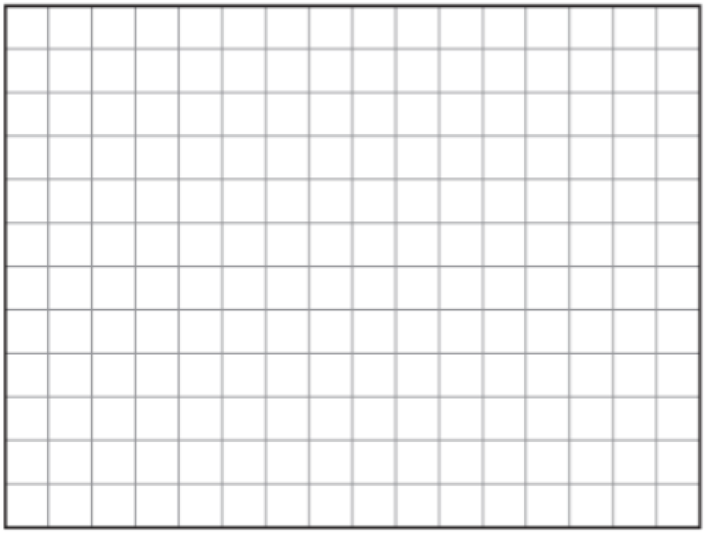
a. What kind of curve did you obtain?

b. What is the relationship between the variables?

c. What is the wavelength of an electromagnetic wave of frequency 350 Hz?

d. What is the frequency of an electromagnetic wave of wavelength 375 m?

3. In an experiment with electric circuits the following data was recorded. Plot a graph with the data:



Current (A)	**Power** (W)
1.0	1.0
2.5	6.5
4.0	16.2
5.0	25.8
7.0	50.2
8.5	72.0

a. What kind of curve did you obtain?

b. What is the relationship between the variables?

c. What is the power when the current is 3.2 A?

d. What is the current when the power is 64.8 W?

Part VI Solving quadratic equations:
Solve each of the following quadratic equations. Obtain your answers in surd, not decimal, form.

1. $x^2 + 8x + 1 = 0$	**2.** $x^2 + 7x - 2 = 0$	**3.** $x^2 + 6x - 2 = 0$
4. $4x^2 + 3x - 2 = 0$	**5.** $2x^2 + 3x - 1 = 0$	**6.** $x^2 + x - 1 = 0$
7. $-x^2 + 3x + 1 = 0$	**8.** $-2x^2 - 3x + 1 = 0$	**9.** $2x^2 + 5x - 3 = 0$
10. $-2s^2 - s + 3 = 0$	**11.** $9x^2 + 16x + 1 = 0$	**12.** $x^2 + 16x + 9 = 0$

Part V Solving logarithmic equations
Solve each of the following logarithmic equations.

(1) Find *without using a calculator*:

(a) $\log_{10} 1000$ (b) $\log_4 16$ (c) $\log_2 64$
(d) $\log_3 27$ (e) $\log_9 81$ (f) $\log_e e^2$
(g) Check (a) and (f) on the calculator.

(2) Solve the following equations:

(a) $\log_{10} x = 5$ (b) $\log_2 y = 5$ (c) $\log_3 z = 4$

(3) Find *without using a calculator*:

(a) $\log_{10} 10$ (b) $\log_4 1$ (c) $\log_{10} 0.1$

(d) $\log_2 0.25$ (e) $\log_{10} 1$ (f) $\log_e \frac{1}{e^2}$

(g) Check (a), (c), (e) and (f) on the calculator.

(4) Express as a single logarithm:

(a) $\log_b 8 - \log_b 2$ (b) $2\log_b 3 + \log_b 2$ (c) $1 - \log_{10} 4$
(d) $\log_b a + \log_b \left(\frac{1}{a}\right)$

(5) Write in terms of $\log_b 2$ and $\log_b 3$:

(a) $\log_b 6$ (b) $\log_b 8$ (c) $\log_b 24$

(6) Find, using a calculator (to 4 decimal places):

(a) $\log_2 6$ (b) $\log_3 8$ (c) $\log_3 1000$ (d) $\log_3 100,000$
(e) $\log_3 0.001$ (f) $\log_3 0.00001$ (g) $\log_3 1$

(7) Solve for x:

(a) $9 = 10\left(2^{-\frac{x}{1620}}\right)$ (b) $3^{5x+2} = 10$