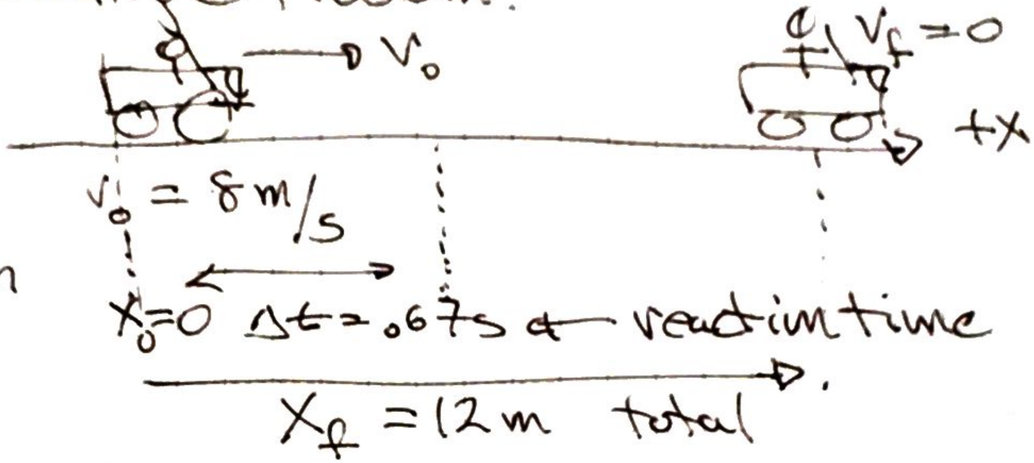
Physics Example Problem

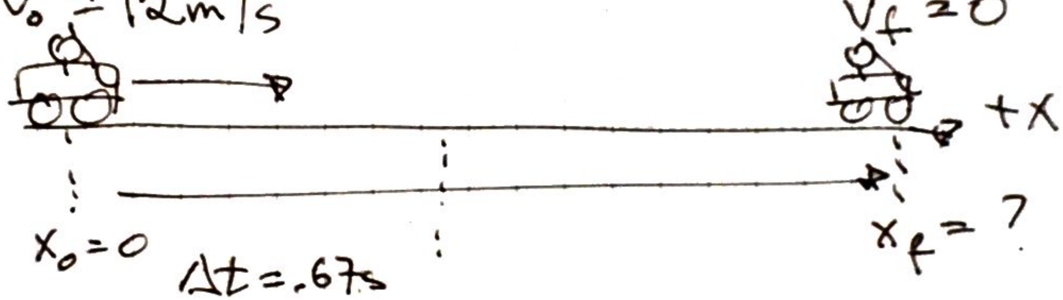
Framing:

first 2/3 s constant v
frame there on $a = cnst$
$\Rightarrow$ 2 parts



what if?

Deal w/ this later!



Assume: $a = cnst$, $a_{slow} = a_{fast}$ ← !! 1D motion
no slowing during reaction.

Info ay

$x_0 = 0$	→ $x_0 = 5.33m$
$x_f = ?$ 5.33m	$x_f = 12\,m$
$v_{x_0} = 8\,m/s$	$v_{x_0} = 8\,m/s$
$v_{x_f} = 8\,m/s$	$v_{x_f} = 0\,m/s$
$a = 0$	$a = ?$
$t_0 = 0$	$t = .67s$ ⟶ t_f

1st part $\quad v = \text{cnst} = 8\,m/s$

Estimate:

$< 1s \Rightarrow < 8m$

my only tool $\quad x_f = \cancel{x_0}^{\,0} + vt$

unknown $\quad$ known

1 eq, 1 unknown — solvable $\quad x_f = 8\,m/s(.67s) = \underline{5.33\,m}$

put this back in my data

2nd Part $\quad a = \text{cnst}$

$\Rightarrow v_f = v_0 + a_x(t - t_0)$ $\quad$ or $\quad x_f = x_0 + v_0\Delta t + \frac{1}{2}a_x\Delta t^2$

$v_f \to 0$

2 unknowns $\quad\quad$ 2 unknowns

or $\quad v_f^2 = v_0^2 + 2a_x(x_f - x_0)$

$v_f \to 0$

1 unknown!!

$0 = v_0^2 + 2a_x(x_f - x_0) \Rightarrow -v_0^2 = 2a_x(x_f - x_0)$

$\Rightarrow \dfrac{-v_0^2}{2(x_f - x_0)} = a_x = -\dfrac{(8\,m/s)^2}{2(12m - 5.33m)} = \dfrac{-64\,m^2/s^2}{13.34\,m} = \boxed{-4.8\,m/s^2}$

opposite direct to $\vec{v}$

2nd Problem:

$x_0 = 12$ $\quad$ 8m $\quad\quad$ $x_0 = 8m$

$x_f = ??$ $\quad\quad$ $x_f = ??$

$v_{x_0} = 12\,m/s$ $\quad\quad$ $v_{x_0} = 12\,m/s$

$v_{x_f} = 12\,m/s$ $\quad\quad$ $v_{x_f} = 0$

$a_x = 0$ $\quad\quad$ $a = -4.9\,m/s^2$

$t = 0$ $\quad$ reactiontime $\quad t = .67$ $\longrightarrow$ stopped!

1st part Same as before (reaction time)

$x_f = \underset{\to 0}{x_0} + v_0 \Delta t \Rightarrow x_f = 12\,m/s(.67s) = \underline{8m} < 12m$ estimate

2nd part (should go farther than previous one.

$\underset{\to 0}{v_f} = v_0 + a_x(t - t_0)$ or $x_f = x_0 + v_0 \Delta t + \frac{1}{2} a_x \Delta t^2$

or $\underset{\to 0}{v_f^2} = v_0^2 + 2a_x(x_f - x_0)$

same eqn has 1 unknown

$0 = v_0^2 + 2a_x(x_f - x_0) \Rightarrow -v_0^2 = 2a_x(x_f - x_0) \Rightarrow \frac{-v_0^2}{2a_x} = x_f - x_0$

$\frac{-v_0^2}{2a_x} + x_0 = x_f = -\frac{(12\,m/s)^2}{2(-4.9\,m/s^2)} + 8m = \frac{+144\,m^2/s^2}{+9.8\,m/s^2} + 8\,m$

$\boxed{x_f = 22.69\,m}$ ← almost 2x as far but only 50% more speed.

Answer Check Matches general sense of estimate - I'm surprised that 12 m/s is 2x the stopping distance.

Would explain law enforcement concern.