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AP® Physics

Summer Assignment

AP® PHYSICS Summer Assignment

1. The following are example physics problems. Place the answer in correct scientific notation, when appropriate and simplify the units. Work with the units, cancel units when possible, and show the simplified units in the final answer. Make sure your calculator is in degree mode when dealing with angle measurements.

a. $T_p = 2\pi\sqrt{\dfrac{125.4 \text{ cm}}{9.81 \text{m/s}^2}} =$ ____________

b. $K = \dfrac{1}{2}\left(3.6\times10^2 \text{ kg}\right)\left(2.32\times10^5 \text{ m/s}\right)^2 =$ ____________

c. $F = \left(8.99\times10^9 \dfrac{N\times m^2}{C^2}\right)\dfrac{\left(4.2\times10^{-9}C\right)\left(8.6\times10^{-9}C\right)}{\left(0.22m\right)^2} =$ ____________

d. $\dfrac{1}{R_p} = \dfrac{1}{4.5\times10^2\Omega} + \dfrac{1}{9.4\times10^2\Omega}$ $R_p =$ ____________

e. $(1.33)\sin 35.0^\circ = (1.50)\sin\theta$ $\theta =$ ____________

2. For each of the following equations, solve for the variable in **bold** print. Be sure to show each step you take to solve the equation for the **bold** variable.

a. $\lambda = \dfrac{\mathbf{h}}{p}$ ____________

b. $F(\mathbf{\Delta t}) = m\Delta v$ ____________

c. $U = \dfrac{G\mathbf{m_1}m_2}{r}$ ____________

d. $v^2 = v_0^{\ 2} + 2\mathbf{a}\Delta x$ ____________

e. $n_1 \sin\theta_1 = n_2 \sin\boldsymbol{\theta_2}$ ____________

f. $\dfrac{1}{s_i} + \dfrac{1}{s_o} = \dfrac{1}{\mathbf{f}}$ ____________

3. Physics uses the ***SI*** system (System Internationale). ***KMS*** stands for kilogram, meter, and second. These are the fundamental units of choice in physics. The equations in physics depend on unit agreement.

Quantity measured	Unit	Symbol	Relationship
Length, width, distance,	millimeter	mm	10 mm = 1 cm
	centimeter	cm	100 cm = 1 m
	meter	m	$1x10^9$ nm = 1 m
	kilometer	km	1 km = 1000 m
Mass	milligram	mg	1000 mg = 1 g
	gram	g	
	kilogram	kg	1 kg = 1000 g
Time	second	s	
Electric current	ampere	A	

a. 3198 *g* = ______________ *kg*

b. 1.3 *km* = ______________ *m*

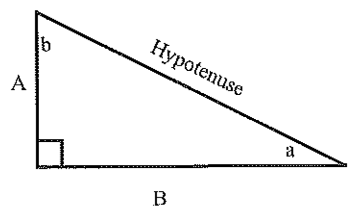
c. 623.7 *nm* = ______________ *m*

d. 1.74 *m* = ______________ *cm*

e. $6.8x10^{-8}$ *m* = ______________ *mm*

f. 1.2 *A* = ______________ *mA*

4. Examine the right triangles pictured below. Remember a right triangle has a 90° angle and that the sum of all of the angles in any triangle is equal to 180°. The two short sides of this right triangle have been labeled A and B. The longest side of a right triangle is known as the hypotenuse. The right angle is marked and the other two angles are marked with 'a' and 'b'. Notice that the right angle is opposite to the hypotenuse and that angle 'a' is opposite to side A and angle 'b' is opposite to side B. Also, side B is adjacent (next to) side A. We use the Pythagorean Theorem to calculate the length of any side of a right triangle when the length of the other two sides is known. We use trigonometric relationships to calculate the length of any side of a right triangle when the length of one side and one angle is known.



Pythagorean's Theorem:

$$\text{Hypotenuse}^2 = A^2 + B^2$$

Trigonometric Relationhips:

$$\frac{O}{H} = \frac{\text{opposite}}{\text{hypotenuse}} = \sin$$

$$\frac{A}{H} = \frac{\text{adjacent}}{\text{hypotenuse}} = \cos$$

$$\frac{O}{A} = \frac{\text{opposite}}{\text{adjacent}} = \tan$$

These relationships are easy to remember if you learn this silly phrase, "Oscar had a heap of apples". The first letter of each word in the phrase helps you remember the sin, cos, tan relationships in that order. This is the same order as the buttons appear on a scientific calculator so that also simplifies the memory task!

Using the right triangle above, solve for the following. ***Your calculator must be in degree mode.***

a. **a** = 55° and ***hypotenuse*** = 22 *m*, solve for ***A*** and ***B***. ______________

b. **a** = 45° and ***A*** = 15 *m/s*, solve for ***B*** and ***hypotenuse***. ______________

c. ***B*** = 18.7 *m* and **a** = 65°, solve for ***A*** and ***hypotenuse***. ______________

d. ***A*** = 9 *m* and ***B*** = 9 *m*, solve for **a** and ***hypotenuse***. ______________

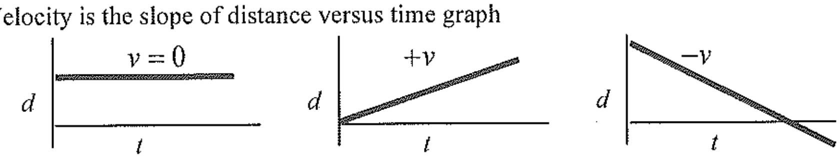
Rates and Graphing

We often create a graph to describe the motion of an object. Remember that when we state two variables using the "versus" terminology that we always state what is being graphed as a y-axis variable versus the x-axis variable. You have already learned that the slope of a position vs. time graph for a moving object is the object's velocity and that a straight line on that graph represents *constant* velocity. You have also learned that if a position vs. time graph is a curve, that the object is changing its velocity which means it is experiencing an acceleration. Additional specific features of the motion of objects are demonstrated by both the shape and the slope. In the graphed examples the y intercepts and slopes would depend on where the problem started and on how fast the rate is changing.

- The slope of a position vs. time graph = velocity.
- The slope of a velocity vs. time graph = acceleration.
- Slope is calculated as $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{“}rise\text{”}}{\text{“}run\text{”}}$
- If the graph shows a *horizontal* straight line, the object is moving at constant velocity with acceleration = zero.
- If the graph shows a *sloped* straight line, the object's velocity is changing, thus the object is accelerating.

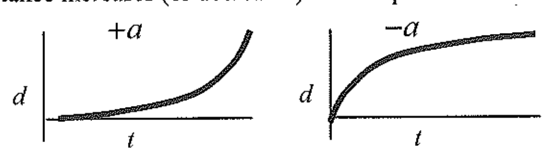
Constant Velocity: change in position $\boxed{v = \frac{d}{t}}$

Velocity is the slope of distance versus time graph

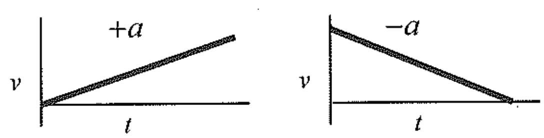


Acceleration:change in velocity $\boxed{a = \frac{\Delta v}{t}}$

Distance increases (or decreases) in an exponential manner.



Acceleration is the slope of velocity versus time graph



Importance of Area Under the Curve

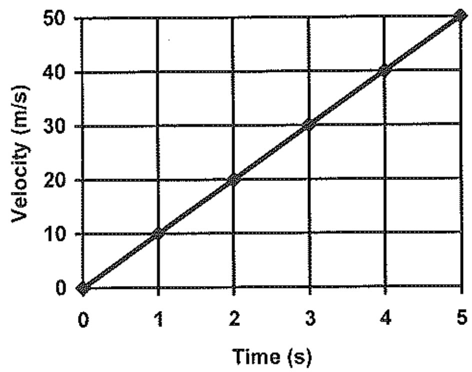
Velocity is the area under the acceleration versus time graph.
Displacement is the area under the velocity versus time graph.

Work is the area under the force versus distance curve.

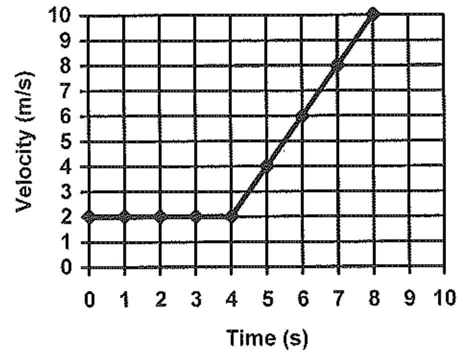
Impulse is the area under the force versus time curve.

Analyze the following velocity vs. time graphs and answer the questions that follow.

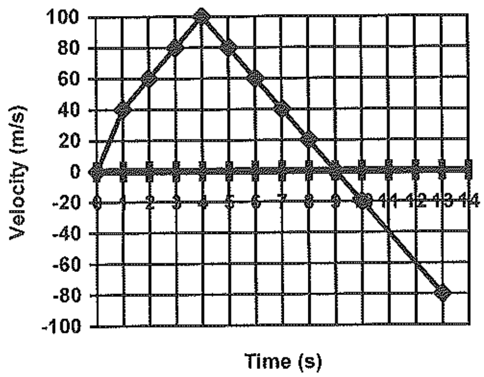
Graph A



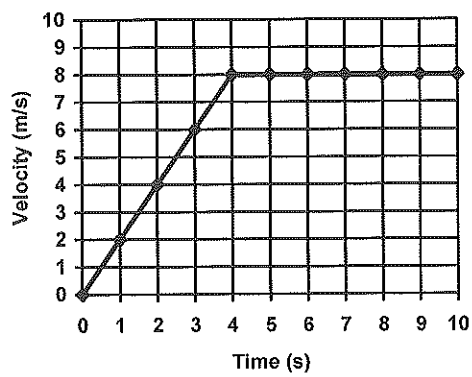
Graph B



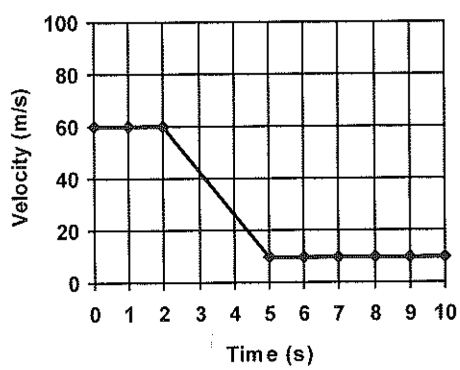
Graph C



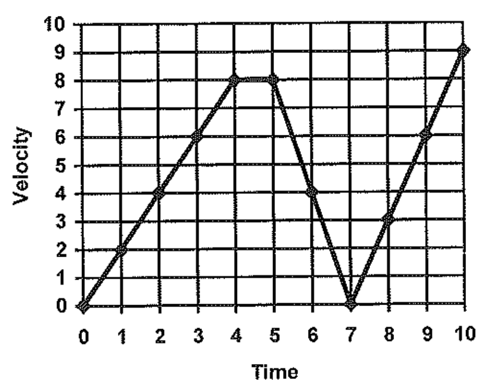
Graph D



Graph E



Graph F



1. Which of the graphs involve a time interval where the velocity of an object was held constant?

2. Which of the graphs involve a time interval where the acceleration of an object was held constant?

3. Calculate the acceleration of the object for any graph(s) you chose as answers to question 2. Show all work in the space provided paying particular attention to units and significant digits.

4. Which of the graphs involve an object that was negatively accelerating?

5. Which of the graphs involve an object that came to a stop?

6. Which of the graphs involve an object that changed direction?

7. Analyze Graph F. For which of the time intervals was the object experiencing the greatest positive acceleration?

8. Calculate the net displacement for the object in Graph B.

9. Calculate the net displacement for the object in Graph D.

10. Calculate the displacement for the object in Graph F for the time interval t = 0s to t = 4 s.