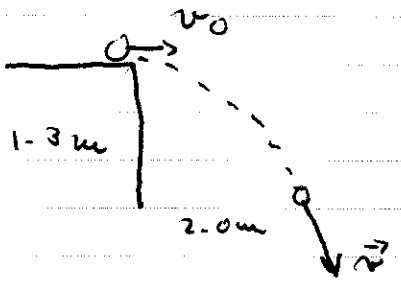
PM - I

1.



$\Delta y = -\frac{1}{2} g t^2 + v_{0y} t$

$-1.3 = -4.9 t^2 \Rightarrow$ **$t = .515$ s**

$x = v_{0x} t \Rightarrow 2.0 = v_0 (.515)$

$v_0 = 3.88$ m/s

$v_x = v_{0x} = 3.88$ m/s

$v_y = v_{oy} - gt = 0 - 9.8(.515) = -5.05$ m/s

$v = \sqrt{v_x^2 + v_y^2}$

$= 6.37$ m/s

2. Use Range formula...

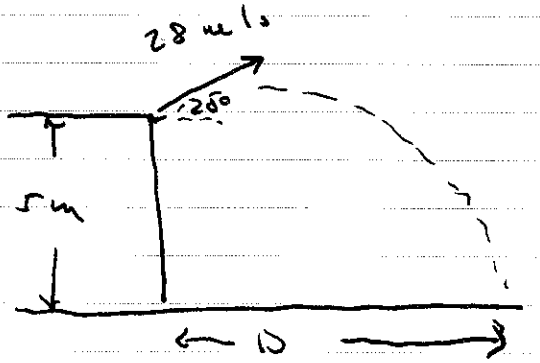
$R = \frac{v_0^2}{g} \sin 2\theta = \frac{20^2}{9.8} \sin 60 =$ **35.3 m**

$R = v_{0x} t \Rightarrow 35.3 = (20 \cos 30) t \Rightarrow$ **$t = 2.04$ s**

max height at $v_y = 0 \Rightarrow v_y^2 = v_{0y}^2 - 2g\Delta y$

$0 = (20 \sin 30)^2 - 2(9.8)\Delta y \Rightarrow$ **$\Delta y = 5.10$ m**

3.



$v_{0x} = 28 \cos 20 = 26.31$ m/s

$v_{0y} = 28 \sin 20 = 9.577$ m/s

$y_0 = 5$ m $x_0 = 0$

max height: $v_y^2 = v_{0y}^2 - 2g\Delta y \Rightarrow 0^2 = 9.577^2 - 2g\Delta y$

gives $\Delta y = 4.679$ m $\Rightarrow$ max height $= 9.679$ m

$v_y = v_{0y} - gt \Rightarrow 0 = 9.577 - 9.8 t_u \Rightarrow t_u = .977$ s

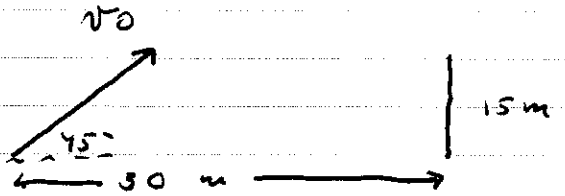
PM - 2

3 coast max height = $\frac{1}{2} g t_D^2 \Rightarrow t_D = 1.405$ s

$t_{TOT} = t_u + t_D = \boxed{2.38 \text{ s}}$

$D = v_{0x} t_{TOT} = 26.31(2.38) = \boxed{62.7 \text{ m}}$

4.



We want $y = 15$ m when $x = 30$ m.

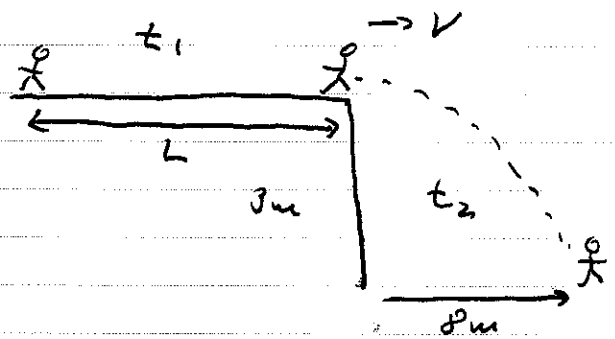
$(v_0 \cos 45)\, t = 30 \Rightarrow t = \frac{30}{v_0 \cos 45}$

$(v_0 \sin 45)\, t - \frac{1}{2} g t^2 = 15$

$(v_0 \sin 45) \frac{30}{v_0 \cos 45} - 4.9 \left(\frac{30}{v_0 \cos 45}\right)^2 = 15$

$30 \tan 45 - \frac{8820}{v_0^2} = 15 \Rightarrow \boxed{v_0 = 24.2 \text{ m/s}}$

5.



$H = \frac{1}{2} g t^2$

$H = \frac{1}{2}(9.8) t_2^2$

$t_2 = .782$ s

$t_1 = 5 - t_2 = 4.22$ s

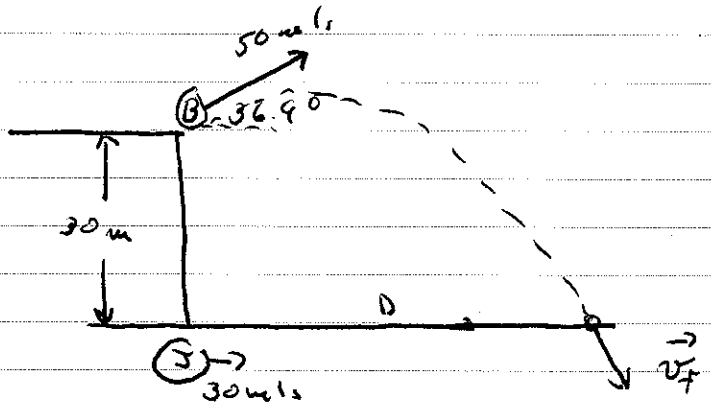
$x = v_{0x} t_2 \Rightarrow 8 = V(.782) \Rightarrow V = 10.23$ m/s

~~$\Delta x = \frac{1}{2} a t^2$~~ on roof: $V = 0 + a t_1$

$10.23 = 0 + a(4.22) \Rightarrow \boxed{a = 2.42 \text{ m/s}^2}$

$v^2 = v_0^2 + 2a\Delta x \Rightarrow 10.23^2 = 2(2.42) L \Rightarrow \boxed{L = 21.6 \text{ m}}$

6.



$v_{0x} = 50 \cos 36.9 = 40 \text{ m/s}$

$v_{0y} = 50 \sin 36.9 = 30 \text{ m/s}$

$y_0 = 30 \text{ m}$

a) max ht at $v_y = 0 \Rightarrow v_y^2 = v_{0y}^2 - 2g\Delta y$

$0 = 30^2 - 2(9.8)\Delta y \rightarrow \Delta y = 45.92 \text{ m}$

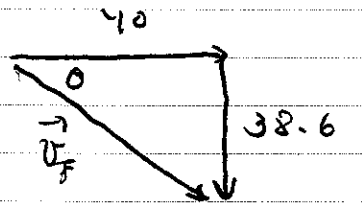
$H_{max} = 75.92 \text{ m}$ $\quad v_y = v_{0y} - g t_u \Rightarrow t_u = 3.06 \text{ s}$

$H_{max} = \frac{1}{2} g t_D^2 \Rightarrow t_D = 3.94 \text{ s} \Rightarrow t_{TOT} = 7 \text{ s}$

b) $v_{fx} = v_{0x} = 40 \text{ m/s}$

$v_{fy} = v_{0y} - g t_{TOT} = 30 - 9.8(7) = -38.6 \text{ m/s}$

$v_f = \sqrt{40^2 + (-38.6)^2}$



$v_f = 55.6 \text{ m/s}$

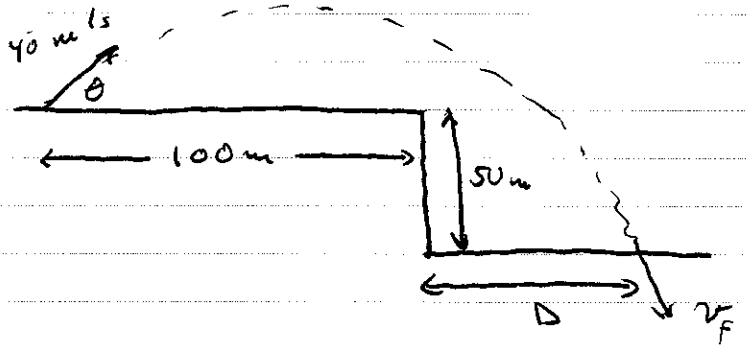
at $\theta = \tan^{-1}\frac{38.6}{40} = 44^\circ$ below horizontal

c) $D = v_{0x} t_{TOT} = 40(7) = 280 \text{ m}$

so $D = 30(7) + \frac{1}{2} a (7)^2 \Rightarrow a = +2.86 \text{ m/s}^2$

PM - 4

7.



a) We need $R = \frac{v_0^2}{g}\sin 2\theta > 100$

$\frac{40^2}{9.8}\sin 2\theta > 100$

$\sin 2\theta > .6125 \Rightarrow 2\theta > 37.77°$

Hence $\theta > 18.88°$ & $\theta < 71.1°$ $\quad 18.9 < \theta < 71.1°$

b) With $\theta = 36.9°$, $v_{0x} = v_0 \cos\theta = 32\ m/s$, $v_{0y} = 24\ m/s$

Want t when $y = 0 \Rightarrow 0 = 50 + 24t - 4.9t^2$

$4.9t^2 - 24t - 50 = 0 \Rightarrow t = -1.57\ s,\ 6.47\ s$

Then $(100 + D) = v_{0x}(6.47) = 32(6.47) = 207\ m$

$D = 107\ m$

$v_{fx} = v_{0x} = 32\ m/s$

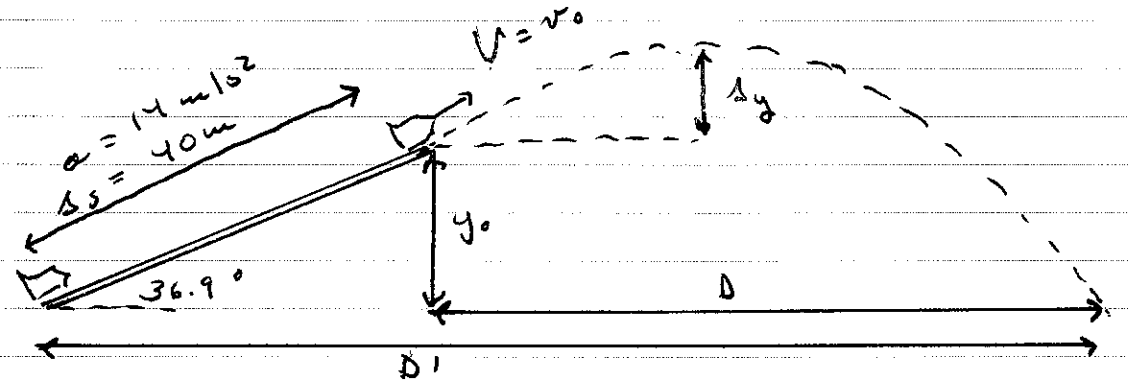
$v_{fy} = v_{0y} - gt = 24 - 9.8(6.47) = -39.4\ m/s$

$v_f = \sqrt{32^2 + 39.4^2} = 50.8\ m/s < 55\ m/s$

No Detonation

PM-5

8.



Moving up track is 1-D motion.

$\therefore \quad v^2 = 0^2 + 2(14)(y_0) \Rightarrow v = 33.5\ m/s$

So v_0 for projectile part of problem $= 33.5\ m/s$

$v_{0x} = v_0 \cos 36.9 = 26.76\ m/s \qquad v_{0y} = v_0 \sin 36.9 = 20.09\ m/s$

$y_0 = 40 \sin 36.9 = 24\ m$

$v_y^2 = v_{0y}^2 - 2g\Delta y \Rightarrow 0 = 20.09^2 - 2g\Delta y$

$\Delta y = 20.6\ m \Rightarrow \boxed{H_{max} = 44.6\ m}$

$v_y = v_{0y} - g t_u \Rightarrow 0 = 20.09 - 9.8 t_u \Rightarrow t_u = 2.05\ s$

$H_{max} = \frac{1}{2} g t_D^2 \Rightarrow t_D = 3.017\ s$

$t_{TOT} = 5.067\ s \Rightarrow D = v_{0x} t_{TOT} = 135.6\ m$

and $D' = 40 \cos 36.9 + D = \boxed{168\ m}$

PM-6

9. Use range formula ... $v_0 = 25$ m/s

with $\theta = 70°$, $R = \frac{v_0^2}{g} \sin 2\theta$ gives

$$D = \frac{25^2}{9.8} \sin 140 = \boxed{41 \text{ m.} = D}$$

$(v_0 \cos\theta)\, t = R$ gives $(25 \cos 70)\, t_{70} = 41$

$t_{70} = 4.794$ s.

The angle $\boxed{\theta = 90 - 70 = 20°}$ also gives us

$R = 41$ m. Now, $(25 \cos 20)\, t_{20} = 41$

gives $t_{20} = 1.745$ s

Therefore $T = t_{70} - t_{20} = 4.794 - 1.745 = \boxed{3.05 \text{ s}}$