Dear future AP Physics 1 students,

We are very excited to have you in AP Physics next year! These classes are Algebra 2/Trigonometry-based, first year college physics course. They are a very rigorous class that non-engineers take as freshman. Physics is the study of the physical world from the small (quarks) to the infinite (the universe). In this class, we will be learning material roughly equivalent of more than a semester of college courses with labs. That means that if you pass the AP exam, you could earn college credits!

To get you ready for this rewarding endeavor, it's time to brush up on some math. While physics is different from math, it will be very useful tool to our studies. In order for you to succeed in Physics, you will need to be able to express and manipulate your thoughts in mathematical terms.

All of the math included here should be familiar to you from your previous ***required*** math courses (*Algebra and Geometry*). Take time this summer and complete this packet. Do the assigned problems on a sheet of paper and show all work. If you struggle with any problems, be sure to get comfortable with the problems.

We are also including ***Khan Academy*** links for videos on how to do these problems.

In the fall, we will expect that you'll know how to tackle these problems and we can focus our energy on physics.
Be prepared to have completed this by August 13, the first day of class!

What if I don't have you until the spring?

In the spring, we will expect that you'll know how to tackle these problems and we can focus our energy on physics.
Be prepared to have completed this by January 7, the first day of class!

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

A. Simply do the best you can, but show some work / effort.

B. Come to class the first day with your questions, in order to resolve these issues prior to
   the test.

C. The problems in the following pages are representative of what we expect you to be able to do when you walk in the door. Weaknesses in a few areas CAN be overcome but the bulk of the responsibility rests on your shoulders. You help yourself by doing as much as possible on your own.

AP Physics 1 Basic Algebra Review

The exercises below are a review of the prerequisite math skills that you need to succeed in AP Physics 1. Make sure to read all directions throughout the packet. Final answers can be in fractions and in terms of mathematical constants (π, e, i, etc.). Use a math book or internet for reference. No physics is needed for this review. If you have difficulty, please do not hesitate to email me at murphyka@lisd.net or ramirezm@lisd.net

In 2015, the head grader for the AP physics test stated that "Basic algebra was often weak". These problems are examples of what College Board considers basic algebra, and can be solved with only the knowledge of Algebra 1, Geometry and Chemistry. Very little time will be devoted to re-teaching these concepts, so any gaps will have to be covered outside of class during your own time.

Significant Figures and Scientific Notation Review

1.) How many significant figures do the following numbers have?

   a.) 6.001   d.) 27.00

   b.) 0.0080   e.) π

   c.) 206,000

Directions: Find the following with a calculator. Final answers should be in scientific notation with the correct number of significant figures.

2.) $(5.0 \times 10^{-8})(2.9 \times 10^{2})$ 3.) $\left(3.25 \times 10^{4} + 7.4 \times 10^{3}\right)$

4.) $6.000 \times 10^{-11} \dfrac{1.00 \times 10^{26}}{2.00 \times 10^{7}}$ 5.) $\dfrac{8400}{1.2 \times 10^{7}}$

Unit Conversions Review (basic stoichiometry)
There are videos on Khan Academy (don't be upset that they are listed for the 4th grade!)
https://www.khanacademy.org/math/cc-fourth-grade-math/cc-4th-measurement-topic

6.) 16.7 kilograms is how many grams?

7.) 560 nm is how many meters?

8.) 15 years is how many seconds?

9.) 8.99×10^{9} seconds is how many years?

10.) 2.998×10^{8} m/s is how many kilometers per hour?

11.) Finish the SI prefix table below. Follow the example of the centi- prefix. You will need to memorize these.

Symbol	Name	Numerical Equivalent
n		
μ		
m		
c	centi	10^{-2}
k		
M		
G		

Geometry/Trigonometry Review
https://www.khanacademy.org/math/geometry/right_triangles_topic/cc-geometry-trig/v/basic-trigonometry

Directions: Use the figure below to answer problems 15-25. Simplify as much as you can. Remember that there are special triangles rules that can help you.
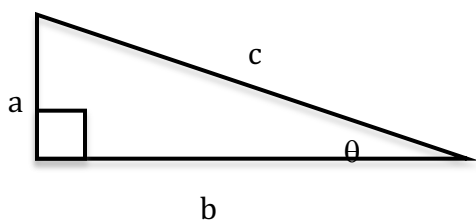
12.) Find c if given a and b.   13.) Find a if given b and c.

14.) Find a if given c and θ.   15.) Find b if given a and θ.

16.) Find c if given b and θ.   17.) Find θ if given b and c.

18.) Find θ if given a and b.   19.) If $a = 2.0$ and $c = 7.0$, what is b?

20.) If $c = 10.0$ and $\theta = 60°$, what is b?   21.) If $a = 12.0$ and $\theta = 30°$, what is b?

Algebra Review

Directions: Physics problems are often done with variables only. Solve the following equations for the variable given with the conditions given. Simplify if needed. Don't let the different letters confuse you. Manipulate them algebraically as though they were numbers.

Example: $2x + xy = z$. Solve for x.

$$x(2 + y) = z$$

$$\boxed{x = \frac{z}{2 + y}}$$

22.) $v_1 + v_2 = 0$. Solve for v_1.

23.) $a = \frac{v}{t}$. Solve for t.

24.) $v_f^2 = v_i^2 + 2ad$

    A.) Solve for v_i.

    B.) Solve for d.

25.) $d_f = d_i + v_o t + \frac{1}{2}at^2$

    A.) Solve for v_o.

    B.) Solve for t, if $v_o = 0$.

    C.) Solve for t, if $d_i = d_f$.

26.) $F = m\frac{v_f - v_i}{t_f - t_i}$

    A.) Solve for v_f, if $t_i = 0$.

    B.) Solve for t_f, if $v_f = 0$ and $t_i = 0$.

27.) $a_c = \frac{v^2}{r}$. Solve for v.

28.) $mg\sin\theta = \mu mg\cos\theta$. Solve for θ.

29.) $\frac{1}{2}mv_f^2 + mgh_f = \frac{1}{2}mv_i^2 + mgh_i$

    A.) Solve for h_f, if $h_i = 0$ and $v_f = 0$.

    B.) Solve for v_f, if $h_f = 0$.

30.) $Ft = mv_f - mv_i$. Solve for v_f.

31.) $m_1 v_{i,1} + m_2 v_{i,2} = (m_1 + m_2)v_f$. Solve for $v_{i,2}$.

32.) $m_1 v_{i,1} + m_2 v_{i,2} = m_1 v_{f,1} + m_2 v_{f,2}$. Solve for $v_{f,2}$ if $v_{i,1} = 0$.

33.) $(F_1 \sin\theta)r_1 + (-F_2 \sin\phi)r_2 = 0$. Solve for r_2.

34.) $-kx + m(-g) = 0$. Solve for m.

35.) $F_g = G\dfrac{m_1 m_2}{r^2}$. Solve for r.

36.) $L - L\cos\theta = \dfrac{v^2}{2}$ Solve for L.

37.) $\dfrac{mv^2}{R} = G\dfrac{Mm}{R^2}$. Solve for v.

38.) $T = 2\pi\sqrt{\dfrac{L}{g}}$. Solve for g.

39.) $\dfrac{1}{2}mv_f^2 + \dfrac{1}{2}kx^2 = \dfrac{1}{2}mv_i^2 + mgh_i$. Solve for x if $v_f = 0$.

40.) $\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$. Solve for R_T.

Miscellaneous

Directions: Simplify without using a calculator. Remember to show all of your work.

41.) $\dfrac{1}{4} + \dfrac{1}{6}$

42.) $\dfrac{1}{3} + \dfrac{1}{18}$

43.) Consider $z = \dfrac{x}{y}$, $c = ab$, $l = m - n$, or $r = \dfrac{s^2}{t^2}$.

a.) As x increases and y stays constant, z _____.

b.) As y increases and x stays constant, z _____.

c.) As x increases and z stays constant, y _____.

d.) As a increases and c stays constant, b _____.

e.) As c increases and b stays constant, a _____.

f.) As b increases and a stays constant, c _____.

g.) As n increases and m stays constant, l _____.

h.) As l increases and n stays constant, m _____.

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

j.) If t is doubled and s stays constant, r is multiplied by _____.

Systems of equations
There are several Khan Academy videos on systems of equations; look under systems of equations in Algebra 2: https://www.khanacademy.org/math/algebra2/systems_eq_ineq
Conceptual Question:
42.) How many equations are needed to solve…
    a.) for 1 unknown variable? _____
    b.) for 2 unknown variables? _____
    c.)   for 3 unknown variables? _____

Use the equations in each problem to solve for the specified variable in the given terms. Simplify.
43.) $F_f = \mu F_N$ and $F_N = mg\cos\theta$. Solve for μ in terms of F_f, m, g, and θ.

44.) $F_1 + F_2 = F_T$ and $F_1 \cdot d_1 = F_2 \cdot d_2$. Solve for F_1 in terms of F_T, d_1, and d_2.

45.) $F_c = ma_c$ and $a_c = \dfrac{v^2}{r}$. Solve for r in terms of F_c, m, and v.

46.) $T = 2\pi\sqrt{\dfrac{L}{g}}$ and $T = \dfrac{1}{f}$. Solve for L in terms of π, g, and f.

Graphing Equations
Khan academy: https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-geometry-topic/cc-5th-coordinate-plane/v/graphing-points-exercise
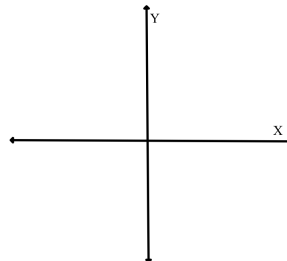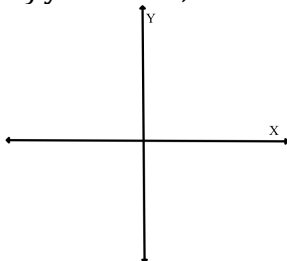https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-slope/v/slope-of-a-line

47.) If $r = c - x*t$ was graphed on an r vs. t graph, what would the following be?
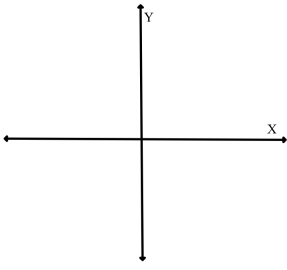   Slope: _____   y-intercept: _____

48.) On the y vs. x graphs below, sketch the relationships given.

a.) y = mx + b, if m > 0 and b = 0.   b.) y = mx + b, if m < 0 and b > 0.

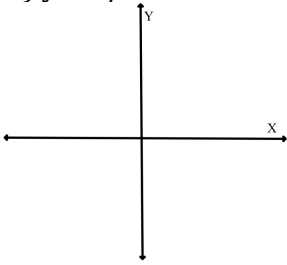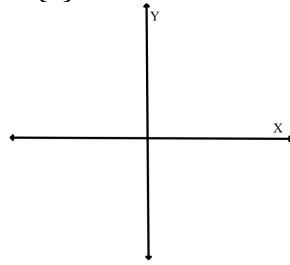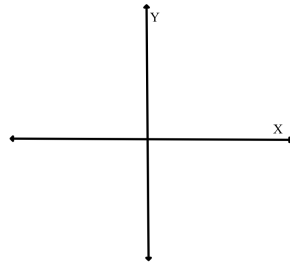c.) y = x²   d.) $y = \sqrt{x}$

e.) y = 1/x

f.) y = sin(x)

Marbles in Cylinder Lab

You received a graduated cylinder with three identical marbles and an unknown amount of water already in it. You placed extra identical marbles in the cylinder and obtained the data below. Use the data to graph a best-fit line showing the relationship between the water level and the number of marbles. The y-intercept should be visible on the graph. Label your axes and include units.

From the graph, determine a mathematical formula for the water level for any number of marbles. Lastly, give an explanation of your formula in words. Make sure to give an explanation of the slope and y-intercept of your formula.

49.) Graph below

Number of Marbles in Water	Water level (mL)
3	58
4	61
5	63
6	65
7	68
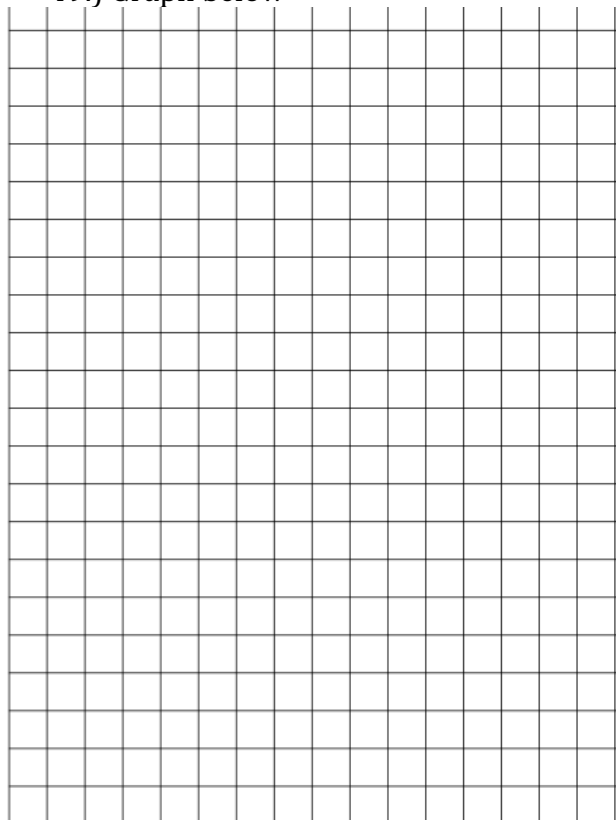
50.) Formula: _____

51.) Explanation of the formula in words: (Include the meaning of the slope and y-intercept.)