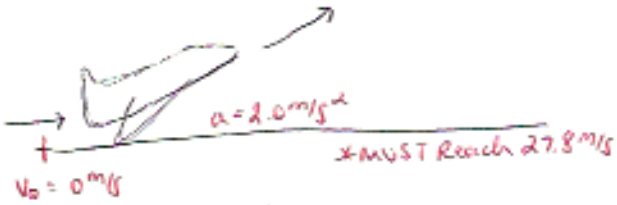
Kinematics:

Example 5:

You are designing an airport for small planes. One of the planes that will use this airfield must reach a velocity of 27.8 m/s to take off. The planes can accelerate at a uniform rate of 2.0 m/s^2.

A. If the runway is 150 meters long, will the airplane be able to take off? Find the velocity of the plane at 150 m to determine if the runway will work?

B. If the runway will not allow the plane to get up to its necessary velocity, find the minimum length the runway can be.



A.) $x = 150\ m$
$V_0 = 0\ m/s$
$a = 2.0\ m/s^2$
$V = ?$

$V^2 = V_0^2 + 2ax$
$V^2 = (0)^2 + 2(2)(150)$
$V^2 = 600$
$V = \pm 24.5\ m/s$ nope, won't make it!

B) $V_0 = 0\ m/s$
$V = 27.8\ m/s$
$a = 2.0\ m/s^2$
$x = ?$

$V^2 = V_0^2 + 2ax$
$(27.8)^2 = (0)^2 + 2(2.0)x$
$772.84 = 0 + 4x$
$x = 193\ m$

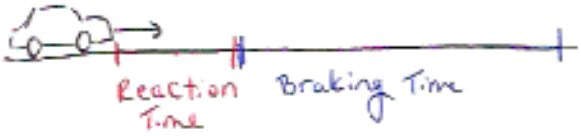
Example 6:

Estimate the total stopping distance of a car traveling at a constant 60.0 mph (approximately 27.0 m/s). To properly calculate the stopping distance, two distances must be taken into account: the reaction time before any action can be taken and the actual braking time. Most people have an average reaction time of about 0.500 s.

A. What is the distance traveled by the car during the reaction time? No braking has yet occurred.

B. What is the distance traveled by the car during the braking time if the car has an average acceleration of -6.00 m/s^2

C. What is the total stopping distance?



$V_0 = 27.0\ m/s$
$t = 0.500\ s$

A.) * If no braking has occurred - the car's initial velocity has not changed. So we can use a constant velocity equation.

$\bar{V} = \frac{\Delta x}{\Delta t}$
$27.0 = \frac{\Delta x}{0.500}$
$\Delta x = (27.0)(0.500)$
$\Delta x = 13.5\ m$

B.) $V_0 = 27.0\ m/s$
$V = 0\ m/s$
$a = -6.00\ m/s^2$
$x = ?$

$V^2 = V_0^2 + 2ax$
$(0)^2 = (27.0)^2 + 2(-6.00)x$
$0 = 729 + (-12) \cdot x$
$-729 = -12 \cdot x$
$x = 60.75\ m$

C.) The total stopping distance is the sum of the two parts

Total Distance = 13.5 + 60.75 = 74.25 m