AP Physics Summer Assignment 2016-17

Name _____

1 INTRODUCTION

The summer assignment is divided into two sections. The first is a review of the basic skills you should already have from your experiences in prior science and math courses. We will use these skills constantly throughout our AP Physics 1 course. While completing this assignment, determine how well you know these skills. A reference page is provided on my website should you need help with these problems.

The second assignment is a look at the first unit of material for class. The chapter from the textbook is linked on my website and the specifics of the assignment are listed below. While I will cover the material the first week in class, you are expected to have done the assignment and developed some knowledge coming in. Otherwise, we simply do not have the time to get to all of the required material for the course throughout our short semester together.

Technically, the AP class does not start until second semester in January, so you may want to brush up on them just prior to returning to school after the December break. I am giving the assignment to you now so that you may choose when the best time to work on it is for you. Please contact me if you need any help here. I can be reached via email, Amanda.lunsford@henry.k12.ga.us. The assignment will be due on the **first Friday of second semester: Friday, January 6, 2017**. Do not hesitate to contact me if you have any questions. I am looking forward to our time together and hope you have a wonderful summer!

2 PROBLEMS – REVIEW AND PREREQUISITE MATERIALS

2.1.1 Unit Conversion Problems

1. The Milky Way Galaxy has a diameter of 9.5×10^{17} km. Express the diameter of the Milky Way Galaxy in meters by writing your answer in standard form.

2. The radius of an atom is so small, that scientists prefer to use the unit of Angstroms to describe its dimensions. Express the radius of an atom (approximately one angstrom) in the units of millimeters by writing the answer in scientific notation.

3. The age of the Universe believed to around 13.78 billion years. Express the age of the Universe in the unit of seconds by writing the answer in scientific notation.

4. Through the use of simple Physics that will be studied in this AP Physics course, we will determine that the mass of the Earth is approximately 5.972×10^{24} kg. Express the mass of the Earth in Mg (Megagrams) by writing the answer in standard form.

5. Lake Cumberland holds an average of volume 7.5 km^3 of water according the latest statistical calculations. Express the volume of water that Lake Cumberland can hold in the units of cm^3 by writing your answer in scientific notation.

6. An experimental constant commonly used in Physics is the Fundamental Gravitational Constant, which has a value of 6.67 x 10^{-11} $\frac{m^3}{kg*s^2}$. Express the Fundamental Gravitational Constant in the unit of $\frac{cm^3}{g*hr^2}$ by writing your answer standard form.

2.1.2 Proportionality and Literal Equation Problems

7. Hooke's Law of a Spring can be described by the equation $F_s = -kx$, where F_s is the force exerted by a spring (in Newtons), k is the spring constant (stiffness of the spring), and x is the amount of distance a spring has been stretched (meters). **(a)** Determine how much the force exerted by a spring changes if k is tripled. **(b)** Determine how much the force exerted by a spring changes if x is decreased by a factor of five. **(c)** Determine how much the force exerted by a spring changes if the spring constant is decreased by a factor of three and x is quadrupled. **(d)** Use the method of Literal Equations to isolate (solve for) the spring constant and determine the dimensions (units) of the spring constant.

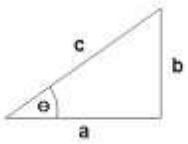
8. The Kinetic Energy of a moving mass can be described by the equation $KE = \frac{1}{2}mv^2$, where KE is the kinetic energy of the object (in Joules), m is the mass of the object (in kilograms), and v is the velocity of the moving object. **(a)** Determine how much the Kinetic Energy changes if the velocity is quadrupled. **(b)** Determine how much the Kinetic Energy changes if the mass is decreased by a factor of two. **(c)** Determine how much the Kinetic Energy changes if the mass is doubled and the velocity is reduced by a factor of four. **(d)** Use the method of Literal Equations to isolate (solve for) the velocity.

9. The position of a moving object in one dimension can be described by the equation $X_f = X_0 + V_{ox}t + \frac{1}{2}at^2$, where X is position (in meters), V is velocity (in meters per second), and t is time (in seconds). Use the method of Literal Equations to isolate "a" and determine the dimensions (units) of "a".

2.1.3 Right Triangle Trigonometry

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

Example: *SOH CAH TOA*



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

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

10. $\theta = 55^o$ and c = 32 m, solve for a and b.

11. $\theta = 45^o$ and a = 15 m/s, solve for b and c.

12. b = 17.8 m and $\theta = 65^o$, solve for a and c.

13. a = 250 m and b = 180 m, solve for θ and c.

3 UNIT 1 – KINEMATICS IN ONE DIMENSION

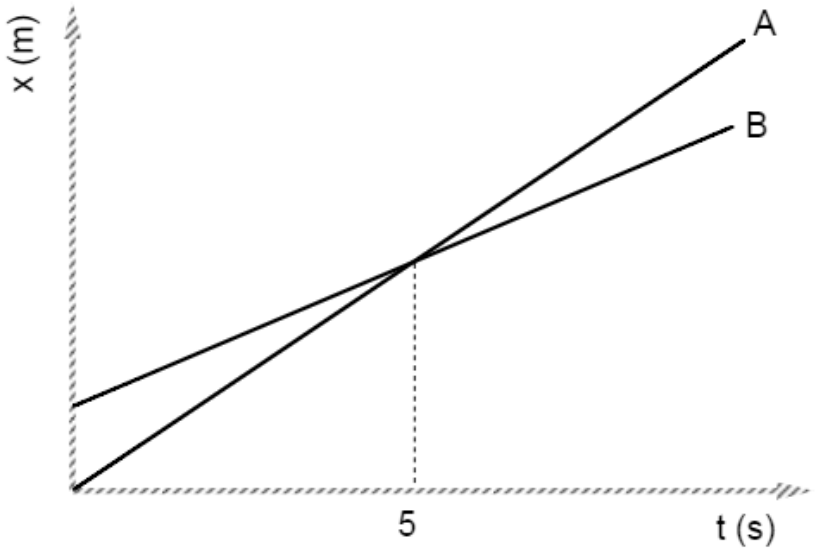
Task One: Please **read Chapter 2**, *Describing Motion: Kinematics in One Dimension* which is posted as a pdf file on my website's Summer Assignment resource page. While reading, **create a chapter outline or complete Cornell Notes** over the major sections. **THIS MUST BE HANDWRITTEN. THIS MEANS YOU CANNOT TYPE IT.** Pay special attention to variables and their units, as well as formulas and how they are used. While I will still cover this material the first week of school (and even though your assignment is not due until Friday), I will be doing so at a pace that assumes you have done this reading and note-taking beforehand. You will find these notes VERY helpful the first week of school (hint).

Task Two: Create concept cards for the following list of terms. I recommend using index cards with a index card box or ring to keep them together. I will flip through them on the due date to make sure they are complete and this will be factored into your grade. The **front** of your card should have the word/concept, the page on which it can be found in your book, and a simple picture or diagram to represent it (you may have to get creative here). The **back** of your card should have the definition, the units if applicable, and the formula if it has one. An example concept card is posted on my website.

Word List: position, displacement, average speed, average velocity, instantaneous velocity, average acceleration, acceleration due to gravity, scalar (Ch. 3), vector (Ch. 3)

Task Three: Complete the following exercises to practice and check for understanding of the material.

1. Consider the position vs. time graph below for cyclists A and B.



a. Do the cyclists start at the same point? How do you know? If not, which is ahead?

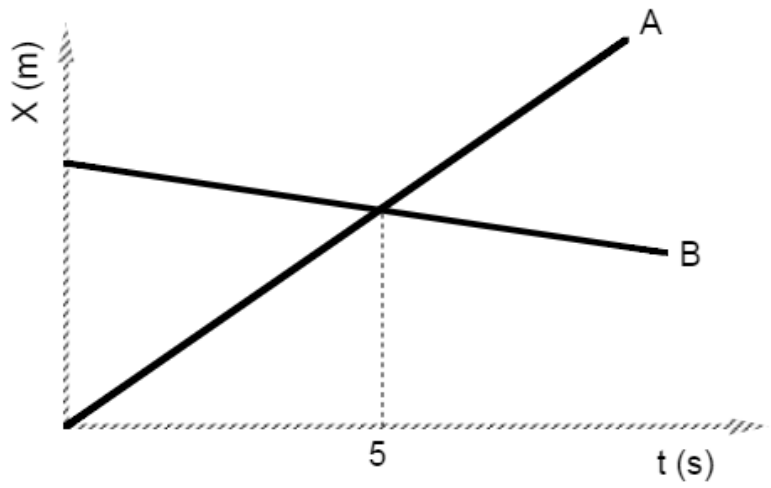
b. At t= 7s, which cyclist is ahead? How do you know?

c. Which cyclist is travelling faster at t = 3s? How do you know?

d. Are their velocities equal at any time? How do you know?

e. What is happening at the intersection of lines A and B?

2. Consider the position vs. time graph below for cyclists A and B.



a. How does the motion of the cyclist A in this graph compare to that of A in the previous graph on page one?

b. How does the motion of cyclist B in this graph compare to that of B in the previous graph on page one?

c. Which cyclist has the greater speed? How do you know?

d. Describe what is happening at the intersection of lines A and B.

e. Which cyclist traveled a greater distance during the first 5 seconds? How do you know?

3. The Spirit and Opportunity robot rovers landed on Mars in 2004 and explored its surface for years. The rovers' spacecraft and the rovers themselves travelled at wildly different speeds. The Spirit rover could move across the Martian landscape at a maximum of 2.68 m/min. How many minutes would it take for it to travel 10.4 m, the length of a typical classroom?

4. A runner in a 1.00×10^2 meter race passes the 40.0 meter mark with a speed of 5.00 m/s.

a. If she maintains that speed, ***how far from the starting line*** will she be 3.00 seconds later?

b. If 5.00 m/s was her top speed, what is the shortest possible time for her entire 1.00×10^2 m run?

5. The head of a rattlesnake can accelerate 50.0 m/s^2 in striking a victim. If a car could do as well, how long would it take for it to reach a speed 24.6 m/s (which is about 55 mi/h) from rest?

6. The speed limit on an 86.0 mile highway was changed from 55.0 mi/h to 75.0 mi/h. How much time was saved on the trip for someone traveling at the speed limit?

7. In an emergency, a driver brings a car to a full stop in 5.00 seconds. The car is traveling along a highway at a rate of 24.6 m/s when braking begins. At what rate is the car accelerated?

8. A supersonic jet flying at 200. m/s is accelerated uniformly at the rate of 23.1 m/s^2 for 20.0 seconds. What is its final speed?

9. If a bullet leaves the muzzle of a rifle with a speed of 600. m/s, and the barrel of the rifle is 0.800 m long, at what rate is the bullet accelerated while in the barrel?