AP Physics 1 – Summer Assignment

Welcome to AP Physics 1! We are looking forward to having you in class this year and sharing our excitement for physics with you.

AP Physics 1 is an algebra-based course that relates matter and energy in order to understand physical phenomena. This course will enable you to improve your critical thinking, physical intuition, and problem solving skills. Among the topics we will cover this year are: motion, force, energy, momentum, rotation, simple harmonic motion, waves, electricity, and circuits.

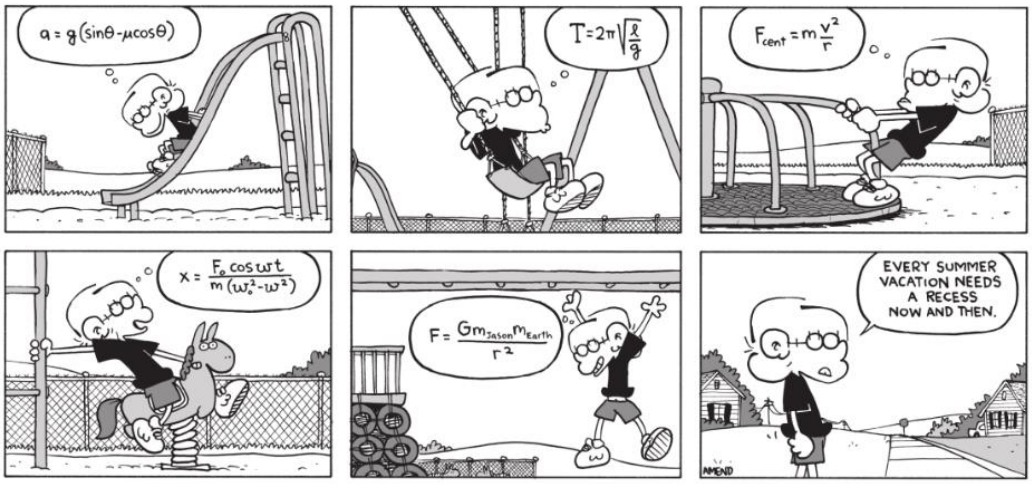
You will receive a textbook for the course in September. The textbook for this course is *College Physics* by Etkina, Gentile, and Van Heuvelen.

This summer assignment contains two parts. Part 1 is a review of science and mathematics topics necessary to be successful in AP Physics 1. Part 2 requires you to perform two experiments, collect data, analyze data, and discuss your results.

Both parts are will be **graded for correctness** and are due **the first day of school, September 7, 2017**, or you will earn a zero.

Mrs. Kate Mercurio
katharinemercurio@hvrsd.org

Mr. David Wilson
davidwilson@hvrsd.org



Foxtrot by Bill Amend

Name: _____

Part 1: Science and Math Basics

For all problems, show your work in the space below the problem. I am interested in your problem solving method as well as your answer. ***You will be graded on both.***

Base Units

mass	kilogram (kg)
length	meter (m)
time	second (s)
electric current	ampere (A)
temperature	kelvin (K)
amount of substance	mole (mol)
luminous intensity	candela (cd)

Metric Prefixes

mega- (M-)	**10^{6}**	**1 million**
kilo- (k-)	**10^{3}**	**1 thousand**
centi- (c-)	**10^{-2}**	**1 hundredth**
milli- (m-)	**10^{-3}**	**1 thousandth**
micro- (μ-)	**10^{-6}**	**1 millionth**
nano- (n-)	**10^{-9}**	**1 billionth**

SI Units – Units are important both in communicating answers and solving problems. Understanding how units relate to each other will help you solve problems and check your answers. Read background information on SI Base Units from the NIST website (http://physics.nist.gov/cuu/Units/units.html).

- Frequency is given by the following expression: frequency = speed / wavelength
  Determine the base units for frequency. (Hint: wavelength is a length measurement.)

- Speed is given by the following expression: $speed = \frac{distance}{time}$. Determine the base units for speed.

- Momentum is given by the following expression: $momentum = mass * speed$. Determine the base units for momentum.

- In Einstein's famous equation $E = mc^2$, m is mass, c is the speed of light, and E is energy. Using unit analysis, determine the base units for energy (also called the Joule).

Dimensional Analysis– Sometimes the units given in a problem or collected in the lab are not the most convenient or useful. It is important to be able to convert from one set of units to another. Use dimensional analysis to solve the following problems. (Take a look at this link for background information if you need it. (http://www2.southeastern.edu/Academics/Faculty/wparkinson/help/dimensional_analysis/)

- The speed of light, *c*, is 3.00×10^8 m/s. What is it in mi/hr? Express this in scientific notation. (There are 1609 m in a mile.)

- How many mg are there in 45 kg?

- Convert 37 cm^3 to m^3.

- Convert 1.5×10^5 fathoms/lunar month to meters/second. (1 lunar month lasts 29 days, 12 hours, 44 minutes and 3 seconds.)

- Order the following measurements from *smallest to largest*. Note that I am *not* asking you if *one* second is longer or shorter than *one* ns, but if 4×10^{-3} s is longer or shorter than 3.6 ns.
  A) 0.008 μs B) 3.6 ns C) 3×10^{-10} Ms D) 4×10^{-3} s

- If light travels at 3.00×10^8 m/s, how long does it take light from our Sun, 1.5×10^{11} m away, to reach Earth? Express this in minutes.

Algebraic Equations– Solving algebraic equations is a critical skill required to interpret relationships between physical quantities as well as to solve for a particular value.

- Solve the following equations for the specified variable.

a. Solve for a: $v_f = v_i + at$ _____

b. Solve for v: $F_c = \frac{mv^2}{r}$ _____

c. Solve for m_1: $F = \frac{Gm_1m_2}{r^2}$ _____

d. Solve for g: $T = 2\pi\sqrt{\frac{l}{g}}$ _____

e. Solve for x: $E = \frac{1}{2}kx^2$ _____

f. Solve for v_i: $\Delta x = v_i t + \frac{1}{2} a\, t^2$ _____

Algebraic Relationships

For the following equations, fill in the blank to explain how the variables relate to each other. For 12-14 use words like increases, decreases, or stays the same.

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

    i. As *x* increases and *y* stays constant, *z* _____.

    ii. As *y* increases and *x* stays constant, *z* _____.

    iii. As *x* increases and *z* stays constant, *y* _____.

- $c = ab$

    i. As *a* increases and *c* stays constant, *b* _____.

    ii. As *c* increases and *b* stays constant, *a* _____.

    iii. As *b* increases and *a* stays constant, *c* _____.

- $p = m\sqrt{n}$

    i. As *n* increases and *m* stays constant, *p* _____.

    ii. As *p* increases and *n* stays constant, *m* _____.

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

    i. If *s* is tripled and *t* stays constant, *r* is multiplied by _____.

    ii. If *t* is doubled and *s* stays constant, *r* is multiplied by _____.

Name: _____

Part 2: Experiments

Experiment 1: Rolling Marbles

For this experiment, you will roll a marble off of a ramp and record the time it takes to travel a range of distances.

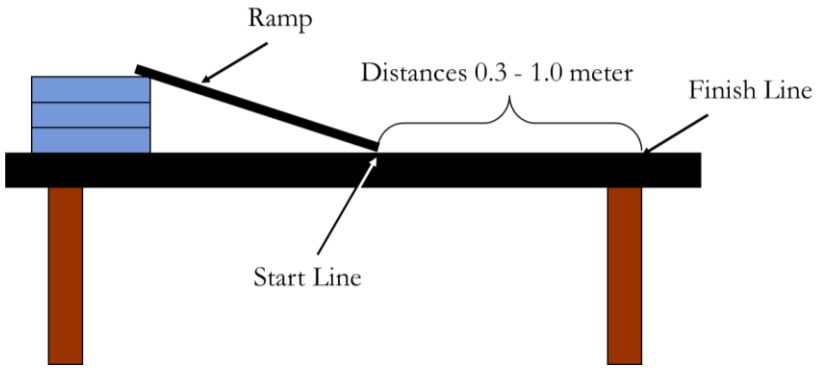
1. Identify the independent and dependent variables. Be sure to include units.

   independent variable _____ dependent variable _____

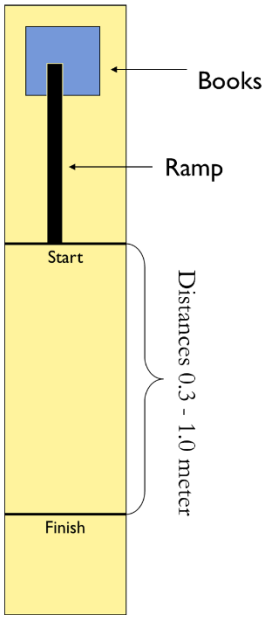
2. Name at least two quantities that you will hold constant.

3. Procedure

The Set Up (Side View)



The Set Up (Top View)

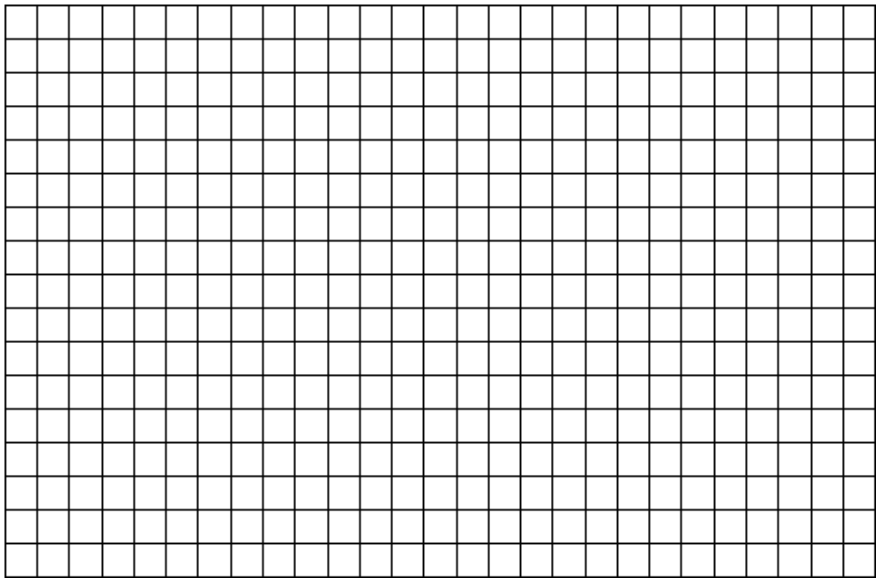


1. Create a ramp by propping up a straight, flat surface about 4 inches high.
2. Measure out the first distance from the end of the ruler.
3. Release the marble from the top of the ramp.
4. Time how long it takes for the marble to travel from the start line to the finish line. Repeat for 3 trials.
5. Change the distance, testing 5 distances in the range of 0.3 – 1.0 meters.

- **Hint** - Good timing is important for accurate results. You may time by hand, but try to be as accurate as possible. Another option is to use a stopwatch/timer and record a video. Place a stopwatch/timer behind the path the marble will travel and start it when the marble hits the table. Record a video that shows the finish ilne. When you play back the video, pause the video when the marble crosses the finish line and note the time on the stopwatch.

4. Record the data you collect in a table. (Don't forget units!)

5. Make a graph of dependent variable vs. independent variable. (Dependent goes on the y-axis and independent on the x-axis.)



6. Carefully draw a best-fit line. Determine the slope and y-intercept of the line. Write the equation of the line in slope-intercept form ($y = mx + b$).

7. In a few sentences, describe the relationship displayed in your graph.

Experiment 2: Dropping Pennies

For this experiment, you will drop a penny from 6 different heights and record the time it takes to hit the ground.

- Identify the independent and dependent variables. Be sure to include units.

  independent variable _____ dependent variable _____

- Name at least two quantities that you will hold constant.

- Procedure

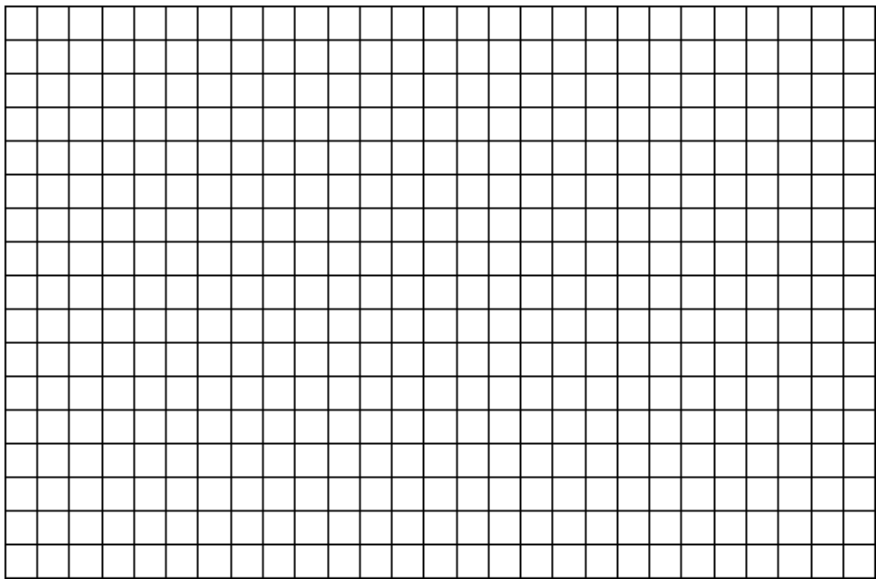
  - Develop a procedure that will allow you to vary the starting height and measure the drop time of the penny. Your procedure should be specific and repeatable. You will need to perform multiple trials for each height and test at least 6 heights (at least one greater than 1.5 meters).

  - Good timing is important for accurate results. If you plan to time by hand, you must perform at least three trials for each height. Another option is to use a stopwatch/timer and record a video. Place a stopwatch at the landing location and start it when the penny is released. Record a video of the landing location. When you play back the video, pause the video at impact and note the time on the stopwatch. You might want to ask a friend, sibling, or parent for help when you get to higher heights.

  Record your procedure here in a list of numbered steps.

- Record the data you collect in a table. (Don't forget units!)

- Make a graph of dependent variable vs. independent variable. (Dependent goes on the y-axis and independent on the x-axis.)



- In a few sentences, describe the relationship displayed in your graph.

- Do you think you would find different results if you drop a quarter instead of a penny? Support your answer.