1. 2 segments to overall motion. choose origin @ car's start posn

I. $v_i = 0$, $a = 2 \frac{m}{s^2}$, $v_f = 20 \frac{m}{s}$

know $v(t) = v_i + at \Rightarrow v_f = v_i + at$

$\Rightarrow t_I = \frac{v_f - v_i}{a} \simeq \frac{20-0}{2} = 10\,s$

vehicle has gone

$x_I(t) = x_i + v_i t + \frac{1}{2} a t^2 = \frac{1}{2} a t^2 = \frac{1}{2}(2)(10)^2$

$x_I \simeq 100\ m$ for segment I

II. $v_i = 20 \frac{m}{s}$, $a = -1.0 \frac{m}{s^2}$, $v_f = 0$. reset origin to new starting posn

↑ neg; slowing!

again, $t_{II} = \frac{v_f - v_i}{a} = \frac{0-20}{-1} = 20\,s$

goes an <u>addl distance</u> in this segment

$x_{II}(t) = v_i t + \frac{1}{2} a t^2 = (20)(20) + \frac{1}{2}(-1)(20^2) = 400 - 200$

$x_{II} \simeq 200\ m$ for segment II

a) $t_{net} = t_I + t_{II} = \underline{30\,s}$.

b) $x_{net} = x_I + x_{II} = 300\ m$

→

2. $v_i = 137 \frac{km}{h} = 38.1 m/s$ (watch units!)

a) $v_f = 90 \frac{km}{h} = 25.0 m/s$

$a = -5.2 \frac{m}{s^2}$ ($\because$ slowing down)

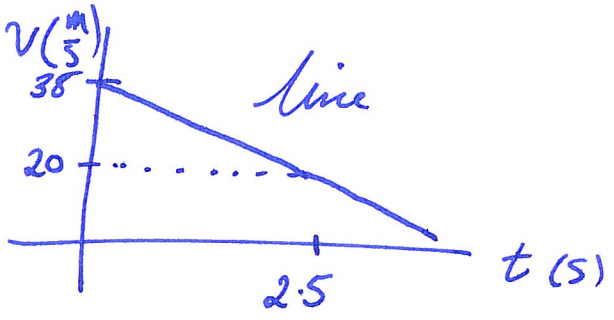
know $v_f = v_i + at \Rightarrow t = \frac{v_f - v_i}{a} = \frac{25 - 38.1}{-5.2} \approx 2.5 sec$

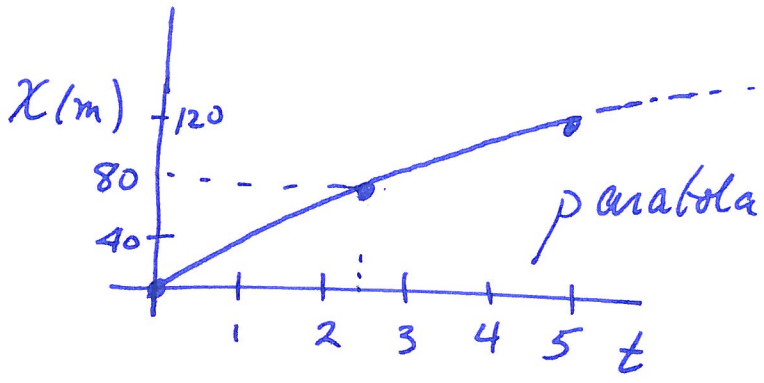
we have a problem!

b) let origin $x=0$ be @ start of accel.

$x(t) = v_i t + \frac{1}{2} a t^2$

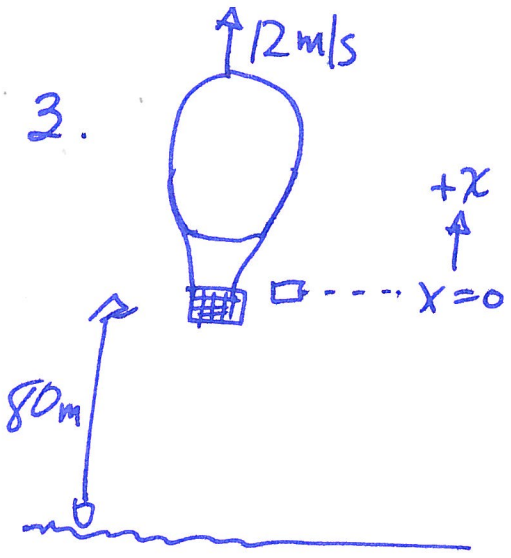
$v(t) = v_i + at$





$x(2.5) \approx 80m$ $x(5) \approx 120m$

3.



for package,

$v_i = +12 \frac{m}{s}$ (up), $x_i = 0$, $a = -g \simeq 9.8 \frac{m}{s^2}$ (down)

hits ground when $x_f = -80m$

$$x(t) = x_i + v_i t - \frac{1}{2} g t^2 = v_i t - \frac{1}{2} g t^2 = x_f$$

$$\frac{1}{2} g t^2 - v_i t + x_f = 0 \quad \Rightarrow \quad t = \frac{v_i \pm \sqrt{v_i^2 - 2 g x_f}}{g} \simeq \{5.45, -3.00\}$$

- negative time is before package is dropped
  $\Rightarrow$ reject as unphysical

$\Rightarrow$ $\underline{t = 5.45 s}$

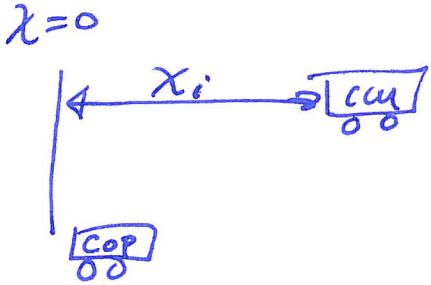
know $v(t) = v_i + at = v_i - gt$

when it hits, $t = 5.45 s$, so

$$v_f = v(5.45) \simeq 120 - (5.45)(9.81) \simeq \underline{41 m/s}$$

4. in the 2 sec before the cop starts, the car goes a dist

$$x_{i,car} = v_{car} \cdot t_{headstart} = \left(18 \tfrac{m}{s}\right)(2s) = 36m$$



- let t=0 when cop starts; at this point car is at x_i.
- origin @ cops pos'n

$$x_{car}(t) = x_{i,car} + v_{car} t \qquad \text{(no accel)}$$

$$x_{cop}(t) = \tfrac{1}{2} a_{cop} t^2 \qquad (v_{i,cop} = 0,\ x_{i,cop} = 0)$$

overtakes when $x_{cop} = x_{car}$

$$\Rightarrow \quad x_{i,car} + v_{car} t = \tfrac{1}{2} a_{cop} t^2$$

$$\tfrac{1}{2} a_{cop} t^2 - v_{car} t - x_{i,car} = 0 \quad \Rightarrow t = \frac{v_{car} \pm \sqrt{v_{car}^2 + 2 a_{cop} x_{i,car}}}{a_{cop}}$$

$t = \{16.2, -1.8\}$ s again neg. soln is silly - before cop started!

$\Rightarrow \underline{t = 16.2 s}$