Welcome to AP Physics 1! This summer packet is intended as a warm-up before we get going in September. Please do the packet during the last week of the summer, any earlier and it is not really a warm-up.

This 8-page packet is broken into sections. If you need review for a section, please see the Khan Academy video lesson provided or find something you like on your own.

This packet should be prepared to be submitted in class on the first day of school. You do not need to print it, an assignment will be posted for this purpose.

If this is your first AP course you should go to https://myap.collegeboard.org/login and create an account (*you may already have one*) and then navigate to https://apcentral.collegeboard.org/pdf/ap-physics-1-course-and-exam-description.pdf?course=ap-physics-1-algebra-based for a description of what we will study. Our priority is learning good Physics followed by helping you to prepare for the AP Physics 1 exam in early May 2023.

Parts of this summer assignment and their review videos:

Part I: Right Triangles –
https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-intro/v/basic-trigonometry-ii

Part 2 : Graph Reading –
https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/position-vs-time-graphs

Part 3 : Metric Units –
https://www.khanacademy.org/math/4th-engage-ny/engage-4th-module-2/4th-module-2-topic-a/v/metric-distance

Part 4 : Making Graphs –
https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/v/fitting-a-line-to-data

Part 5 : Scientific Notation –
https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-scientific-notation/v/scientific-notation-old

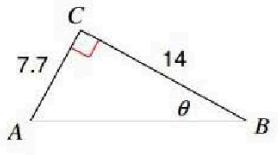
Part 6 : Algebraic Relationships and Solving Equations -
https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:manipulating-formulas/v/rearrange-formulas-to-isolate-specific-variables

If you are especially anxious to get started in Physics, I suggest you look at two things: 1) your free on-line OpenSTX textbook "College Physics", we will use this as our official course book; and look at the edX open course in Physics - https://courses.edx.org/courses. Neither of these is required, but they are available.

AP Physics 1 – Summer Assignment Name_____

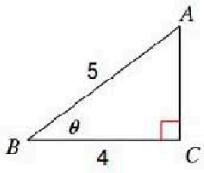
Part I: Right Triangles – Right triangle geometry is used in AP Physics 1 **- f**ind the measure of the angle or side indicated. Please show all of your work. Use SOH-CAH-TOA and the Pythagorean Theorem.

1) Find θ



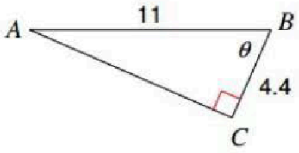
θ = _____

2) Find θ



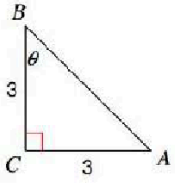
θ = _____

3) Find θ



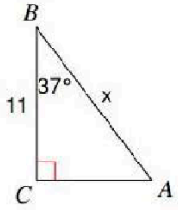
θ = _____

4) Find θ



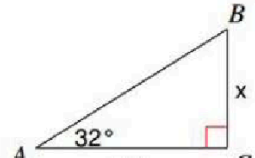
θ = _____

5) Find x



x = _____

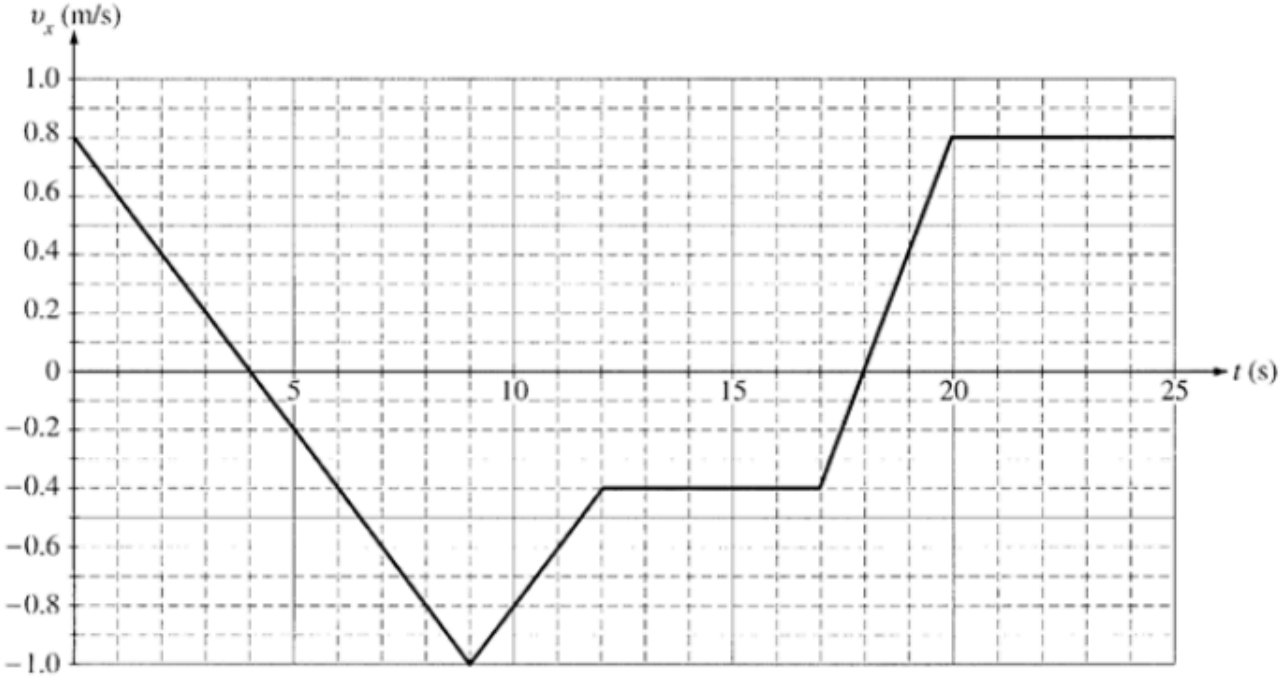
6) Find x



x = _____

Part 2 : Graph Reading – We work with graphs regularly in AP Physics 1 – answer the questions AND NEATLY annotate the graph to show how you arrived at your answers.

This graph illustrates the horizontal velocity, v_x, of a cart moving along a straight and level track during a period of time. Assume movement to the right is assigned the positive direction.



1) When was the cart at rest? *("At rest" in Physics means the velocity of the object is 0 meters per second even if only for an instant.)* On the graph, circle when this occurs and label the time.

2) Calculate the slope of the first segment of the graph from 0-9 seconds. First write out the equation for calculating slope and then show your work from start to finish. Annotate on the graph what you did to determine the slope.

3) In regards to the velocity of a cart on a level horizontal track, what would a zero slope indicate about the movement of the cart? What does a positive slope indicate? A negative slope?

4) Label on the graph when the cart is moving right, when it is moving left, when it is increasing its velocity, when it is moving at a constant velocity, when its velocity is decreasing.

5) Calculate the area under the line from 20-25 seconds (show work on graph) – the resulting answer tells you something about the movement of the cart during that time interval. Explain what that is and how you know.

6) There is a difference between velocity and speed, even though you might use them interchangeably outside of Physics. Compare and contrast "speed" and "velocity".

7) The rate at with velocity changes is called _____. Using information available on the graph, what calculation can you do that will determine this quantity? (*You are not doing the calculation here, you are just telling me what the calculation is.*)

Part 3 : Metric Units – We work with metric units by default in AP Physics 1 – answer the following questions concerning the important units in Physics. Important symbols are shown the first time the unit or prefix is mentioned.

1) The metric unit of _____ is the meter (m); 1 kilometer (km) = _____=

_____ centimeters (cm) = _____ millimeters (mm).

2) Our classroom is 8.31 m long. This is equal to _____cm, _____ km,

and _____ mm.

3) The most used metric unit of _____ is the kilogram (kg); the "k" in kg means

that there are _____ of whatever follows the "k". 2.5 kg = _____ grams (g).

4) The metric unit for time is the _____ (___). How many of these are in an average human lifetime? Show your work and state your assumptions.

The Fundamental units in Physics are the meter, kilogram, and second. These are the units that all other units are based on. A derived unit is one that is based on fundamental units and an example is meters per second (m/s), the unit for speed.

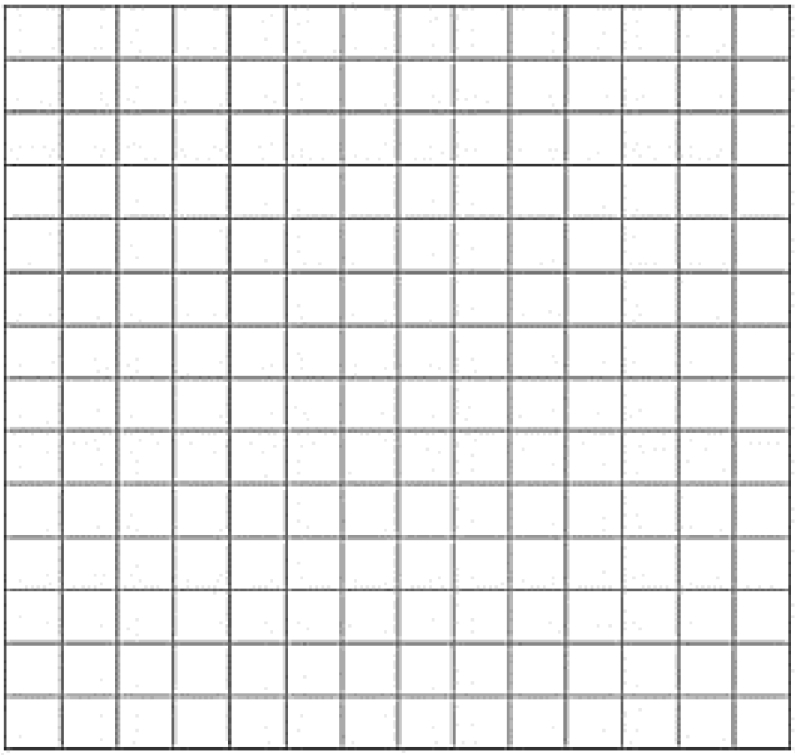
The unit of force we use in Physics is the "Newton", named after the famous physicist. It is defined as the amount of force that will make 1 kg of mass change its velocity by 1 m/s in a 1 s period of time.

5) What is the derived unit for the Newton (N)?

Part 4 : Making Graphs – We often make graphs in AP Physics to look for predictable relationships between variables. Answer the following questions regarding the use of graphs.

1) You have been asked by your teacher to measure the diameter, radius and circumference of some round objects, such as tin cans, lids, CD's, coins, etc. You have collected the measurements and recorded them in this table. Graph the data on the grid provided. Choose the correct independent (x) and dependent (y) variables, choose an appropriate and consistent scale, label the axes, and plot the points.

Radius (cm)	Circumference (cm)
1.1	3.5
3.2	10.0
4.8	15.1
8.8	27.5
9.6	29.9
12	37.6



2) Draw the line-of-best-fit, a single straight line that assumes a perfect linear relationship between the x & y variables even though the data may be imperfect. The line should come as close to all the points as possible, even though it may not go through any one point.

3) Find the slope of this line-of-best-fit. Annotate the graph to show what points you used. Show all your work, including the equation and all the steps to reach a final answer.

4) The equation for a straight line is y = mx + b. Write the specific equation for this graph using the appropriate symbols for radius and circumference in place of the x and y symbols.

5) There is a well-known name given to the slope of this line. What is that name and what is its special universal significance?

Part 5 : Scientific Notation - when using especially large or small numbers it is helpful to employ scientific notation or powers of ten notation. See the examples and answer the questions.

Examples: $200{,}000 = 2 \times 10^{5}$ $0.00000123 = 1.23 \times 10^{-6}$

Note – the first number, the coefficient, is always equal to or greater than 1 but less than 10. That is why the second example is 1.23×10^{-6}, not 12.3×10^{-5}.

1) Which of the following is written in proper scientific notation? *(Circle your answer*)

(A) 0.25×10^{3} (B) 2.5×10^{2} (C) 25×10^{1} (D) 250

Express the following numbers in scientific notation:

2) 86,400 s =

3) 300,000,000 m/s =

4) 0.000564 m =

5) 0.0000000000667 =

Convert from scientific notation to normal notation:

6) 9×10^{9} =

7) 1.93×10^{4} kg/m^{3} =

8) 1×10^{-3} m =

9) 4.5×10^{-7} m =

Multiplication and division with scientific notation:

11) $(2.5 \times 10^{8})(1.2 \times 10^{1})$ =

12) $(6.0 \times 10^{-2})(6.1 \times 10^{-2})$ =

13) $(1.8 \times 10^{3})(7.3 \times 10^{-8})$ =

14) $(5.5 \times 10^{9})(4.0 \times 10^{11})$ =

15) $(2.5 \times 10^{8}) / (1.2 \times 10^{1}) =$

16) $(6.0 \times 10^{-2}) / (6.1 \times 10^{-2}) =$

13) $(1.8 \times 10^{3}) / (7.3 \times 10^{-8}) =$

14) $(5.5 \times 10^{9}) / (4.0 \times 10^{11}) =$

Part 6 : Algebraic Relationships and Solving Equations - basic algebra is used throughout AP Physics 1 – it is an algebra based course. Answer these questions.

Consider the following: $z = x/y$ $c = ab$ $l = m\sqrt{n}$ $r = s^2/t^2$

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

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

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

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

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

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

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

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

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

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

The force of gravitational attraction between any two masses in the universe can be determined by Newton's Law of Universal Gravitation. The mathematical expression of the law is

$\mathbf{F_g = G (m_1) (m_2) / d^2}$ where F_g is the force of attraction, G is the universal gravitational constant, m_1 and m_2 are the two masses, and d is the distance between the masses.

Rearrange the equation above to solve for the following:

11) G =

12) d =

13) m_1 =

14) m_2 =

Directions: Use algebra to solve for the indicated variable. Please show all work. *Be careful to recognize that subscripts are used to identify variables and are bound to them, not manipulated algebraically*.

15) $\Delta V = IR$, solve for I

16) $v_f = v_o + at$, solve for a

17) $mgh = \frac{1}{2} mv^2$, solve for v

18) $\Delta x = v_o t$, solve for t

19) $v_f^2 = v_o^2 + 2a(x_f - x_0)$, solve for a

20) $T = 2\pi \sqrt{(l/g)}$, solve for g

21) $U_s = \frac{1}{2} kx^2$, solve for x

23) In the equation $F_g = G(m_1)(m_2) / d^2$ the units for F_g are Newtons (N), the units for both masses are kilograms (kg), and the units for distance are meters (m). Based on this, what should the units for "G" be? The answer will be expressed in terms of N, m, and kg.