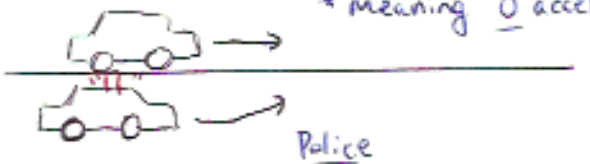
Class Example #7 Re-visited

Example 7:
A speeding driver flies along a straight, desert road going 120.0 km/h and passes a stationary police officer. The officer immediately takes off in pursuit with a constant acceleration of 2.78 m/s². How much time will it take for the police officer to catch the speeder?

Dimensional Analysis

$$\frac{120\ \text{km}}{1\ \text{h}} \left| \frac{1000\ \text{m}}{1\ \text{km}} \right| \frac{1\ \text{h}}{3600\ \text{s}} = 33.3\ \text{m/s}$$

v = constant velocity = $120^{km/h} = 33.3^{m/s}$
*meaning 0 acceleration



Police
$v_0 = 0\ m/s$
$a = 2.78\ m/s^2$

GOAL: time (t)?
when do they catch each other?

*We have 2 different objects - two sets of equations that need to come together somehow to solve for time. So each need an equation with t. But with two equations - we normally have two unknowns - but when the two catch each other - their position will be the same. $x_{speeder} = x_{police}$

$$33.3 \cdot t = 1.39\ t^2$$

*Now we have an equation in terms of time.

$$33.3 = 1.39 \cdot t$$

$$t = \frac{33.3}{1.39}$$

$$t = 23.96\ s \approx 24.0\ s$$

① Speeding Car

$x = v_0 t + \frac{1}{2} a t^2$

$x = 33.3 \cdot t + \frac{1}{2}(0) t^2$

$x_{speeder} = 33.3 \cdot t$

② Police Car

$x = v_0 t + \frac{1}{2} a t^2$

$x = (0) t + \frac{1}{2}(2.78) t^2$

$x = \frac{1}{2}(2.78) t^2$

$x_{police} = 1.39\ t^2$