

AP Physics 1 Summer Assignment

- I. The Advanced placement exams are in early May which necessitates a very fast pace. This summer assignment will allow us to start on the Physics subject matter immediately when school begins. This packet is a math review to brush up on valuable skills, and perhaps a means to assess whether you are correctly placed in Advanced Placement Physics.
- II. Physics, and AP Physics in particular, requires an exceptional proficiency in algebra, trigonometry, and geometry. In addition to the science concepts, Physics often seems like a course in applied mathematics. The following assignment includes mathematical problems that are considered routine in AP Physics.
- III. The attached pages contain sample problems. It is hoped that combined with your previous math knowledge this part of the assignment is merely a review and a means to brush up before school begins in the fall. Please read the text and instructions throughout.
- IV. Your first Unit test will also cover the material on the summer assignment.

Significant Digits

Significant figures are the digits in any measurement that are known with certainty plus one digit that is uncertain.

Rule 1: In numbers that do not contain zeros, all the digits are significant.

3.1428	[5]
3.14	[3]
469	[3]

Rule 2: All zeros between significant digits are significant.

7.053	[4]
7053	[4]
302	[3]

Rule 3: Zeros to the left of the first nonzero digit serve only to fix the position of the decimal point and are not significant.

0.0056	[2]
0.0456	[3]
0.0000001	[1]

Rule 4: In a number with digits to the right of a decimal point, zeros to the right of the last nonzero digit are significant.

43	[2]
43.0	[3]
43.00	[4]
0.00200	[3]
0.40050	[5]

A. How many significant digits are in each of the following numbers?

1837	
3.1415×10^4	
6005	
0.08206	
0.000014	
149356	
8.7300	
0.00743	
302400	
8.732	
14.000	
19.7324	

Scientific Notation

B. Convert the following numbers into or out of scientific notation:

142.63	
1,500,000	
0.00336	
1.63×10^7	
3.11×10^{-4}	
0.00125	
86,400	
1.01×10^6	
9.81×10^1	
0.000000000000144	
4,663,310.56	

Rounding

General Rules for Rounding:

Digit after place you are rounding to is ≥ 5 , round up

Digit after place you are rounding to is < 5 , don't change

C. Round each of the following numbers to four significant digits. Some may require scientific notation. Generally, you do not need scientific notation for numbers < 1000 .

6.16782	
6.19648	
0.0019872	
3.14146×10^4	
213.25	
17.163000	
90,210	
234.4	
1200.43	
0.0022475	

Science uses the **KMS** system (**SI**: System Internationale). **KMS** stands for kilogram, meter, second. These are the units of choice of physics. The equations in physics depend on unit agreement. So you must convert to **KMS** in most problems to arrive at the correct answer. Now, I know you could just look up the conversions using Google, but I don't believe that Google will be available on the AP Exam. Use the following information to solve the conversion problems below.

Name	Symbol	Equivalent	Name	Symbol	Equivalent
tera	T	10^{12}	deci	d	10^{-1}
giga	G	10^9	centi	c	10^{-2}
mega	M	10^6	milli	m	10^{-3}
kilo	k	10^3	micro	μ	10^{-6}
hecto	h	10^2	nano	n	10^{-9}
deca	-	10	pico	p	10^{-12}

$$1 \text{ L} = 10^3 \text{ cm}^3$$

$$\text{K} = \text{C}^\circ + 273$$

[L = liters; cm^3 = cubic centimeters]

[K = temperature in Kelvin degrees; $^\circ\text{C}$ = temperature in Celsius degrees]

a. $4008 \text{ g} = \underline{\hspace{2cm}} \text{ kg}$

b. $1.2 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

c. $298 \text{ K} = \underline{\hspace{2cm}} \text{ }^\circ\text{C}$

d. $8.8 \times 10^{-8} \text{ m} = \underline{\hspace{2cm}} \text{ mm}$

e. $25.0 \text{ } \mu\text{m} = \underline{\hspace{2cm}} \text{ m}$

f. $2.65 \text{ mm} = \underline{\hspace{2cm}} \text{ m}$

g. $6.23 \times 10^{-7} \text{ m} = \underline{\hspace{2cm}} \text{ nm}$

h. $5.4 \text{ L} = \underline{\hspace{2cm}} \text{ m}^3$

Substituting and solving. A large (and fairly easy) portion of your work in physics will consist of substituting values into an equation and solving. For each of the following, substitute the given values and solve. If you understand how, include the units in your answer (if you don't understand now, you eventually will). **Show your substitutions. The first one is done for you.**

1. $t = \sqrt{\frac{2y}{a}}$ ($y = 800 \text{ m}$; $a = 4 \text{ m/s}^2$)

$$t = \sqrt{\frac{2(800 \text{ m})}{4 \text{ m/s}^2}} = \sqrt{400 \text{ s}^2} = 20 \text{ s}$$

3. $T = 2\pi\sqrt{\frac{l}{g}}$ ($l = 2.0 \text{ m}$; $g = 10 \text{ m/s}^2$)

5. $P = \frac{V^2}{R_1 + R_2}$

($V = 200 \text{ V}$; $R_1 = 80 \text{ } \Omega$; $R_2 = 20 \text{ } \Omega$)

2. $K = \frac{1}{2}mv^2$ ($m = 4 \times 10^3 \text{ kg}$; $v = 2 \times 10^5 \text{ m/s}$)

4. $F = m_1 \left(a_1 - \left(\frac{m_2}{F_g} + a_2 \right) 4 \right)$

($m_1 = 4 \text{ kg}$; $m_2 = 5 \text{ kg}$; $a_1 = 7 \text{ m/s}^2$; $a_2 = 2.5 \text{ m/s}^2$; $F_g = 5 \text{ kg} \cdot \text{m/s}^2$)

6. $\mu = \frac{m_1 g + m_2 g}{(m_1 + m_2) a}$

($m_1 = 2 \text{ kg}$; $m_2 = 4 \text{ kg}$; $g = 10 \text{ m/s}^2$; $a = 5 \text{ m/s}^2$)

$$7. y = y_0 + v_0 t + \frac{1}{2} a t^2$$

$$(y_0 = -4 \text{ m}; v_0 = -5 \text{ m/s}; a = 6 \text{ m/s}^2; t = 4 \text{ s})$$

$$9. T = mg - ma - \mu mg$$

$$(m = 5 \text{ kg}, g = 10 \text{ m/s}^2, a = -4 \text{ m/s}^2, \mu = 0.4)$$

$$8. a = \frac{m_1 g}{m_2} - \frac{m_2 g}{m_1}$$

$$(m_1 = 5 \text{ kg}, m_2 = 4 \text{ kg}, m_3 = 12 \text{ kg}; g = 10 \text{ m/s}^2)$$

$$10. F_e = \frac{K q_a q_b}{r^2}$$

$$(K = 9 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2; q_a = 3 \times 10^{-6} \text{ C}; q_b = 3 \times 10^{-5} \text{ C}; r = 3 \text{ m})$$

Manipulating equations. An important skill for a physics student is manipulating equations to solve for a specific variable. Solve each of the following equations for the variable indicated. **The first one is done for you.**

1. $v = \frac{\Delta x}{\Delta t}$ (solve for Δt)

$$\Delta t = \frac{\Delta x}{v}$$

3. $F = ma$ (solve for a)

5. $F_s = T - mg$ (solve for m)

7. $K = \frac{1}{2}mv^2$ (solve for v)

9. $f = \frac{1}{T}$ (solve for T)

11. $v^2 = v_0^2 + 2a(d - d_0)$ (solve for v_0)

2. $y = y_0 + v_0t + \frac{1}{2}at^2$ (solve for a)

4. $F\Delta t = mv$ (solve for v)

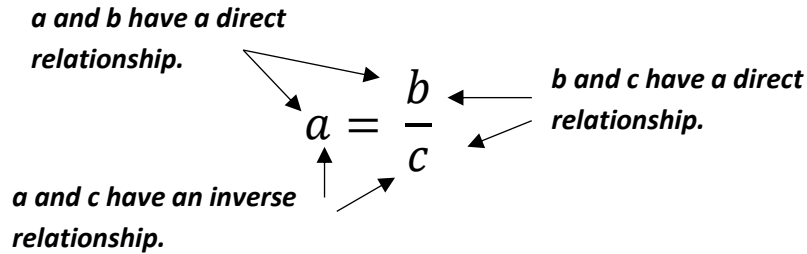
6. $P = \frac{v^2}{R}$ (solve for R)

8. $a_{cp} = \frac{v^2}{r}$ (solve for v)

10. $T = 2\pi\sqrt{\frac{l}{g}}$ (solve for l)

12. $F_e = \frac{Kq_aq_b}{r^2}$ (solve for r)

Understanding algebraic relationships. It will often be necessary to understand how changing one variable affects another in an equation. To do this, you must know the difference between direct and inverse relationships. In a **direct relationship**, as one variable increases, another variable increases by the same amount. For example, if one variable is doubled, the other is also doubled. In an **inverse relationship**, as one variable increases, another variable decreases by the same amount. For example, if one variable is tripled, the other is reduced by one third. (Hint: if the variable is squared, then the relationship is also squared).



Consider the following equations:

$$z = \frac{x}{y}$$

$$n = pq$$

$$r = \frac{s^2}{t^2}$$

- a.) If x is doubled and y stays constant, z _____
- b.) If y is quadrupled and x stays constant, z _____
- c.) If x is reduced by one-third and y stays constant, z _____
- d.) If y is halved and x stays constant, z _____
- d.) As p increases and n stays constant, q _____
- e.) As n increases and q stays constant, p _____
- f.) As q increases and p stays constant, n _____
- g.) If s is tripled and t stays constant, r is multiplied by _____
- h.) If t is doubled and s stays constant, r is multiplied by _____

Trigonometry. You have to be familiar with SOH CAH TOA in physics because of the nature of the problems. You will understand this more as we begin working on motion in two dimensions, but for now, make sure you can do the following:

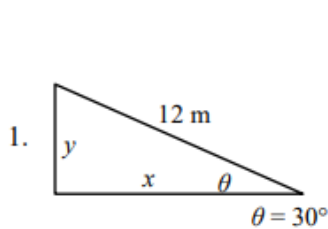
Write the formulas for each one of the following trigonometric functions. Remember SOHCAHTOA!

$\sin\theta =$

$\cos\theta =$

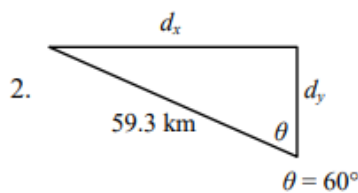
$\tan\theta =$

Calculate the following unknowns using trigonometry. Use a calculator, but show all of your work. Please include appropriate units with all answers. (Watch the unit prefixes!)



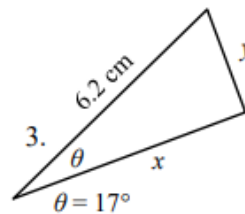
$y =$ _____

$x =$ _____



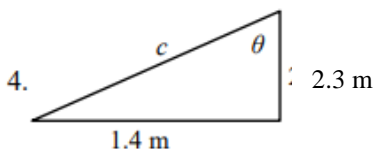
$d_x =$ _____

$d_y =$ _____



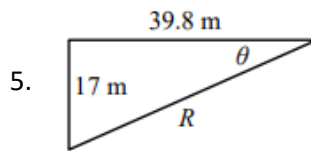
$x =$ _____

$y =$ _____



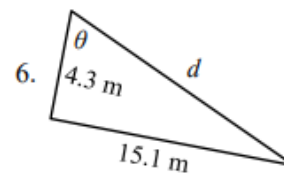
$c =$ _____

$\theta =$ _____



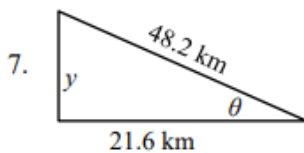
$R =$ _____

$\theta =$ _____



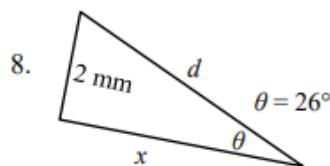
$d =$ _____

$\theta =$ _____



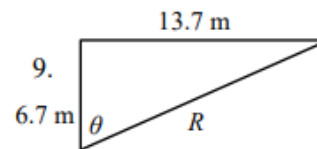
$y =$ _____

$\theta =$ _____



$x =$ _____

$d =$ _____



$R =$ _____

$\theta =$ _____

Congratulations! You have finished the summer assignment. Contact me at corey.dehart@maryville-schools.org or on Remind if you have questions.