Pre-AP Physics Summer Packet

Welcome to Pre-AP Physics! This is going to be a fun and challenging class. As this class is designed to build on the knowledge and skills that you have developed in your previous classes, it is important that you maintain them throughout the summer. "The brain is just like other muscles, if you don't use it, it atrophies!" In that vein, this summer packet is a guide to help you flex your brain. I broke things down into four simple parts:

I. Basic Science Skills
II. Essential Mathematics
III. Scientific Investigations
IV. Physics Concepts

For each part, there are two activities. I am expecting you to complete one activity from each part. Each activity is weighted equally, so choose what you find the most interesting. You will have four turn-in dates (turn in one activity on each date via e-mail, twithee@gmail.com). The first activity is due on **June 26**, the second on **July 10**, the third on **July 24** and the fourth on the **first full day of school (August 17)**. NO LATE WORK WILL BE ACCEPTED (so turn them in early if you won't be home/near a computer with internet). If you have any questions or concerns, please e-mail me at twithee@gmail.com.

In order to help you and for me to keep things organized, you MUST e-mail me by June 12. (Please have your subject line indicate your first and last name and class you are in: example: Subject: Albert Einstein in Pre-AP Physics)

Good luck and have a great summer!

I) Basic Science Skills

Activity One – The Metric System

The Systeme International de Units was developed so that scientists across the globe would have and accurate way of recording and sharing information. In physics, the SI system is useful in making sure that you are recording/reporting/calculating what you intended to record/report/calculate. For example, a simple calculation of speed from traveling 32 m in 16 s reveals a speed of 2 m/s. Knowing that m/s is an acceptable unit of speed, we move on. Similarly, reporting the mass of an

electron as 0.511 MeV/c^2 instead of $9.11*10^{-31}$ kg is also acceptable. Your task is to develop a USEFUL table of metric units two of their alternative representations/conversions. Do NOT find a table of conversions and send it to me. You must develop your own.

Activity Two – Light Years From Here

Physics is notorious for using outrageous units that make it difficult to understand the concepts that are addressed. Your task is to write a short story (two to three paragraphs) that utilizes the most outrageous units you can. As a simple example, how tall are you in Angstrom Units? What is your mass in slugs? (You should not use the same unit more than once in your story AND you should use as many units as possible).

II) Essential Mathematics

Activity Three – The Language of Science

Mathematics is an important tool of science, it is the language that scientist communicate their ideas in. If a picture is worth a thousand words, then an equation is worth a trillion words. In science, we break down the variables into three simple categories: Dependent, Independent and Constant. A dependent variable is what you are concerned about being effected by your experiment. An independent variable is what you are manipulating in your experiment. The constants are all those things that matter but you are not altering during your experiment. Take the following formulas and perform the following:

a) Identify what the variables stand for (ie. F is for force).
b) Solve each formula for each non-constant variable
    a. F = ma
    b. m = F/a
    c. a = F/m
c) For each phrasing of the formula identify the dependent variable and how the dependent variable is affected by the independent variable.
    a. When force is dependent, it is directly related to both the mass and the acceleration.
    b. When mass is dependent, it is directly related to force and inversely related to acceleration.
    c. When acceleration is dependent, it is directly related to force and inversely related to mass.

Your formulas are:

$d = vt$

$a = \Delta v/t$ (hint Δ means change and is not a variable)

$E_k = \frac{1}{2}mv^2$

$F_G = Gm_1m_2/r^2$

Activity Four – All that Math

Mathematics is an important part of understanding relationships between physical properties. We will be using everything you have learned in your math classes (and learning some new stuff). Here are a few Math problems for you to brush up on your skills.

Solve the following as indicated.

1) sin 8°
2) cos 59°
3) sin 54.6°
4) tan 2°
5) cot 74.9°

Convert each degree measure to exact radian measure (360° = 2π).

1) 818°
2) -90°
3) -432°
4) -135°
5) 754°

Convert each radian measure to degree measure.

1) $29\pi/36$
2) $17\pi/12$
3) $8\pi/9$
4) $55\pi/36$
5) $5\pi/18$

Solve the following equations

1) $7x - 2 = 33$
2) $- 8 - 5x = - x + 16$
3) $4(1x + 1) = 8$
4) $5x + 4y = 54$
   $- 2x + 4y = 12$
5) $x^2 + 4x - 77 = 0$
6) $5a^2 - 6a = 1$

7) $7t^2 + 4t + c = 0$

Scientific Investigations

Activity Five – Experimental Design

Your goal here is to design and perform a simple experiment. You must have a testable hypothesis, control variables, one dependent variable and one independent variable. Once you have designed your simple experiment, perform your experiment, collecting data on your dependent variable (I suggest at least ten trials for each state of your independent variable). Then analyze your data by plotting a graph. If possible state any conclusions that you can draw from your analysis. Then discuss all possible sources of error and any potential further investigations you would suggest.

Activity Six – Science Olympiad

Your goal here is to begin preparing for Science Olympiad, TEAMS competition or WYSE competition. Choose one topic from one of these three and prepare the necessary materials. (All three competitions and their guides can be found online at the various websites. You will have to use last years materials, 2008 - 2009)

Science Olympiad - http://www.soinc.org/events/index.htm
WYSE - http://www.engr.uiuc.edu/wyse/AC/students.html
TEAMS - http://www.jets.org/TEAMS/archives/index.cfm

Activity Seven – The Media

Scientific topics are all over the media. Throughout the summer, find one scientific topic that makes the headlines and follow up on its sources. Make a short report (two to three pages, should be mostly facts/tables/graphs that you copied) that explains what the topic is and the important features. Then, discuss the impact of this topic in the world today and possible changes society will have to make to adjust around the new topic.

Physics Concepts

Activity Eight – Mechanics

Mechanics is the study of motion. How distance, time, velocity and acceleration are related as well as using this knowledge to predict the outcome of certain situations.

1) A car is traveling at 63 mph down the interstate. How far does the car go in 2.8 h?
2) A car travels for 280 miles on a long road trip. If you include all the pit stops for food and bathroom breaks, it takes the driver 4 h. On average, how fast was the driver going?
3) A plane takes off and attains a cruise speed of 150 mph and maintains this speed for 5 hours. How far does the plane go?
4) On the interstate, your friend has a 20 mile head start on a trip to Chicago. If your friend maintains a speed of 62 mph and you maintain a speed of 68 mph, how long does it take you to catch your friend?

Activity Nine – Beyond Mechanics

Physics and chemistry overlap on several key ideas including light, temperature and thermodynamics. Using what you learned in chemistry, answer the following?

1) An unknown sample is observed to displace 35 mL of water when placed in an overflow container. The sample is then massed on a digital scale and found to be 50g. What is the density of the sample?
2) How much energy does it take for an electron to emit a photon with a frequency of 600 MHz?
3) What temperature is 82°F in degrees Celsius and Kelvin?
4) An unknown metal sample is recorded at 90°C to have a mass of 2.8 kg. This sample is then placed in 100 mL of water at 0°C and observed to reach an equilibrium temperature of 36°C. What is the specific heat of the metal and how much heat energy was transferred from the metal to the water?