Holy Cross High School

Advanced Placement Program 2019-2020

Summer Assignment

AP Physics 1

Required Materials: None

Due Date: First day of school

Expected time for completion: 4 Hours

Additional Resources:

Physics and math tutorials on the web

- www.hippocampus.org
  - Math review videos
  - Physics videos at various levels
- www.physicsclassroom.com/class

Teacher Contact Information: Mr. Sutton csutton@holycrosshs-ct.com

Purpose of assignment:

This assignment serves as the beginning of our rigorous course of study in AP/ECE Physics. The primary goal of this assignment is to serve as a math review that will help you brush up on the mathematical concepts utilized throughout the course.

Skills/Knowledge required for completion:

Algebra and Geometry math skills
Ability to follow a given procedure.

Grading:

Graded for completion and assessed with a **Major Assessment** within the first week of school.

AP 1 Physics **Name:** _____
Summer Assignment

Dear student,

Welcome to AP 1 -Physics !!!! AP Physics is a first year physics course that covers the equivalent of two semesters of college level physics. Due to the large amount of material in the AP curriculum and the short amount of time we have to cover that material, this course moves at a very fast pace. This level of academic rigor is likely more than you have experienced in your past studies, but in the end you will not only be prepared to take the AP exam, but you will also be ready for the style of academic study found within most college programs.

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. This includes knowing several key metric system conversion factors and how to employ them, graphical analysis of data, and understanding vectors.

The attached pages contain carefully crafted review, hints, and example problems. It is hoped that combined with your previous math knowledge, this assignment is a review and a starting point in your study of physics.

Please read the text and instructions throughout.

There will be a test covering this packet the first week of class.

What if I don't get all the problems or don't understand the instructions?

1. Seek help!
    a. Physics and Math Tutorials on the web
        i. www.hippocampus.org for math and physics videos
        ii. www.physicsclassroom.com/Class
2. Show work in order to receive credit
3. Come to the class on the first day of school, ready with your questions, so that you can resolve these issues prior to the test.

Consider the following statements...

1. Would you like to mow my lawn? I'm gonna pay you 10!
2. My cousin only weighs 11.
3. This morning I ran 4.
4. I slept for 7 last night.
5. My car has a top speed of 225.

Questions:

1) Why are the above statements peculiar and ill defined?

2) What important piece of information needs to be added to the above statements for them to make physical sense?

Rewrite each statement with added information.

1)

2)

3)

4)

5)

STORY ONE: Circus Routines – Fill in the "libs" (blanks) with appropriate words (units).

My friend Johnny is thinking of joining the circus. He can do some awesome things. First of all John-Boy can lift 800 _____right over his head and can run at a top speed of 30 _____ for a time of 4 _____! Just last week he threw a 70 _____ rock right over a 1200_____wall and was awarded 7500 _____ for that amazing feat. Johnny is 2 ____ tall and weighs an unworldly 310 _____. To keep up his physique he must eat 4 _____ of chicken and 6 _____ of beef every _____ and exercise with 20 _____weights for 12 _____. Johnny is hopeful that his impressive skills and routine will earn him the job of his dreams.

Consider the following statements...

1. An employee at Target earns dollars *per* hour ($/hr). *(note the word "per" always means "divided by")*
2. An average person has a mass of kg and a weight of newtons.
3. I use my cellphone outside of class, for seconds in a month.
4. The height from floor to ceiling in this classroom is meters
5. The speed limit on a Canadian highway is km per hour (km/hr)

Questions:

1) Why are the above statements incomplete?

2) What important piece of information needs to be added to the above statements for them to make physical sense?

Rewrite each statement with added information.

1)
2)
3)
4)
5)

STORY TWO: The Northeastern Turkle – Fill in the "libs" (blanks) with appropriate sensible values.

It is well known that the Northeastern Turkle (Turtle body with Turkey neck and head) will run at a top speed of _____ centimeters/hour and has a mass of _____kilograms. The unique shelled wings of the Turkle give it the surprising ability to fly at an altitude of _____ meters. The amazingly acute vision of the turtle means that it can see objects that are as small as _____ mm tall by _____ mm wide at a distance of _____ meters away. Unfortunately it doesn't have terrific sense of hearing, and is only able to detect the sound of other yelping Turkles at the relatively close distance of _____meters way. The mature Turkle is an incredibly powerful creature and can use its talons to lift a person riding a bicycle weighing up to _____ newtons. While most Turkles are nocturnal in their natural Northeastern Habitat, they can fly _____ hours without resting during migration cycles to Lima, Peru. The favourite meal of the Turkle is bacon wrapped starfish which is slow cooked at a temperature of _____ °C for _____ hours.

Section One: Working with Equations

Problems in Physics are first done using variables only. Only after solving for the desired variable should values be substituted into the equations. The following problems require you to solve for specific variables. Don't let the different letters confuse you.

1. $v^2 = v_o^2 + 2a(s - s_o)$ $a =$ _____

2. $K = \frac{1}{2}kx^2$ $x =$ _____

3. $T_p = 2\pi\sqrt{\frac{l}{g}}$ $g =$ _____

4. $F_g = G\frac{m_1 m_2}{r^2}$ $r =$ _____

5. $mgh = \frac{1}{2}mv^2$ $v =$ _____

6. $x_m = \frac{m\lambda L}{d}$ $d =$ _____

7. $pV = nRT$ $T =$ _____

8. $sin\theta_c = \frac{n_1}{n_2}$ $\theta =$ _____

9. $qV = \frac{1}{2}mv^2$ $v =$ _____

10. $\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$ $s_i =$ _____

11. $ma = mg\sin\theta - \mu mg\cos\theta$ $\mu =$ _____

12. $n_1\sin\theta_1 = n_2\sin\theta_2$, if θ=90° $n_1 =$ _____

13. $\rho_L A(H-a)g = \rho_S AHg$ $a =$ _____

14. $quB\sin\theta = m\frac{v^2}{r}$ $v =$ _____

15. $P = IV$ and $I = \frac{V}{R}$ Find two other equations for P.

16. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $R_2 =$ _____

Section Two: **Working with Calculations / Scientific Notation**

The following are ordinary physics problems. Place the answer in scientific notation when appropriate and simplify the units. Scientific notation is used when it takes less time to write than the ordinary number does. As an example, 200 is easier to write than 2.00×10^2, but 2.00×10^8 is easier to write than 200,000,000. Do your best to cancel units, and attempt to show the simplified units in the final answer.

17. $T_s = 2\pi\sqrt{\frac{4.5\times10^{-2}kg}{2.0\times10^{3}\frac{kg}{s^2}}}$ _____

18. $K = \frac{1}{2}\left(6.6\times10^{2}kg\right)\left(2.11\times10^{4}\frac{m}{s}\right)^2$ _____

19. $F = \left(9.0\times10^{9}\frac{N\cdot m^2}{C^2}\right)\frac{(3.2\times10^{-9}C)(9.6\times10^{-9}C)}{(0.32m)^2}$ _____

20. $\frac{1}{R_P} = \frac{1}{4.5\times10^{2}\Omega} + \frac{1}{9.4\times10^{2}\Omega}$ $R_P =$ _____

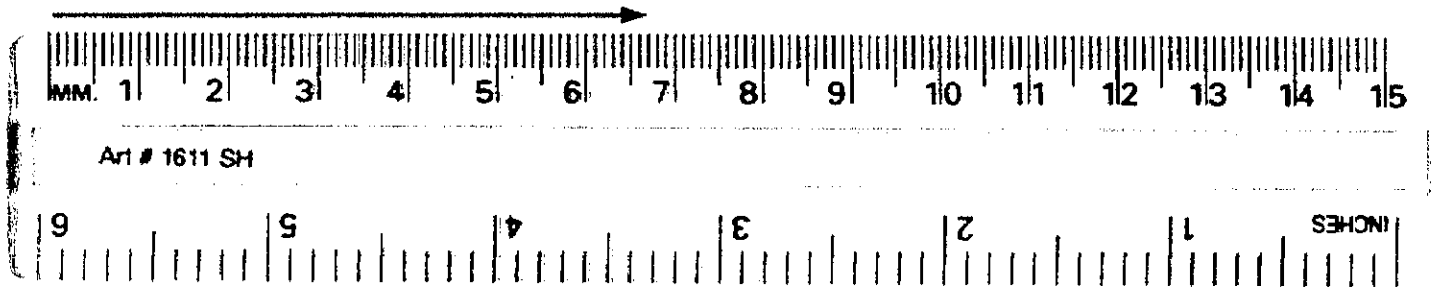
21. $e = \frac{1.7\times10^{3}J - 3.3\times10^{2}J}{1.7\times10^{3}J} =$ _____

22. $1.33sin25^\circ = 1.50sin\theta$ $\theta =$ _____

Section Three: Measurements

When using a measuring device, you MUST estimate between the smallest marks on the instrument. For example, if a ruler is marked off in increments of whole numbers, you estimate the length of an object to the closest tenth of a millimeter.

23. Use the ruler below to measure the length of the arrow. Remember to estimate between the smallest marks.



The length of the arrow is _____ mm.

Section Four: Units

Science uses the MKS system based on SI (SI - Systeme Internationale - the metric system). MKS stands for meters, kilograms, seconds. These are the basic units of physics. The equations in physics depend on unit agreement. Therefore, you must convert to MKS in most problems to arrive at the correct answer.

There are two categories of conversions: (1) converting with SI prefixes and (2) converting to different scales.

(1)
kilometers (km) to meters (m)and meters to kilometers
centimeters (cm) to meters (m) and meters to centimeters
millimeters (mm) to meters (m) and meters to millimeters
nanometers (nm) to meters(m) and meters to nanometers
gram (g) to kilogram (kg) and kilogram to gram

(2)
Celcius (°C) to Kelvin (K)
atmospheres (atm) to Pascals (Pa)
Liters (L) to cubic meters (m^3)

Metric Prefixes

Tera	10^{12}	T
Giga	10^{9}	G
Mega	10^{6}	M
Kilo	10^{3}	k
Hecto	10^{2}	h
Deca	10^{1}	da
Deci	10^{-1}	d
Centi	10^{-2}	c
Milli	10^{-3}	m
Micro	10^{-6}	μ
Nano	10^{-9}	n
Pico	10^{-12}	p

(1) One Simple Method for Converting SI Prefixes:
Where you see the prefix, simply replace with the exponential notation
Example:

600 nm
From above chart: nano = 10^{-9}
600 x 10^{-9} m

(2) Factor Label Method for Converting Units (*preferred!*):

Example: 150 yards to inches

$$\frac{150\ yards}{} \times \frac{3\ feet}{1\ yard} \times \frac{12\ inches}{1\ foot} = 5400\ inches$$

What if you don't know the conversion factors? Colleges (and employers) want students who can find their own information. Hint: try a good dictionary and look under measure or measurement. The internet can also help!

24. 4008 g = _____ kg

25. 2.1 km = _____ m

26. 823 nm = = _____ m

27. 298 K = _____ °C

28. 0.77 m = _____ cm

29. 8.8×10^6 m = _____ mm

30. 25.0 μm = _____ m

31. 2.65 mm = _____ m

32. 8.23 m = _____ km

33. 40.0 cm = _____ m

34. 6.23×10^{-3} m = _____ nm

35. 1.5×10^{11} m = _____ km

36. $\frac{60\ km}{hour}$ = _____ $\frac{m}{s}$

Section Five: Geometry Review

Solve the following geometric problems.

37. Line B touches the circle at a single point. Line A extends through the center of the circle.
    a. VOCAB: What is the line B in reference to the circle?

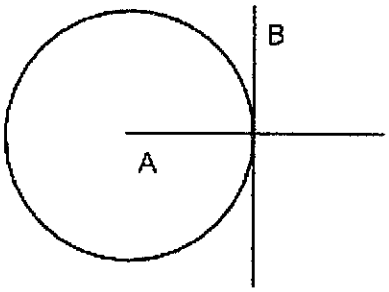
    _____

    b. VOCAB: What is A in reference to the circle?

    _____

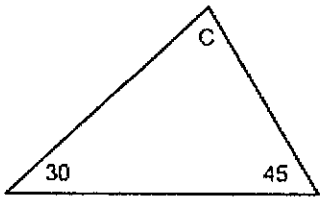
    c. How large is the angle between A and B?

    _____



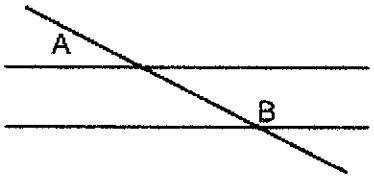
38. What is angle C?

    _____



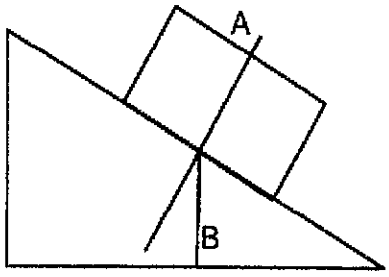
39. If Angle A is 30°, what is angle B?

    _____



40. If Line A is perpendicular to the ramp, and Line B is perpendicular to the bottom of the ramp, and the incline of the ramp is 30°, what is the angle between Lines A and B?

    _____



41. The radius of a circle is 5.5 cm.
    a. What is its circumference in meters?

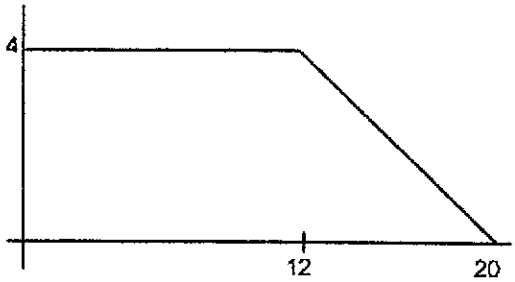
    _____

    b. What is its area in square meters?

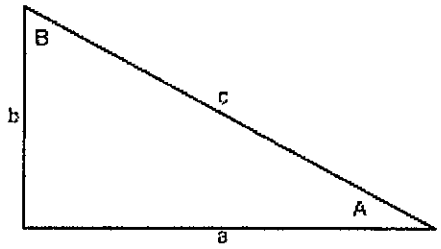
    _____

42. What is the area of the space enclosed between the plotted line on the graph and the x and y axes at the right?

    _____



Using the generic triangle to the right, Right Triangle Trigonometry and the Pythagorean Theorem, solve the following. (*Your calculator must be in degree mode!)*



43. If A = 55° and c = 32 m, find sides a and b and angle B

44. If A = 45° and a = 15 m/s, find sides b and c and angle B

45. if a = 3 N, and b = 6.5 N, find angle A and B and side c

46. if c = 40 m, and b=35m, find angle A and B and side c

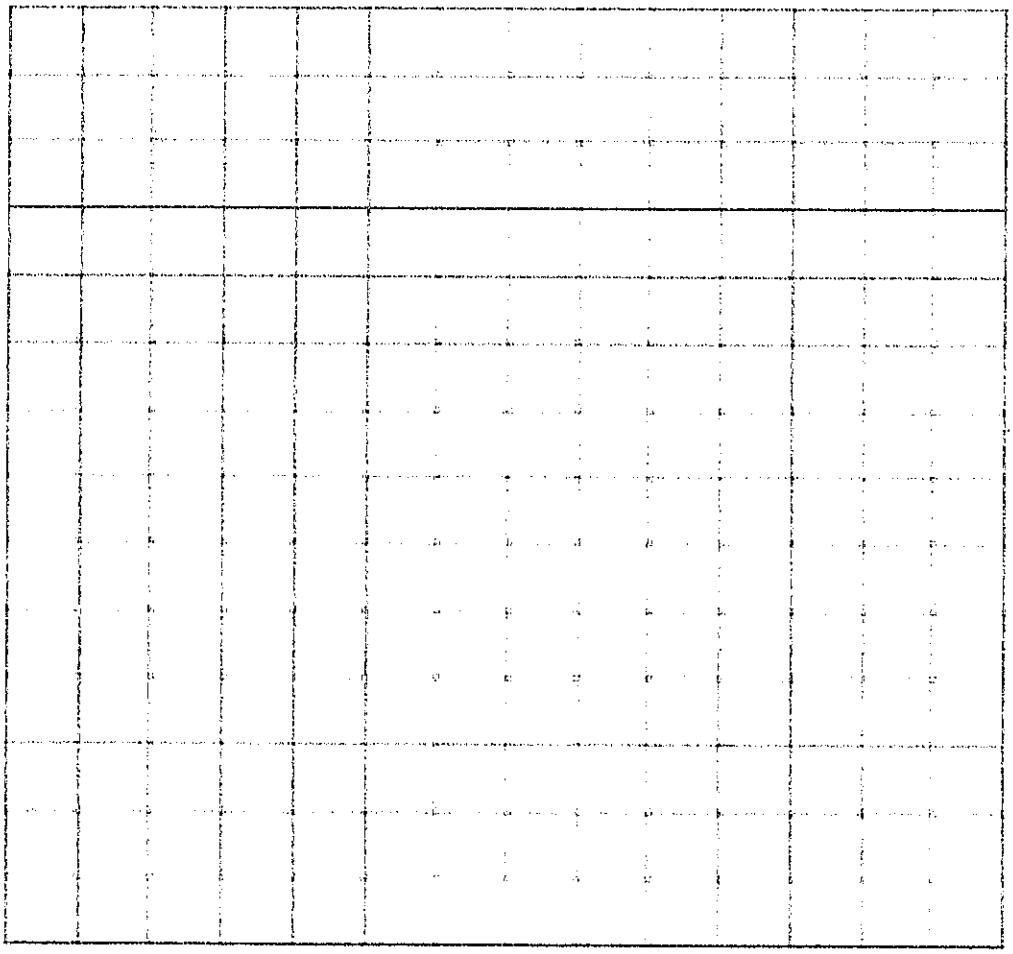
Section Six: Graphical Analysis

Time (s)	Distance (m)
0.0	0
1.0	5.1
2.0	9.9
3.0	15.2
4.0	25.2

You should be familiar with graph construction (both by hand on graph paper and on a computer). Graphing is a topic that often appears on AP exams and will be required in many labs.

Note: When you are told to graph Apples vs. Oranges, the 1st thing goes on the y-axis, the second thing on the x-axis.

Using the following table, plot the points on the grid below as distance vs. time. Be sure to correctly label the graph (axis labels, units and title).



Now use a computer to plot the graph. Record the equation of the best-fit line and the R^2 or RMSE value. (Attach the printed graph to this packet.)

What is the slope of the line you plotted as determined by the computer?

_____

Section Seven: Problem Solving Methodology

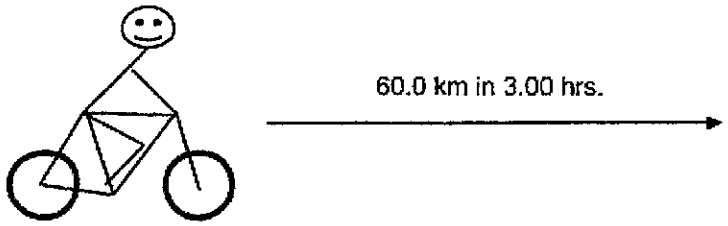
In Physics, problems can become complicated very quickly. Therefore, we utilize a Problem Solving Methodology to give us a step-by-step process to solve problems. You will use this process for solving all problems during the year. There are ten steps to this process. They are:

1. **Read** the problem.
2. Create a meaningful **Diagram.**
3. List all **Variables** and associated **Values** (with units).
4. **Convert** any units to the base units (MKS).
5. Select the appropriate **Formula(s).**
6. **Rearrange** the formula to solve for the appropriate variable.
7. **Substitute** values for variables (with units).
8. **Solve** for the proper answer (with units).
9. Adjust your answer to have the appropriate number of **Significant Figures.**
10. **Circle** your final answer (with units).

For example: Susie rides her bike for 60.0 km in 3.00 hours. What was her average speed?

Step 1: Read the problem. (Done!)

Step 2: Create a meaningful diagram:



Step 3: List all values and associated variables

$x = 60.0\ km$

$t = 3.00\ hr$

Step 4: Convert any units to the base units (MKS).

$\frac{60.0\ km}{} \times \frac{1000\ m}{1\ km} = 6.00 \times 10^4 m$

$\frac{3.00\ hr}{} \times \frac{60\ min}{1\ hr} \times \frac{60\ sec}{min} = 1.08 \times 10^4 s$

Step 5: Select the appropriate formula(s).

$x = vt$

Step 6: Rearrange the formula to solve for the appropriate variable.

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

Step 7: Substitute values for variables.

$v = \frac{6.00 \times 10^4\ m}{1.08 \times 10^4 s}$

Step 8: Solve for the proper answer.

$v = 5.555555555555556 \frac{m}{s}$

Step 9: Adjust your answer to have the appropriate number of significant figures.

$v = 5.56 \frac{m}{s}$

Step 10: Circle your final answer.

$v = 5.56\ m/s$

Using the Problem Solving Methodology, solve the following problems.

47. Pete walks at a rate of $4.0\frac{mi}{hr}$ for 30 minutes in the same direction. How far did he walk?

48. What is your weight on Mercury? The formula you will need is $F_g = G\frac{m_p m_{you}}{r_p^2}$, where $G = 6.67 \times 10^{-11} N\frac{m^2}{kg^2}$, m_p is the mass of Mercury (look it up!), r_p is the radius of Mercury (look that up too!), and m_{you} is your mass (not weight).

49. A cylinder with a radius of 8.0 cm is held at a constant temperature of 293 K and pressure of 2.0×10^5 Pa. If there are 0.53 moles of gas and the relationship between the variables is PV=nRT where $R = 8.31\frac{J}{mol \cdot K}$, find the height of the cylinder.

50. Susie pulls a 23.2 kg box to the right with a force of 53.2 N, and Joey pulls the same box to the left with a force of 30.5 N. What is the total force on the box from Susie and Joey (magnitude and direction)? Since Isaac Newton discovered that $F = ma$, what is the acceleration of the box (magnitude and direction)?

51. A standard Blu-Ray player consumes 96W of power and a flat-screen TV consumes 131 W. For simplicity sake, let's say you watch one 2-hour movie every day for a year, during which time your electrical company charges $0.12 / kW-hr for the energy used. If energy is calculated by E=Pt, how much does the electricity for your movie habit cost in one year?

52. Joe walks 5 blocks east, and then turns around and walks 7 blocks west. How far did Joe walk? What is his displacement from his starting point?
(Draw Scale vector diagrams)

53. Francine drives 20 miles east, and then turns and drives 15 miles north. How far did Francine drive? What is her displacement from her starting point?

54. Jackson walks 5 blocks east, turns and walks 6 blocks north, turns and walks 2 blocks west, turns and walks 7 blocks south, and finally walks 10 blocks east. How far did Jackson walk? What is his displacement from his starting point?