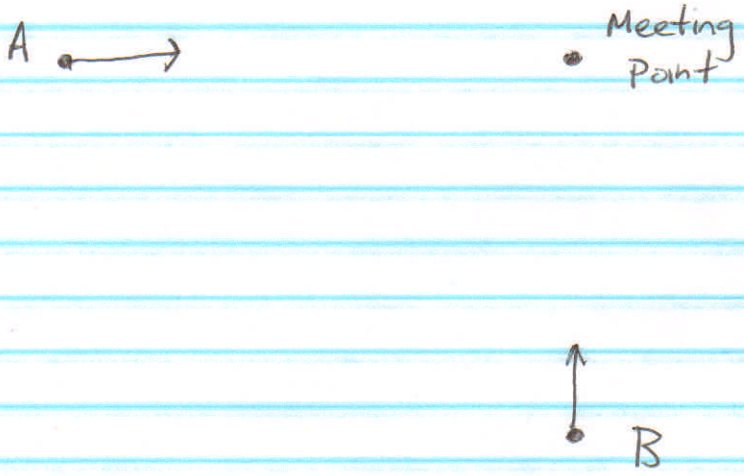
1)



To get to top speed:

Car B - $v_{fB} = v_{oB} + a_B t_B$ $\quad 72\,m/s = (5\,m/s^2)\,t_B$

$t_B = 14.2\,s$

Car A - $v_{fA} = v_{oA} + a_A t_A$ $\quad 55\,m/s = (6\,m/s^2)\,t_A$

$t_A = 9.17\,s$

Total time is t_B + 4.7s of top speed travel

$= \boxed{19.1\,s}$

$\Rightarrow$ Car A travels at top speed for $19.1 - 9.17\,s = 9.93\,s$

Distance travelled

Car A - $\Delta s = \left(\frac{1}{2} a_A t_A^2\right) + \left(v_{TA} t_{TA}\right)$ ← velocity and time at top speed

$= \frac{1}{2}(6\,m/s^2)(9.17\,s)^2 + (55\,m/s)(9.93\,s)$

$= \boxed{798\,m}$

Car B - $\Delta s = \left(\frac{1}{2} a_B t_B^2\right) + \left(v_{TB} t_{TB}\right)$

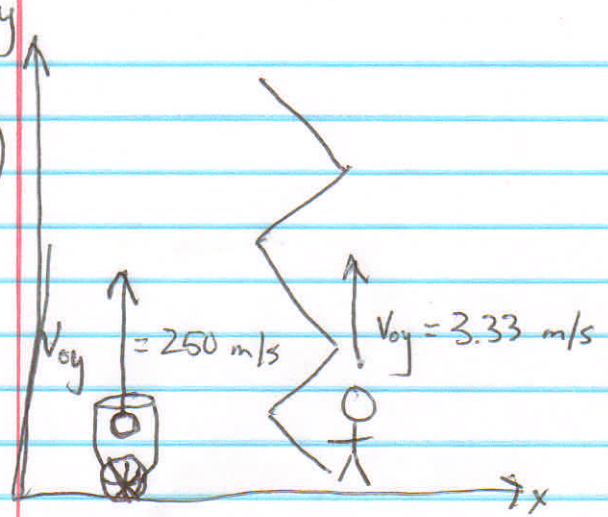
$= \frac{1}{2}(5\,m/s^2)(14.2\,s)^2 + (72\,m/s)(4.7\,s)$

$= \boxed{843\,m}$

Initial distance from each other

$\sqrt{798^2_m + 843^2_m} = 1161\,m$

2)



Ball		Bolt
$y_o = 0m$		$y_o = 0m$
$y_f = ?$	=	$y_f = ?$
$V_{oy} = 250 m/s$		$V_{oy} = 3.33 m/s$
$V_{fy} = ?$		$V_{fy} = 3.33 m/s$
$a_y = -9.8 m/s^2$		$a_y = 0 m/s^2$
$t = ?$	=	$t = ?$

The final positions of the ball and Bolt must be the same, T - Tennis Ball, B - Bolt

$$y_{oT}^{\nearrow 0} + V_{oyT} t + \frac{1}{2} a_{yT} t^2 = y_{oB}^{\nearrow 0} + V_{oyB} t + \frac{1}{2} a_{yB}^{\nearrow 0} t^2$$

$$V_{oyT} t + \frac{1}{2} a_{yT} t^2 = V_{oyB} t$$

$$(250 m/s) t + \frac{1}{2}(-9.8 m/s^2) t^2 = (3.33 m/s) t$$

$$(246.67 m/s) t + \frac{1}{2}(-9.8 m/s^2) t^2 = 0$$

$$t(246.67 m - 4.9 m/s\, t) = 0$$

Solutions for t, $t = 0$ and $246.67 - 4.9t = 0$

$\Rightarrow t = 0s$ and $t = \boxed{50.3s}$

# of flights of stairs

$$\#\text{flights} = \left(\frac{1 \text{ flight}}{3s}\right)(50.3s) = \boxed{16.8 \text{ flights}}$$

speed of ball

$$V_{fyT} = V_{oyT} + a_{yT} t$$

$$V_{fyT} = (250 m/s) + (-9.8 m/s^2)(50.3s)$$

$$\vec{V}_{fyT} = -243 m/s$$

$$\text{speed} = |V_{yT}| = 243 m/s$$