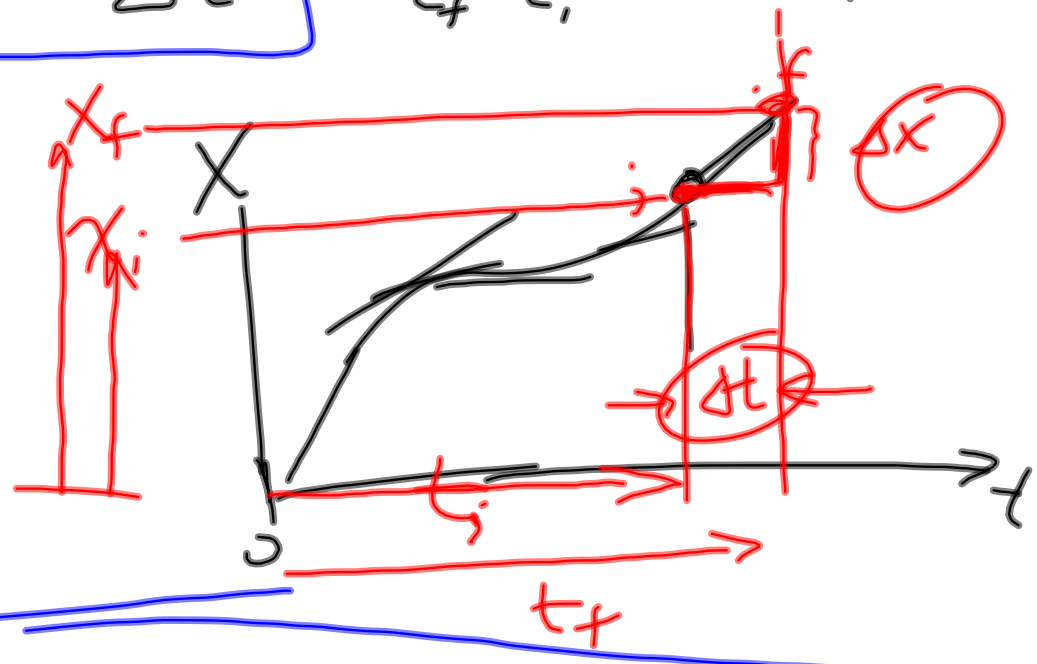
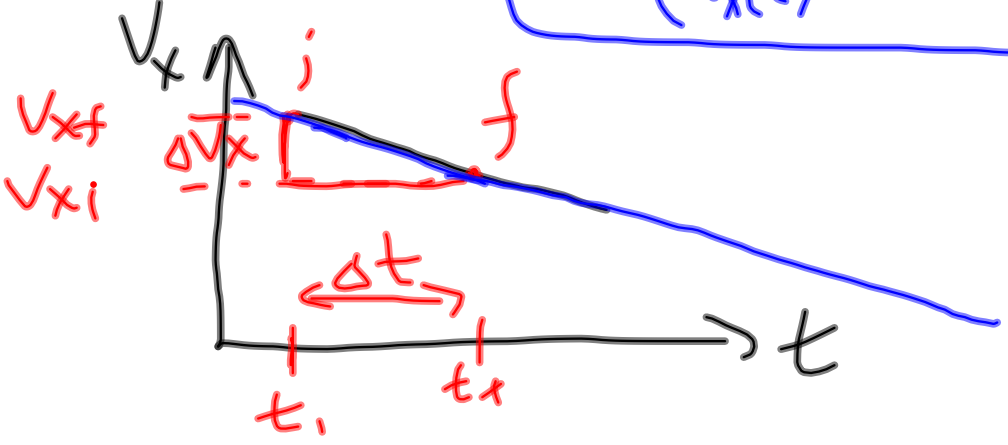
ave

$$v_{x,ave} \doteq \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$ ~ slope of x(t)

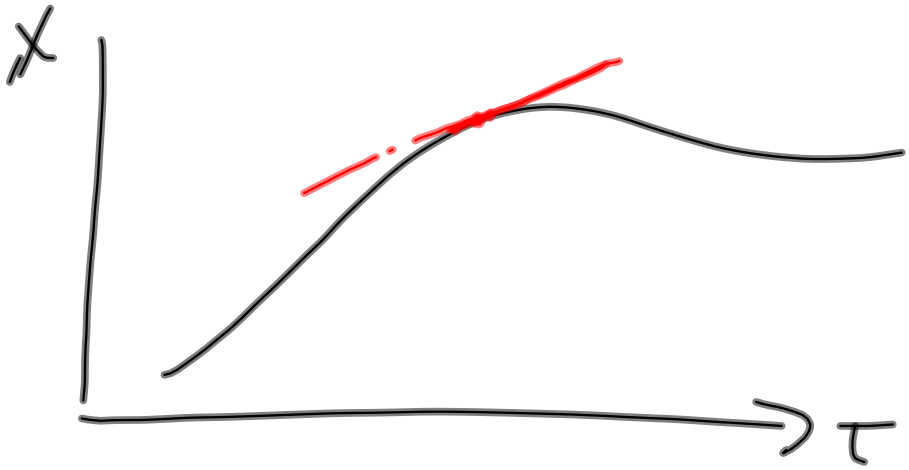
$$a_{x,ave} \doteq \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{t_f - t_i}$$ ~ slope of v(t)

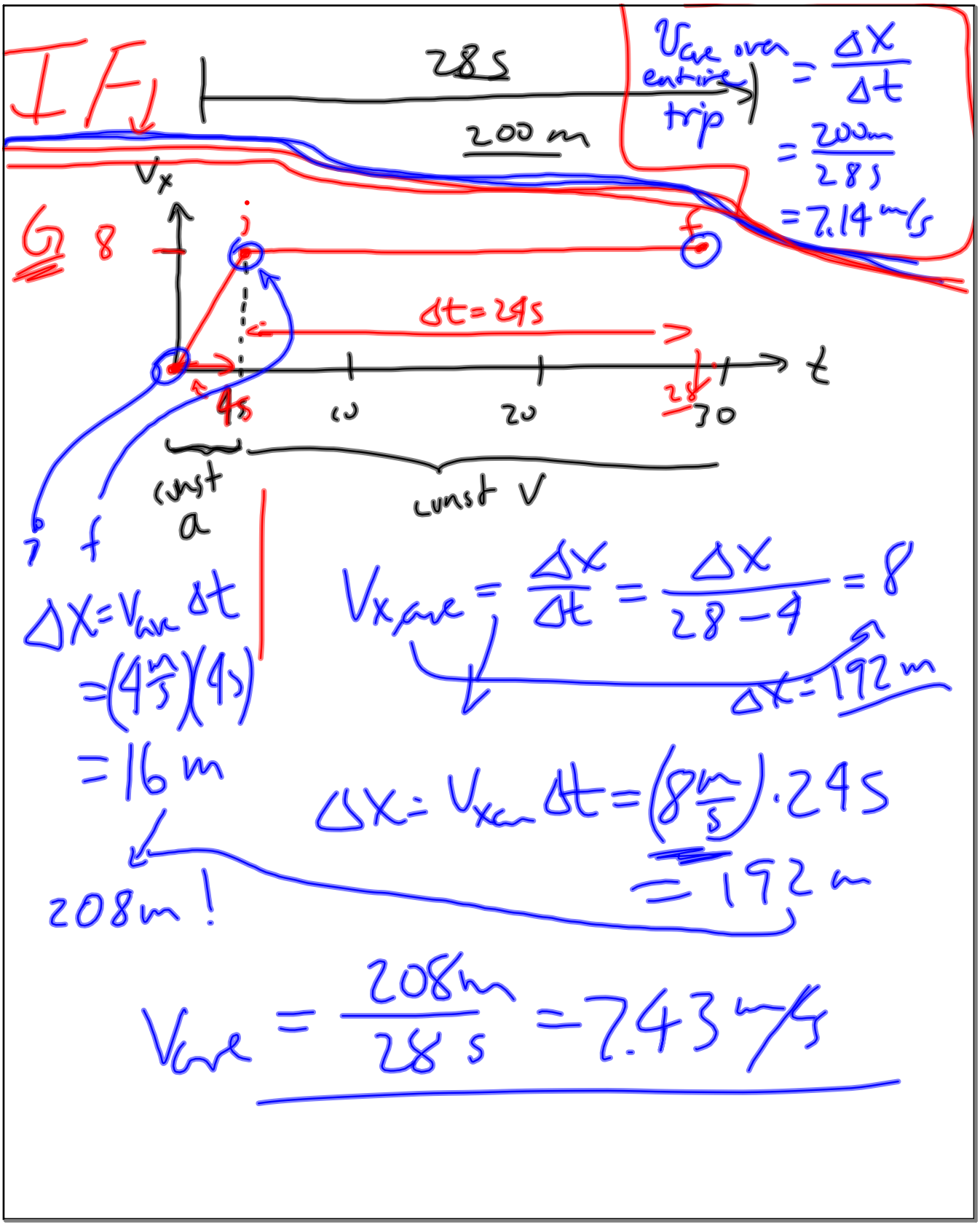


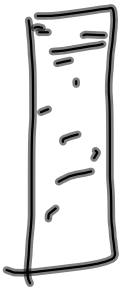
$$v_{x,ave} \overset{*}{=} \frac{v_i + v_f}{2}$$ if a_x ~ constant (v_x(t) is linear)



instantaneous $v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$




IF
28 s
200 m
$v_{ave\ over\ entire\ trip} = \frac{\Delta x}{\Delta t}$
$= \frac{200 m}{28 s}$
$= 7.14 m/s$
v_x
i
f
$\Delta t = 24 s$
4s
28
t
const a
const v
$\Delta x = v_{av} \Delta t$
$= (4 \frac{m}{s})(4 s)$
$= 16 m$
208m!
$v_{x ave} = \frac{\Delta x}{\Delta t} = \frac{\Delta x}{28 - 4} = 8$
$\Delta x = 192 m$
$\Delta x = v_{x av} \Delta t = (8 \frac{m}{s}) \cdot 24 s$
$= 192 m$
$v_{ave} = \frac{208 m}{28 s} = 7.43 m/s$



$v_i = 30 \frac{\text{mi}}{\text{hr}} \left(\frac{1\ \text{hr}}{3600\ \text{s}}\right)\left(\frac{1609\ \text{m}}{1\ \text{mi}}\right) = 13.4\ \text{m/s}$

$v_f = 0 \qquad \Delta t = ? \qquad a = ? \qquad \Delta x = .5\text{m}$

$$a = \frac{v^2 - v_0^2}{2\Delta x}$$

$$= \frac{0^2 - (13.4\ \text{m/s})^2}{2(.5\ \text{m})} = -180\ \frac{\text{m}^2}{\text{s}^2\text{m}}$$

$g = 9.8\ \frac{\text{m}}{\text{s}^2} \sim 10\ \text{m/s}^2$

$\sim -18\ g\text{'s}$

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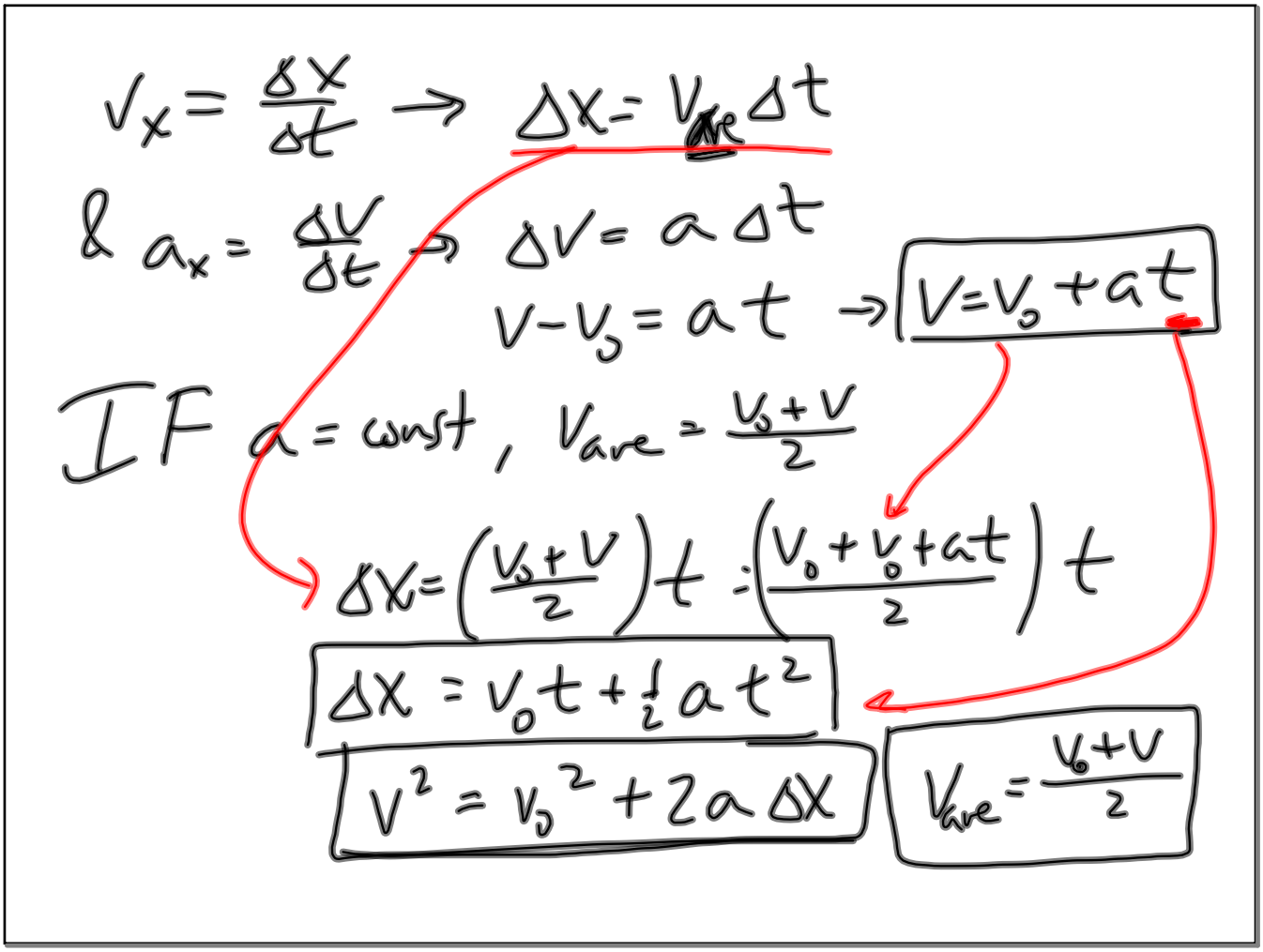
no seatbelt, dash $\Delta x = .1\text{m}$

$$a = \frac{v^2 - v_0^2}{2\Delta x} = \frac{0^2 - (13.4\ \text{m/s})^2}{2(.1\text{m})}$$

$$= -900\ \text{m/s}^2 \sim 90\ g\text{'s}$$


$v_x = \frac{\Delta x}{\Delta t} \rightarrow \Delta x = v_{ave} \Delta t$
& $a_x = \frac{\Delta v}{\Delta t} \rightarrow \Delta v = a \Delta t$
$v - v_0 = at \rightarrow v = v_0 + at$
IF $a = const$, $v_{ave} = \frac{v_0 + v}{2}$
$\Delta x = \left(\frac{v_0 + v}{2}\right) t = \left(\frac{v_0 + v_0 + at}{2}\right) t$
$\Delta x = v_0 t + \frac{1}{2} a t^2$
$v^2 = v_0^2 + 2a\Delta x$
$v_{ave} = \frac{v_0 + v}{2}$