AP Physics Summer Assignment

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Summer 2019

Introduction

AP Physics 1 is a course designed to mimic the rigor and complexity of an entry level college physics course. It will focus on reasoning and logical thinking to help you navigate the wonderful world of Physics! Before we can dive into the fun and exciting topics that this course can offer, we must make sure that everyone starts with the same math and logic skills. This assignment is designed to refresh some material that we will immediately start using in class and possibly help you learn some new techniques for solving problems.

1 Scientific Notation and Dimensional Analysis

In Physics, we may work with extremely large or small numbers. To more easily write and understand these numbers, we use scientific notation. You should try and work on this section without a calculator to get used to quick conversions.

Rewrite the following numbers in proper scientific notation. Keep the unit that is provided and remember to ALWAYS WRITE YOUR UNITS!

1. 7,000 m
2. 2,560,000 kg
3. .00065 m/s
4. .00000007 s

Frequently when we work with scientific notation we will be solving problems that include equations involving these numbers. For the next problem set, solve the mathematical operations involving numbers already in scientific notation. The rules for this are as follows:

- When numbers are multiplied you multiply the bases and add the exponents.
- When numbers are divided you divide the bases and subtract the exponents.
- When an exponent is raised to another exponent, you multiply the exponent.

Using these rule, simplify the numbers in the following problem set.

5. $(4 \times 10^6)\times(2 \times 10^4) =$
6. $(3.2 \times 10^2) \ / \ (4 \times 10^{-3}) =$
7. $(3 \times 10^9)\times(1.5 \times 10^{-10}) =$
8. $(6 \times 10^4)^2 =$
9. $(3 \times 10^{-7}) \ / \ (5.3 \times 10^4) =$
10. $(1.6 \times 10^{-8})^5 =$

It is also extremely important to be able to convert across metric units. If a unit has no prefix, then it is a base unit with a 10^0 for its power, which is also equal to 1.

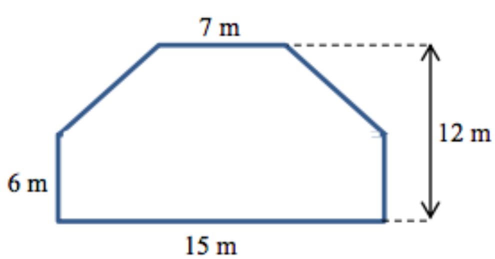
Convert the numbers given in the following problem set. Remember to keep appropriate units and use scientific notation if there are more than 4 digits.

1. 31 kg = ____________ g
2. 70 Hz = ____________ GHz
3. 5.9 cm = ____________ nm
4. 5.7 m^2 = ____________ mm^2
5. 4.96 km/s = ____________ m/s
6. 8.46 km/s^2 = ____________ nm/s^2

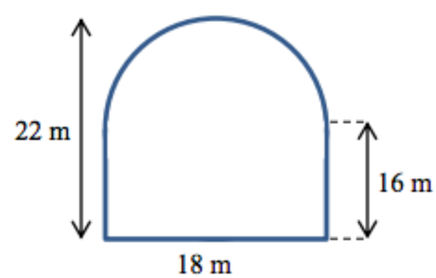
2 Geometry

Find the area of the following shapes, breaking them up into common shapes if needed.

1. Area = ____________

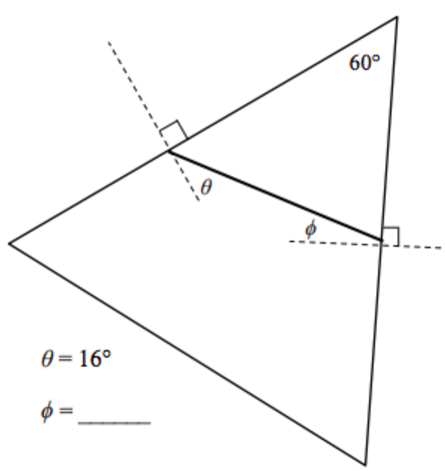


2. Area = ____________

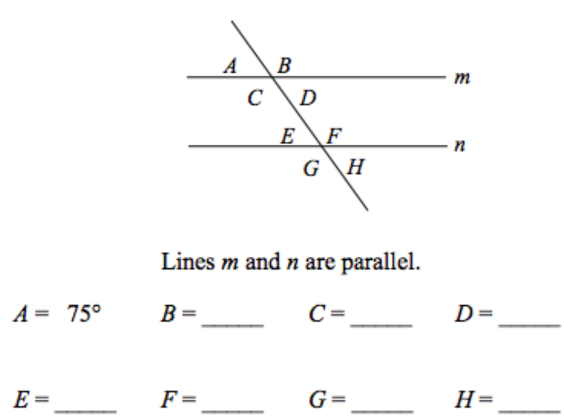


Calculate the unknown angles for the following problems.

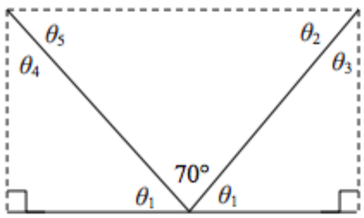
3.



4.



5.



$\theta_1 =$ _____

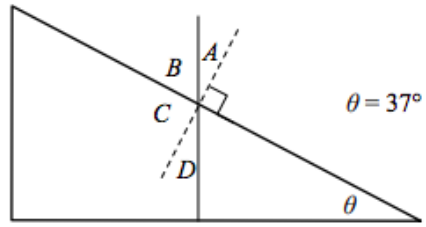
$\theta_2 =$ _____

$\theta_3 =$ _____

$\theta_4 =$ _____

$\theta_5 =$ _____

6.



$A =$ _____ $B =$ _____

$C =$ _____ $D =$ _____

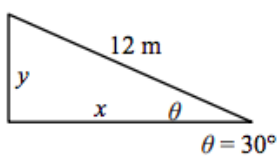
3 Trigonometry

Write the proper simple trig ratios for each of the following functions.

Sin $\theta =$ Cos $\theta =$ Tan $\theta =$

Solve for the following unknowns using your trig functions. You can use a calculator but show all of your work and include units.

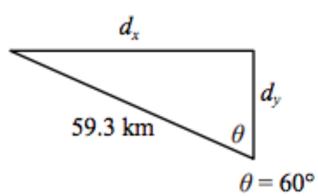
1.



$y =$ _______

$x =$ _______

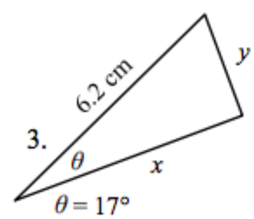
2.



$d_x =$ ______

$d_y =$ ______

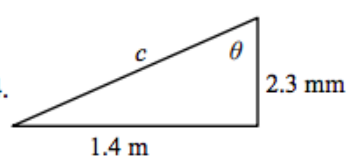
3.



$x =$ _____

$y =$ _____

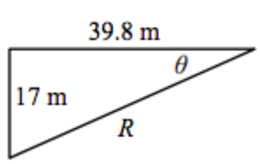
4.



$c =$ ______

$\theta =$ ______

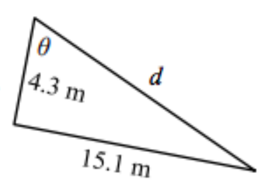
5.



$R =$ ______

$\theta =$ ______

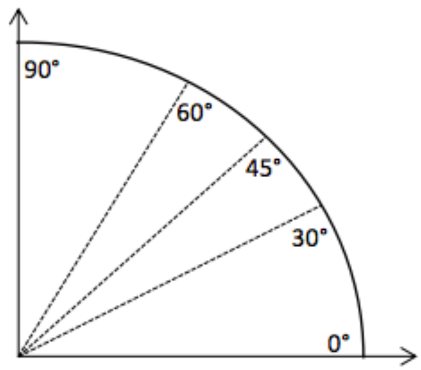
6.



$d =$ ______

$\theta =$ ______

For this class, you will need to know some of the common angles from the unit circle. Fill out the following chart by calculating the different angles of the unit circle. Be sure the write the answers in fraction form.



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

Use your completed chart to answer the following questions.

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 maximum?

13. At what angle is cosine at a minimum?

14. At what angle are sine and cosine the same?

15. As the angle 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?

4 Algebra

The following problems should give you some practice with the types of equations and necessary algebra that we will use in class. Make sure to show every step for every problem and use proper units!

Section I: Use the following 3 equations for the following problems.

$$v_f = v_0 + at \qquad x_f = x_0 + v_0 t + \frac{1}{2}at^2 \qquad v_f^2 = v_0^2 + 2a(x_f - x_0)$$

1. Using the first equation, solve for a, given $v_0 = 2$ m/s, $v_f = 10$ m/s, and $t = 1$ s.

2. Using the second equation, solve for t given $x_f = 40$ m, $x_0 = 0$, $v_0 = 6$ m/s, and $a = 2$ m/s^2.

3. Using the third equation, solve for v_0, given $v_f = 10$ m/s, $a = 3$ m/s, $x_f = 8$ m, and $x_0 = 2$ m.

4. How does each equation simplify when $a = 0$ m/s^2 and $x_0 = 0$ m?

Section II: Use the following 4 equations for the following problems.

$$\Sigma F = ma \qquad f_s \leq \mu_s N \qquad f_k = \mu_k N \qquad F_s = -kx$$

5. Using the first equation, solve for m, given $\Sigma F = 15$ N and $a = 2$ m/s^2.

6. Given $\Sigma F = f_k$, $m = 115$ Kg, $\mu_k = .1$, and $N = 10m$, find a.

7. If $\Sigma F = T - 10m$, and $a = 0$ m/s^2, use the first equation to find m in terms of T.

8. Using the last equation, solve for k, given $F_s = 850$ N and $x = 2$ m.

Section III: Use the following 2 equations for the following problems.

$$a = \frac{v^2}{r} \qquad \tau = rFsin\theta$$

9. If $a = 8$ m/s^2 and $r = 2$, what is v?

10. In one instance, $a = 25$ m/s^2. In the next instance, r is tripled, what is a now?

11. Using the second equation solve for θ, given $\tau = 3$ Nm, $r = 5$ m, and $F = .6$ N.

Section IV: Use the following 6 equations for the following problems.

$$K = \frac{1}{2}mv^2 \qquad W = F(\Delta x)cos\theta \qquad P = \frac{W}{t}$$

$$\Delta U_g = mgh \qquad U_s = \frac{1}{2}kx^2 \qquad P = Fv_{avg}cos\theta$$

12. Using the first equation, solve for K, given $m = 2.3$ kg and $v = 10$ m/s.

13. The Δ symbol means the change in some variable between two situations, so Δx equals the final x, x_f, minus the initial x, x_i. Using the second equation, solve for the final x, x_f, given $x_i = 2$ m, $F = 20$ N, W = 45, and θ = 45 degrees.

14. The constant g represents gravity's acceleration on an object, where $g = 9.8$ m/s^2. Knowing this, solve for the change in U_g, given $m = 5$ kg and $h = 28$ m.

15. Solve for P, given $F = 120$ N, $v_{avg} = 1.2$ m/s, and $\theta = 20°$.

16. Solve for W, if $P = 1200$ W and $t = 30$ s.

Section V: Use the following 3 equations for the following problems.

$$p = mv \qquad F\Delta t = \Delta p \qquad \Delta p = m\Delta v$$

17. If $m = 2$ kg and $v = 12.3$ m/s, what is p?

18. Solve for m, given $F = 150$ N, $\Delta t = 4$ s, and $\Delta v = 4.5$ m/s.

19. Solve for the final t, t_f, given $\Delta p = 23$ kgm/s, $F = 40$ N, and $t_i = 1$ s.

Section VI: Use the following 3 equations for the following problems.

$$T_s = 2\pi\sqrt{\tfrac{m}{k}} \qquad T_p = 2\pi\sqrt{\tfrac{l}{g}} \qquad T = \tfrac{1}{f}$$

20. Solve for k, given $T_s = 3$ s and $m = 20$ kg.

21. If $T = T_p$, solve for f, given $l = 1$ m. (Use the constant g given previously, units for f are Hertz (Hz))

Section VII: Use the following 2 equations for the following problems.

$$F_g = -G\tfrac{m_1 m_2}{r^2} \qquad U_g = -G\tfrac{m_1 m_2}{r}$$

22. The constant $G = 6.67 \times 10^{-11}$ m^{3}kg^{-1}s^{-2}. Solve F_g, given $m_1 = m_2 = 1.2$ x 10^{20} kg and $r = 2$ x 10^{18} m.

23. Solve U_g, given the same variables in question 22.

Section VIII: Use the following 9 equations for the following problems.

$$V = IR \qquad R = \frac{\rho l}{A}$$

$$I = \frac{\Delta Q}{t} \qquad R_S = (R_1 + R_2 + R_3 + ... + R_i) = \Sigma R_i$$

$$P = IV \qquad \frac{1}{R_P} = (\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_i}) = \Sigma \frac{1}{R_i}$$

24. Solve for V, given $I = 1.5$ A and $R = 20\ \Omega$. (V has the unit of Volts (V)).

25. Let $R_S = R$. If $R_1 = 50\ \Omega$ and $R_2 = 25\ \Omega$ and $I = 0.15$ A, find V.

26. Let $R_P = R$. If $R_1 = 50\ \Omega$ and $R_2 = 25\ \Omega$ and $V = 10$ V, find P.

27. Rewrite the 5th equation ($P = IV$) so that P is equal to some equation involving R. Use the first equation to substitute.

5 Scalars and Vectors

Scalars and Vectors are similar but very distinct types of quantities. For this section, you will be reviewing the general idea of them. I hope this will help you start understanding a complicated topic.

1. Read the following web page and summarize in YOUR OWN WORDS what each of the types of quantities are, scalars and vectors. Give 1 example of each, which can be found on the same web page.

https://www.physicsclassroom.com/class/1DKin/Lesson-1/Scalars-and-Vectors

Bonus
Make an equation sheet, either on paper or digitally, that you can reference back to throughout the year, that includes every equation given in this packet.

*Adapted from Rich Township High School AP Physics Summer Assignment