WESTCHESTER
COUNTRY DAY SCHOOL

AP Physics Summer Packet

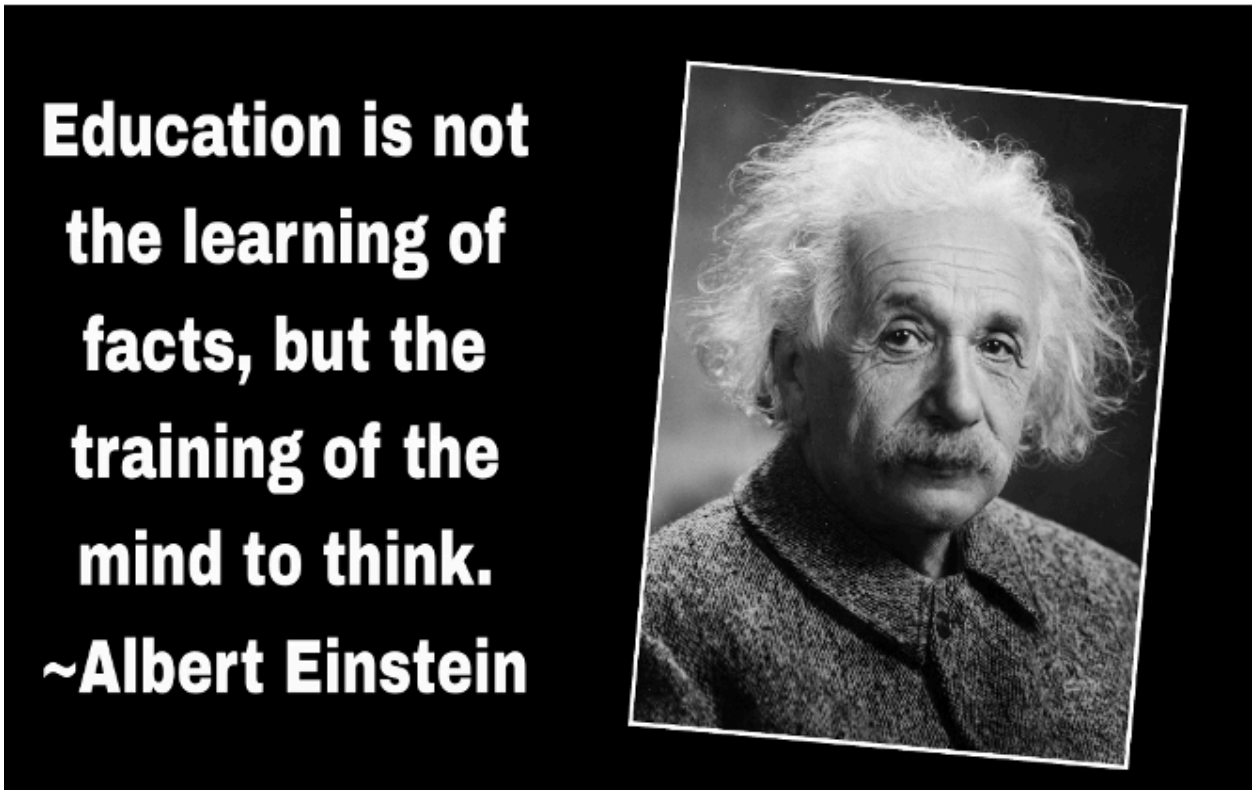


photo: Public Domain

The following assignment comes from material that you should have previously learned from your past math classes. These topics will be essential for your success in AP Physics and you will be completely lost without a solid foundation of the following topics. If for any reason you are struggling with the material it is your responsibility to gain a better understanding of it through: Khan academy, YouTube, Tutor, or Textbook. During the first week of school we will have a test on questions similar to the Summer Packet.

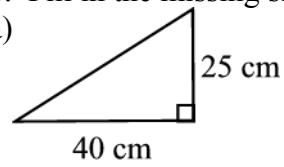
Physics is unlike any subject you have taken before and it will constantly test not what you memorized, but your ability to apply the knowledge you gained.

Geometry & Trigonometry

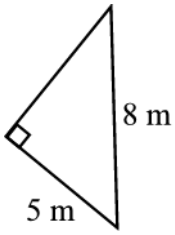
Answer the following questions using Pythagorean theorem, trigonometric functions and inverse trigonometric functions. For full credit, be sure to show your setup and work for each problem.

1. Fill in the missing side of each triangle:

a)

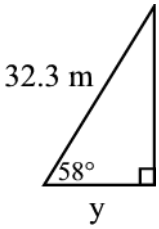


b)

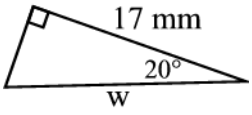


2. Find the marked side of each triangle:

a)

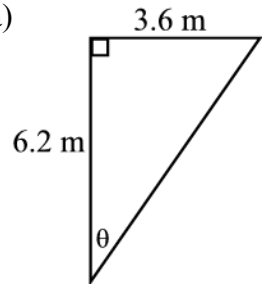


b)

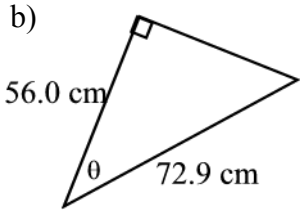


3. Find the value for the marked angle

a)

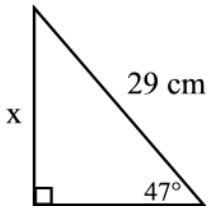


b)

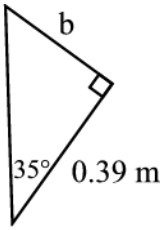


4. Find the marked side of each triangle:

a)

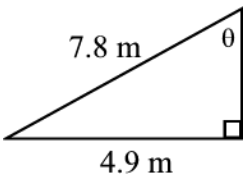


b)

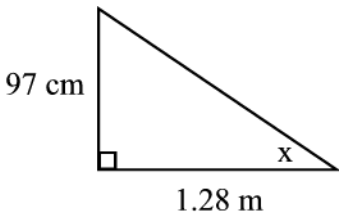


5. Find the value for the marked angle

a)



b)



Dimensional Analysis

6. Although it is widely believed that Germany's Autobahn highway has no speed limit whatsoever, much of the highway has regulated speed limits of 130 km/hr or less, and in some places speed is limited to just 60 km/hr.
a. How many miles per hour is 130 km/hr? (1 mile = 1.61 km)

$$\frac{130km}{hr}\left|\frac{1mi}{1.61km}\right| = 80.7\frac{mi}{hr}$$

b. How many miles per hour is 60 km/hr?

7. If you are traveling at 65 miles per hour, how many feet will you be traveling in one second? (There are 5,280 feet in one mile.)

8. The speed of light is 3 x 10^8 meters/second. What is the speed of light in miles/year? (1609 meters = 1 mile)

9. What is 53 yards per hour into inches per week?

10. 721 lbs per week into kg per second (1 kg = 2.2 pounds)

Algebra

11. Make ***x*** the subject of the formula in each of the following cases. (Solve for x.)

a) $a + 3x = y + z$

b) $\frac{x}{a} = 1 + \frac{y}{b}$

c) $y = \frac{x+a}{x-a}$

d) $\sqrt{x} - 3 = y$

e) $a + x = y + z$

f) $\frac{x+y}{y} = \frac{y}{a} + \frac{a}{y}$

g) $\frac{y}{x} + a = b$

12.

Solve each equation with the quadratic formula.

a) $m^2 - 5m - 14 = 0$

b) $2m^2 + 2m - 12 = 0$

c) $x^2 + 4x + 3 = 0$

This may make your brain hurt; it leads into the first unit. First you will select a relevant equation from the "reference sheet". Decide what is held constant and what variables are changing (and by what factor) then explain how the changed variable affects the original value.

Relevant Equation:	Constant Values:	Changed Variables (including factor):	Result (in terms of original variable):

For example

An object starts at rest and accelerates to a final velocity of 50m/s. What is the final velocity if the object accelerated at the same rate, but for 3 times as much time?

Answer:

$V_f = V_{xo} + a_x t$

If v_{xo}, and the acceleration do not change (constant), but the time increases by a factor of 3.

Then v_f will increase by a factor of 3 because v_f is directly proportional to time. Therefore, the final velocity will be 150m/s

$50m/s = 0 + a_x t \quad \rightarrow \quad 150m/s = 0 + a_x 3t$

$v_x = v_{x0} + a_x t$

$x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$

$v_x^2 = v_{x0}^2 + 2a_x (x - x_0)$

$\vec{x}_{cm} = \frac{\sum m_i \vec{x}_i}{\sum m_i}$

$\vec{a}_{sys} = \frac{\sum \vec{F}}{m_{sys}} = \frac{\vec{F}_{net}}{m_{sys}}$

$|\vec{F}_g| = G\frac{m_1 m_2}{r^2}$

$|\vec{F}_f| \le |\mu \vec{F}_n|$

$\vec{F}_s = -k\Delta\vec{x}$

$a_c = \frac{v^2}{r}$

$K = \frac{1}{2} m v^2$

a = acceleration
d = distance
E = energy
F = force
J = impulse
k = spring constant
K = kinetic energy
m = mass
p = momentum
P = power
r = radius, distance, or position
t = time
U = potential energy
v = velocity or speed
W = work
x = position
y = height
θ = angle
μ = coefficient of friction

13. If an object accelerates from rest at 12m/s/s to reach a final velocity after 20 seconds, what acceleration would be necessary in order to reach the same final velocity in only 4 seconds?

$\mathbf{V_f = V_{xo} + a_x t}$

Notice that there are no "numbers" for given variables.

14. An object starts at rest and accelerates at a rate a for time t until it reaches a final velocity v. In terms of the original acceleration, a, what acceleration would be needed in order to reach velocity 2v, in a time of t/2? $\mathbf{V_f = V_{xo} + a_x t}$

15 A car starts at rest and accelerates at a rate, a, for a time, t, reaching a location X from the origin (X_o=0) a. What is the final position if the car accelerated (at the original rate) but for a time of 3t? $\mathbf{x_f = x_i + V_{xo}\, t + \frac{1}{2}\, a_x t^2}$

b. What is the final position if the car accelerated at a rate of 3a but for the original amount of time? $\mathbf{x_f = x_i + V_{xo}\, t + \frac{1}{2}\, a_x t^2}$

c. What is the final position if the car accelerated instead at a rate of 3a for a time of 3t?

d. How much time would be required, in terms of the original t, in order for the car to reach location 2X, with the same original acceleration? $\mathbf{x_f = x_i + V_{xo}\, t + \frac{1}{2}\, a_x t^2}$

e. How much time would be required, in terms of the original t, in order for the car to reach location 16X, with the same original acceleration? $\mathbf{x_f = x_i + V_{xo}\, t + \frac{1}{2}\, a_x t^2}$

Video Analysis

Physics will be unlike any subject you have ever taken before. As a teacher, I have discovered that students that develop an interest in the subject, and come into the class with lots of physics questions like, “Why is the sky blue?” often do the best in the class. That being said, I'm going to post some YouTube channels. From the following list of sites, watch at least **3** of the videos that compel your interests, and write a paragraph or two 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!

https://www.youtube.com/user/1veritasium

https://www.youtube.com/user/destinws2

https://www.youtube.com/user/minutephysics