University of Jordan
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Solutions to selected Problems
Chapter 2 / Giancoli 7th edition

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2] average speed $\bar{S} = \dfrac{\text{total distance}}{\text{total time}} = \dfrac{235}{2.75} \simeq 85.5 \,\dfrac{km}{h}$

11] Note the car and the truck are moving at constant velocities $\Rightarrow a = 0$ for each.

$x_f - x_i = v_i t + \frac{1}{2} a t^2 = v_i t$ since $a = 0$

for car: $x_f^c - 0 = v_c t$ (at $t=0$ the car was at $x=0$)

for truck: $x_f^T - \frac{210}{1000} = v_T t$ (at $t=0$ the truck was at $x = 210\,m$)

$\therefore x_f^c = 95t$

$x_f^T = \frac{210}{1000} + 75t$

when the car reaches the truck $\Rightarrow x_f^c = x_f^T$

$\Rightarrow 95t = \frac{210}{1000} + 75t \Rightarrow 20t = \frac{210}{1000}$

$\therefore t = 0.0105\,h = 37.8\,s$.

23] $v_i = 14\ m/s$, $v_f = 21\ m/s$, $\Delta t = 6\ s$.

$$v_f = v_i + at \Rightarrow a = \frac{v_f - v_i}{t} = \frac{21-14}{6} = \frac{7}{6}\ m/s^2$$

$$x_f - x_i = v_i t + \frac{1}{2}at^2$$

$$\Delta x = x_f - x_i = 14(6) + \frac{1}{2}\left(\frac{7}{6}\right)(6)^2 = 105\ m.$$

24] $v_i = 0$, $v_f = 35\ m/s$, $a = 3\ m/s^2$

$$v_f^2 - v_i^2 = 2a(x_f - x_i)$$

$$(35)^2 - 0 = 2(3)\Delta X$$

$$\therefore \Delta X = \frac{(35)^2}{6} \simeq 204.2\ m.$$

30] $v_i = 95\ \frac{km}{h} \simeq 26.4\ m/s$.

During the reaction time (0.4s) the car moves at constant velocity and moves a distance $\Delta x_1 = 0.4 \times 26.4 = 10.56\ m$.

The car moves an additional distance during deceleration.

(i) $a = -3\ m/s^2 \Rightarrow v_f^2 - v_i^2 = 2a\Delta x_2$

$$\Delta x_2 = \frac{0-(26.4)^2}{2(-3)} = 116.16\ m$$

$\Rightarrow$ total stopping distance $= 10.56 + 116.16 = 126.72\ m$

(ii) $a = -6 \Rightarrow \Delta x_2 = \frac{0-(26.4)^2}{2(-6)} = 58.1\ m$

$\Rightarrow$ total stopping distance $= 58.1 + 10.56 = 68.66\ m$

31] $v_i = 18$ m/s , $a = -3.65$ m/s^2

Displacement covered before applying the breaks (during the reaction time) is

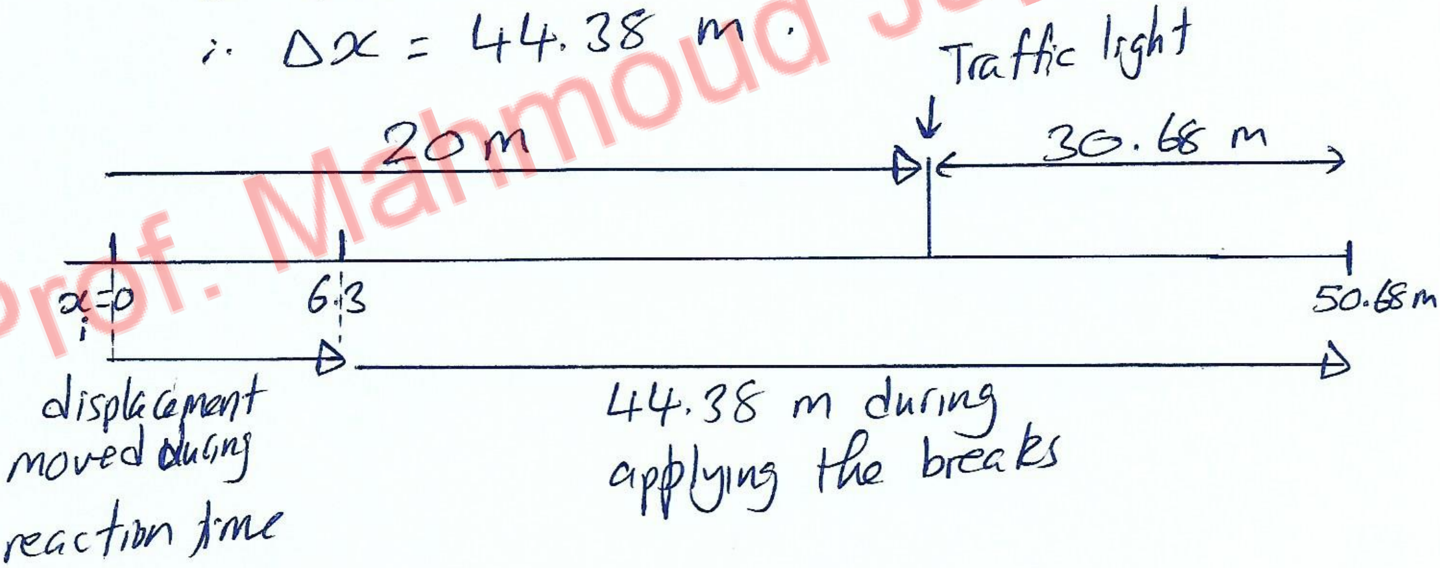
$$\Delta x_1 = 18 \times 0.35 = 6.3 \text{ m}.$$

Displacement while applying breaks untill car stops is

$$v_f^2 - v_i^2 = 2a\Delta x$$

$$0 - (18)^2 = 2(-3.65)\Delta x$$

$$\therefore \Delta x = 44.38 \text{ m}.$$

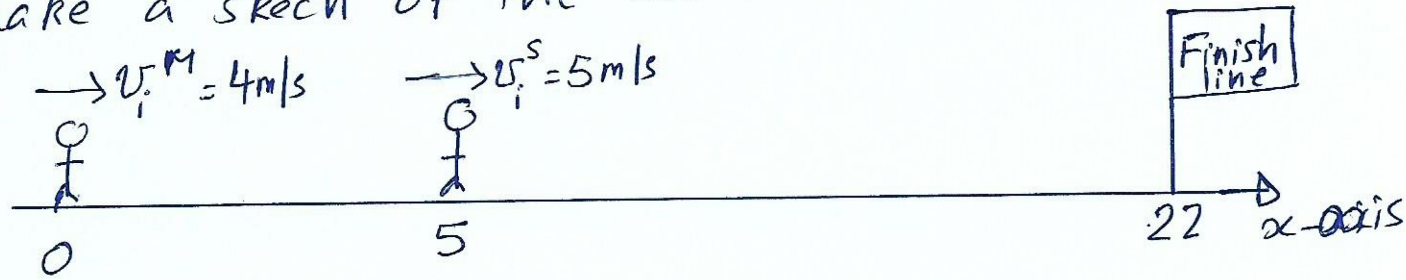


She will not stop on time. She will pass the traffic light. When it stops the car will be at $x = 50.68$ m $= 6.3 + 44.38$

That is $50.68 - 20 = 30.68$ m past the traffic light.

35] $v^{Mary} \equiv v^M$, $v^{Sally} \equiv v^S$

make a skech of the situation at $t=0$



Write the equation of motion for each:

For Mary: $x_f^M - x_i^M = v_i^M t + \frac{1}{2} a t^2$

$$x_f^M - 0 = 4t + \frac{1}{2} a t^2 \Rightarrow x_f^M = 4t + \frac{1}{2} a t^2 \quad \text{— (1)}$$

For Sally: $x_f^S - x_i^S = v_i^S t + \frac{1}{2} a_S t^2$

$$x_f^S - 5 = 5t - 0.2t^2$$

$$x_f^S = 5 + 5t - 0.2t^2 \quad \text{— (2)}$$

Crossing the line side-by-side $\Rightarrow x_M = x_S = 22$ at the same instant of time t. We use (2) to find t:

$$22 = 5 + 5t - 0.2t^2 \Rightarrow 0.2t^2 - 5t + 17 = 0$$

$\therefore t = 4.05$ (ignore $t = 21$ s, see below)

substitute for t in (1) to find $a \Rightarrow$

$$22 = 4(4.05) + \frac{1}{2} a (4.05)^2 \Rightarrow a \approx 0.71 \text{ m/s}^2$$

$\Rightarrow$ Mary has to accelerate at 0.71 m/s^2.

Note another solution for $t \simeq 21$ s

This time means sally will be at $x = 22$ m while moving to the left after reversing her direction of motion. But surely she will stop when she reaches the finish line. So just ignore $t = 21$ s.

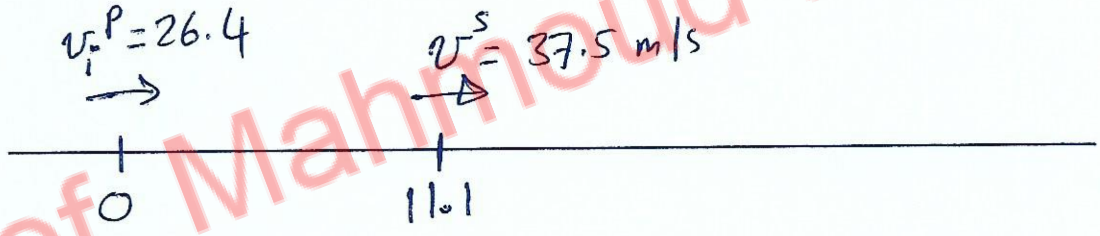
36] $v^{speeder} \equiv v^{s}$, $v^{police} \equiv v^{P}$

$v^{s} = 135 \frac{km}{h} = 37.5$ m/s. (Constant).

$v_i^{P} = 95$ km/h $= 26.4$ m/s

Assume $t=0$ when the policeman starts to accelerate and assume the policeman to be at the origin at this moment ($t=0$).

Also, at $t=0$ the speeder is ahead of the policeman by $(37.5-26.4)\times 1 = 11.1$ m



for policeman $x_f^{P} - x_i^{P} = v_i^{P} t + \frac{1}{2} a t^2$

$$x_f^{P} - 0 = 26.4t + \tfrac{1}{2}(2.6)t^2$$

for speeder $x_f^{s} - 11.1 = 37.5t$ (note $a=0$ for speeder)

at the moment of overtaking $\Rightarrow$

$$x_f^{P} = x_f^{s}$$

$$26.4t + 1.3t^2 = 11.1 + 37.5t$$

$$1.3t^2 - 11.1t - 11.1 = 0$$

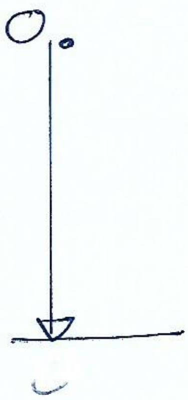
$$t = \frac{11.1 \pm \sqrt{(11.1)^2 - 4(1.3)(-11.1)}}{2(1.3)} = \frac{11.1 \pm 13.5}{2.6}$$

$\therefore t = \frac{24.6}{2.6} \sim \underline{9.46\ s}$.

just to check calculate x_f^{P} and x_f^{s} at $t = 9.46$ s. You will find they are equal ~ 366 m.

37] dropped $\Rightarrow v_i = 0$

$\downarrow +$ $\boxed{a = +g}$



$$y_f - y_i = v_i t + \frac{1}{2} g t^2$$

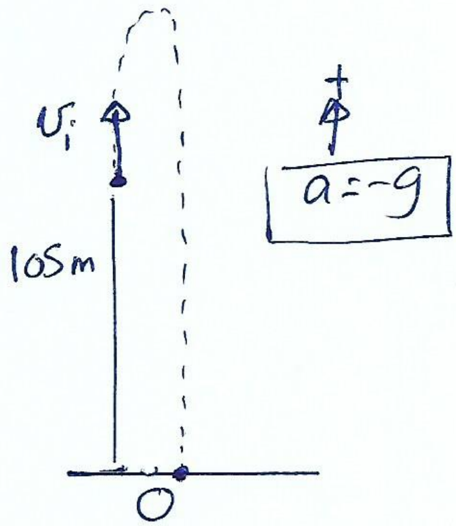
$$y_f - 0 = 0 + \frac{1}{2}(9.81)(3.55)^2$$

$$y_f = 61.8 \text{ m} \equiv \text{height of cliff.}$$

46] At the instant of dropping the package, it must have the same initial upward speed as the helicopter. That is it does NOT start moving down immediately after release.

At $t=0$ the system looks like in the graph.

$v_i = 5.4$ m/s, at a height of 105 m. Note after dropping the package is in free fall.



$$y_f - y_i = v_i t - \frac{1}{2} g t^2$$

$$0 - 105 = 5.4t - 4.905t^2$$

$$4.905t^2 - 5.4t - 105 = 0$$

$$\Rightarrow t = \frac{5.4 \pm \sqrt{(5.4)^2 - 4(4.905)(-105)}}{2(4.905)} = \frac{5.4 \pm 45.7}{9.81}$$

$t = 5.2$ s (ignore negative answer).