Physics You Learned

Physics Concepts	Is There an Equation?
When driving it takes a certain amount of time, called **reaction time**, to recognize a hazard, decide what to do, and initiate an action such as applying the brakes. During this time, the vehicle is still moving, and the distance traveled is the reaction distance.	
All instruments must be adjusted to read correctly in a process called calibration. This process compares the instrument to a standard to determine its accuracy.	
No measurement is exact (accurate to an infinite number of decimal places). Measurements are often repeated many times to average out uncertainties. Sources of uncertainty include **systematic errors** due to improper calibration, and **random errors**.	
Accuracy refers to the ability of measurements to give an average value close to the accepted standard. **Precision** refers to the ability to repeat a measurement to almost the same value regardless of its accuracy.	
Scientists use the SI system of measurements. Units are related to their sub-units in multiples of ten.	
Average speed is the distance traveled, Δd, in a given interval of time, Δt. By definition, average speed is distance traveled divided by time taken.	$v_{\text{av}} = \frac{\Delta d}{\Delta t}$
The equation of average speed can be used to find the time needed for an object to travel a certain distance or the distance traveled during a period of time.	$\Delta d = v_{\text{av}} \times \Delta t$ $\Delta t = \frac{\Delta d}{v_{\text{av}}}$
The slope of a distance vs. time graph at any point is the object's instantaneous speed. If the object is traveling with constant speed, the graph is a straight line with a constant slope. If the graph is not a straight line, the slope may be found by drawing a tangent to the curve at a point.	
When a source of sound is moving toward or away from an observer, the frequency of the sound detected by the observer is shifted. This shift is referred to as the **Doppler effect**.	$f = \frac{f_0 s}{(s - v)}$
Acceleration is a change in an object's velocity, Δv, with respect to time, Δt. By definition, acceleration is the change in an object's velocity divided by the interval of time. Acceleration can be positive or negative.	$a = \frac{\Delta v}{\Delta t}$
An object's change in velocity with respect to time, or the time that is required for an object to change its velocity, can be found using the definition of acceleration.	$\Delta v = a \times \Delta t$ $\Delta t = \frac{\Delta v}{a}$
The slope of a velocity vs. time graph at any point is the object's acceleration at that time. If the slope of the velocity vs. time graph is constant, the object is traveling with constant acceleration.	

When an object is moving, the direction of the movement is as important as the size (magnitude). Quantities that have both size and direction, such as velocity and acceleration, are **vectors**. Those that have only size and no direction, such as mass, are known as **scalars**.	
The equations of motion can be used to predict whether a vehicle is in the STOP, GO, Dilemma, or Overlap Zone when approaching a yellow light.	
Active Physics *Plus* — The average velocity (v_{av}) of a constantly accelerating object is equal to the quantity initial velocity (v_i) plus the final velocity (v_f) divided by 2. The average velocity is the average of the initial and final velocities for an accelerating object.	$v_{av} = \frac{(v_i + v_f)}{2}$
Active Physics *Plus* — The distance covered by an accelerating object (d) is equal to the object's initial velocity (v_i) times the time of travel (t) plus one half of the object's acceleration (a) times the square of the travel time (t^2). The distance traveled by an accelerating object depends upon both its initial velocity and its acceleration.	$d = v_i t + \frac{1}{2}at^2$
The distance covered by an object that is undergoing uniform, negative acceleration when coming to rest depends upon the initial velocity squared. The stopping distance for an automobile (d) is equal to the square of the initial velocity $(v_i)^2$ divided by twice the acceleration provided by the brakes (a). The distance covered by an object that is undergoing uniform, negative acceleration when coming to rest depends upon the square of the initial velocity.	$v_i^2 = 2ad$ $d = \frac{v_i^2}{2a}$
Active Physics *Plus* — The square of the final velocity (v_f^2) of an accelerating object is equal to the square of the initial velocity (v_i^2) plus twice the acceleration times distance traveled while accelerating. When an object accelerates, the final velocity of the object depends upon the initial velocity, the object's acceleration, and the distance traveled during the acceleration.	$v_f^2 = v_i^2 + 2ad$
When an automobile goes around a curve, a centripetal force is needed to cause the direction of the automobile to change so that it can make the turn safely. The force is directed toward the center of the circle.	
Active Physics *Plus* — The centripetal acceleration (a_c) of an object traveling in a circle at constant speed equals the square of the object's speed (v^2) divided by the radius of the circle (r).	$a_c = \frac{v^2}{r}$
Active Physics *Plus* — The centripetal force (F_c) on an object traveling in a circular path with constant speed equals the mass of the object (m) multiplied by the square of the object's speed (v^2) divided by the radius (r) of the circle.	$F_c = \frac{mv^2}{r}$