Immaculate Conception High School

Summer Assignment

Physics Honors

* Email Ms. Lusamba if you have any questions: plusamba@ichspride.org

Directions: This assignment consists of two parts. Part 1 will take through the journey of the major concepts in Physics that we will be studying next year. Part 2 is a list of interactive videos investigating topics explored in Part 1. Complete the entire summer assignment by Wednesday September 04, 2019. For each part creates a new Google Doc and answer the questions on the Doc. Share these docs with Ms. Lusamba by the due date when completed.

Honors Physics Summer Assignment

Name : _____ Date: _____

Part one: Learning Concepts in Physics.

Concept 1: Scientific Notation Video reference: "Can you solve this?"
https://youtu.be/vKA4w2O61Xo?list=PL16649CCE7EFA8B2F

Scientist very often deal with very small and very large numbers, which can lead to confusion when counting zeros. We have learned to express these numbers as powers.
Scientific notation takes the form of M x 10n where $1 \leq M < 10$ and n represents the number of decimal places to be moved. Positive n indicates the standard form is a large number. Negative n indicates a number between zero and one.
Example: Convert 1,400,000 to scientific notation. We move the decimal point so that there is only one digit to its left, a total of 6 places. 1.4 x 106
Example: Convert 0.000025 to scientific notation. For this we move the decimal place 5 places to the right. 0.000025 = 2.5 x 10-5.

Concept 2: Significant figures

Significant figures in a measurement expression comprises all digits that known with certainty, plus one digit that is uncertain. PLACEHOLDERS ARE NOT SIGNIFICANT. Eg 0.0004 has 1 significant figure.
Rules for determining the number of significant figures in a given value:
1. All non-zero digits are significant.
2. All zeros between two nonzero digits are significant. (aka: sandwich rule)

Write the number in proper scientific notation.

(a) 410,000,000

(b) 0.00003650

2. Provide the proper response. (Note: use a calculator if you must, but you should also be able to complete both without using a calculator!)

(a) (3 x 107) * (6 x 10-12) =

b. (2 x 10-4) * (4 x 10-3) =

c (6 x 107) / (2 x 103) =

d. $\frac{(3 \times 10^{5})(8 \times 10^{-3})}{(2 \times 10^{14})(6 \times 10^{6})} =$

Algebra / Equation Manipulation For example, if F = ma, then a = F/m

3. Given the density equation D = M/V, rearrange the equation to obtain an expression for V.

4. Given the equation for work, W = Fx, and for power, P = W/t, solve for P in terms of F,x, and t. In other words, your final answer should be an equation for power with F, x, and t on the other side of the equals sign.

5. Given the following equation: x = vot + ½ gt2, where vo is equal to zero, solve for an expression for t, which is time (remember quadratic equation).

6. Given an expression for x(t), (read as "position as a function of time") use the quadratic formula to solve for time. Because this is a quadratic, you will get two answers. They are both correct. (We are solving for the time when x = 0. This object is thrown up in the air, so the times correspond to the object on the way up, and then on the way down):

$x(t) = -4.9t2 + 16t - 8$ (in which "x" is measured in meters)

7. Using the following data, prepare a graph depicting force (y-axis) vs. position (x-axis) (which is represented by "x").

Force (N)	x (m)
25	5.0
35	7.25
45	8.5
55	11.0
65	13.0
75	15.25
85	17.5
95	19.25
105	21.0
110	23.5

Determine the slope of the best fit line. We draw the best fit line as a way of representing the trend established by the data. (Excel does this for you in Graph options)

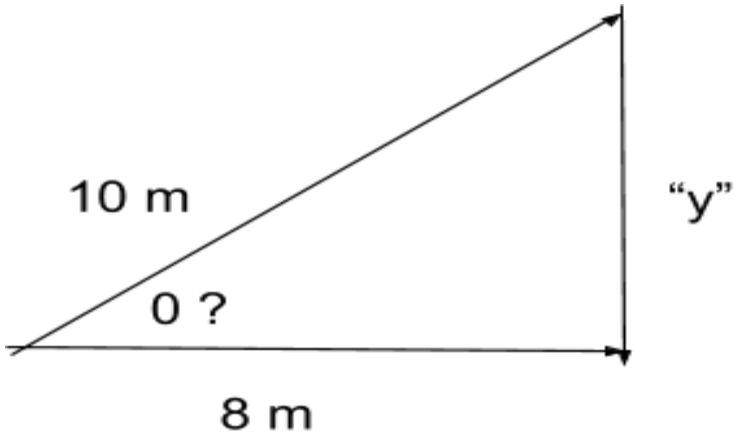
The data presented here represents the force required to stretch a spring; the more the spring I stretched, the bigger the force. The relationship is clearly linear and the slope of the line is called the force constant of the spring.

Record the force constant of the spring with proper units (the slope of the line): _____

Concept 3: Geometry

8. Given the legs of a right triangle as 20 cm and 35 cm, determine the hypotenuse of the triangle.

9. Given the following displacement triangle depicting two separate displacements being added together, determine the missing displacement, “y”, and determine the angle indicated by the “?.”



10. If you drove 5 miles East and then 8 miles North,
    a. how far away would you be from your initial location?
    b. 10 meters?
    c. 8 meters?

Concept 4: Algebra

A strong foundation of algebra will help you understand relationships between different quantities in Physics. This includes analysis of units. Unit analysis is really useful for checking your work. Keep in mind definitions such as (16 ounce in 1 pound). Use the following exercises for algebra exercise. Show all your work including definitions and algebraic manipulations.

1. How many seconds are there in one day?

2. A student is told the equation 3y = x represents the statement: “There are three times as many cars as pickup trucks in the parking lot.” She says, “The letter x represents the cars and the letter y represents the pickups.” What, if anything, is wrong? If something is wrong, identify and explain how to correct all errors. If this is correct, explain why.

3. A certain physics test, which is several pages long is copied on 20-pound paper (500 sheet have a weight of 20 pounds) so the weight per test is 0.25 pounds. The class has 39 students, so the instructor makes 40 copies of this test. What is the weight of the paper that she brings to the class on the test day?

A student say: “To find the total weight of the paper in the test I need to divide the 40 copies by the 0.25 test/pound, and that will give me 16 pounds”

The student’s analysis in the statement above is wrong. Identify the problem and explain how to correct it.

4. Solve for the following variables using the base equation show. Show all algebraic manipulations.
   a. G = 4mT Solve for T
   b. $Y = 2\square \sqrt{\frac{C}{G}}$ Solve C
   c. $4P = \frac{BmK}{L^2}$ Solve for L

Concept 5: Scientific Abilities

A large component of next year will explore your ability to think and express yourself like a scientist. Take this short exercise to refresh yourself on scientific abilities. Read the statements below and classify each into one of the three groups: Experimental evidence, Hypothesis, Prediction.

1. As the plants grow their mass increases.
2. The mass of the plants increases because you water them
3. The increase in the mass of the growing plant should be exactly equal to the decrease in the mass of the potting soil in a pot with a plant. Measure when the soil is dry.
4. The mass of the plants increases because they absorb carbon from the air.

5. The mass of the plants increases because they absorb nutrients from the soil.
6. The increase in the mass of the growing plant should be exactly equal to the mass of the water used to water the plant.
7. Explain how you understand the difference between the term experimental evidence, hypotheses, and prediction. Provide your own example of each.

Concept 6: Kinematics

The first topic we cover in Honors Physics is Kinematics, the study of motion. We will spend time learning the graphs and equations that describe the motion of an object.

The most basic of all kinematics problems is when an object is traveling at a constant velocity. Velocity is "distance traveled" divided by "time". The equation would be written like this:

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

$$a = \frac{Vf - Vi}{t}$$

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

a = acceleration in Meters per second squared (m/s^2)
v = velocity in Meters per second (m/s)
v_f= final velocity in Meters per second (m/s)
v_i = initial velocity in Meters per second (m/s)
d = distance traveled in Meters (m)

Let's try a few problems here … Don't worry if you don't get these right.

1. A car is traveling 30 m/s (meters per second (in physics we use metric units)). How much time does it take for the car to reach its destination, 115 km (kilometers) away? (Note: 1000 meters = 1 kilometer)

2. A person can run at 3 m/s. How many meters can they travel in 20 minutes? (Don't forget to convert 20 minutes into seconds.)

3. If a spaceship can travel 1000 meters in 2.3 seconds, what is its velocity?

4.A car traveling 35 km/hr accelerates to a speed of 45 km/hr in 0.25 hr. What is its acceleration?

5. A car accelerates from 25 mi/hr to 55 mi/hr in 0.0083 hr. What is its acceleration?

Concept 7: Newton's Laws of Motion

Refer the following videos about Newton's 3 Laws:
https://www.youtube.com/watch?v=5-ZFOhHQS68
https://www.youtube.com/watch?v=ou9YMWlJgkE
https://www.youtube.com/watch?v=By-ggTfeuJU

The movement of an object with respect to time, space and speed. Sir Isaac Newton is known for his many contributions to science by explaining the movement of objects according to 3 Laws

- Newton's 1st Law: An object will move at a constant velocity until a net force acts on it.
- Newton's 2nd Law: **F = ma**
    - F : The force exerted on an object in Newtons (N)
    - m : The mass of the object in Kilograms (kg)
    - a: acceleration in Meters per second squared (m/s^2)
- Newton's 3rd Law: Every action has an equal opposite reaction. **p = mv**

$$\mathbf{p_1 = p_2}$$
$$\mathbf{m_1v_1 = m_2v_2}$$

    - p: Momentum in (kg x m/s)
    - p_1 : Momentum of the first object n (kg x m/s)

- p_2 : Momentum of the second object n (kg x m/s)
- m: mass of the object in (kg)
- m_1: mass of the first object in (kg)
- m_2: mass of the second object in (kg)
- v: velocity/speed at which moves in (m/s)
- v_1: initial velocity in (m/s)
- v_2: final velocity in (m/s)

Let's try a few problems here … Don't worry if you don't get these right.

1. Your are pushing a friend on a sled. You push with a force of 40N. Your friend and the sled together have a mass of 80kg. Ignoring friction, what is the acceleration of your friend on the sled?

2. What is the momentum of a car with a mass of 1300 kg travelling at a speed of 28 m/s?

Concept 8: Energy

Another important topic you will cover next year is Energy: The ability to cause change. We will explore the change energy in both still and moving objects. 3 forms of energy will explored including, Kinetic, Potential, and Thermal

Kinetic Energy (KE): Energy in Motion. $KE = ½ mv^2$

v = velocity in Meters per second (m/s)
m: mass of the object in (kg)

Potential Energy (PE): Stored energy. $PE = mgh$

m: mass of the object in (kg)
g: acceleration due to gravity (9.8 m/s^2)
h : height in meters (m)

Thermal Energy (TE): $Q = mc\Delta T$

m: mass of the object in (kg)
c: Specific heat in J/kg ^0C
ΔT: Change in temperature ($T_f - T_i$) in ^0C
Q: Change in thermal energy in Joules (J)

Let's try a few problems here … Don't worry if you don't get these right. Try them.

1. A wooden block has a mass of 20 kg and specific heat of 1,700 J/(kg ^{0}C). Find the change in thermal energy of the block as it warms from 15 ^{0}C to 25 ^{0}C.

2. A Viking ship roller coaster at the fair has a mass of 36,000 kg. If at its peak it reaches a height of 20 m off the ground, how much gravitational potential energy does it have?

3. A baseball with a mass of 0.15 kg is moving at a speed of 40 m/s. What is the baseball's kinetic energy?

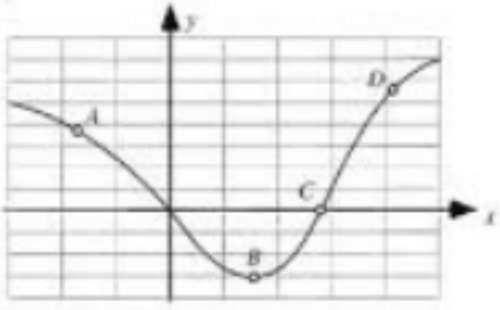
4. A jogger with a mass of 60 kg is moving at a speed of 3.0 m/s. What is the jogger's kinetic energy?

Concept 9: Graphing

Graphing is one of the most useful ways to represent and analyze data. Answer the following questions and show me your own graphing skills at the very end!

1. Compare Points on a Graph:

Four points are labeled on a graph.



Rank the slopes of the graph at the labeled points.

				OR			
1 Greatest	2	3	4 Least		All the same	All zero	Cannot determine

Explain your reasoning.

For this graph, you will need to collect data on the circumference and diameter of several circles in meters. Record at least 8 different data points in the table provided. Take a picture of your objects preferably gathered together and attach it to this summer assignment.

Trial	Object	Circumference (meters)	Diameter (meters)
1			
2			
3			
4			
5			
6			
7			
8			

a) Plot a graph to show the relationship if any between the circumference and diameter of the circular objects. Label each axis with the correct units.
b) Represent the pattern that you observe in the graph using a trendline.
c) Determine the slope of your graph. Include units!
d) Write an equation that describes the relationship expressed by the graph.

Part 2: Explore concepts in Physics

I want you to come into the course with tones of positivity, math skills, a little practice with some physics problems, and a strong work ethic. I also want you to look at this new experience as an adventure, full of puzzles to solve, misconceptions to dispel, and moments that make you think, "Wow- how does that happen?" So, I am asking that you take some time this summer to choose (3) videos from the following list of sites, watch them, and write a paragraph about what you learned from each (why did you choose this video, what surprised you, what new ideas or questions does it make you think of, etc). This work will be collected, along with your work from Part 1, on the first day of school. Please type and print your video response paragraphs. Of course, feel free to watch more than three!

Smarter Everyday Videos

"Turning gravity into light" https://www.youtube.com/watch?v=Jsc-pQIMxt8

You won't believe your eyes" https://www.youtube.com/watch?v=_FlV6pgwlrk

"Kinematics of grasshopper hops" https://www.youtube.com/watch?v=O-JVepPdZbY

"The archer's paradox" https://www.youtube.com/watch?v=O7zewtuUM_0

"Mind blowing magnets" https://www.youtube.com/watch?v=IANBoybVApQ

Veritasium Videos

"Can you solve this?" https://youtu.be/vKA4w2O61Xo?list=PL16649CCE7EFA8B2F

"The most amazing thing about trees" https://www.youtube.com/watch?v=BickMFHAZR0

"The truth about toilet swirl" https://youtu.be/ihv4f7VMeJw?list=PL16649CCE7EFA8B2F

"Sparks from falling water": https://www.youtube.com/watch?v=rv4MjaF_wow

"Is there gravity in space?" https://www.youtube.com/watch?v=d57C2drB_wc

"Misconceptions about the universe" https://www.youtube.com/watch?v=XBr4GkRnY04

"Chain drop experiment"
https://www.youtube.com/watch?v=1erU-Cwcl2c

"Shadow illusion" https://www.youtube.com/watch?v=liqF6EamiE4

You can also select a Minute Physics video, or any other appropriate video, and write about it. If you have questions, feel free to send me an email plusamba@ichspride.org

End of Assignment. Well done!