Key

1) x-Dir

$\Delta x = D$

$V_{ix} = V$

$a_x = 0\ m/s^2$

y-dir

$\Delta y = \cancel{y_f}^{0} - h$

$V_{iy} = 0\ m/s$

$a_y = g$

Solve for time in y: $\Delta y = \cancel{V_i t}^{0} + \frac{1}{2} a t^2$

$$\Delta y = \frac{1}{2} a t^2 \Rightarrow t = \sqrt{\frac{2\Delta y}{a}} = \sqrt{\frac{2(-h)}{g}}$$

$$V_{ix} = \frac{\Delta x}{t} = \boxed{\frac{D}{\sqrt{\frac{2(-h)}{g}}}}$$

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2) $\theta_{ic} = 11°$ $V_i = V$ unknown y max & θ_0 for 2 y max

Only need y-Direction.

θ_{ic} & y max

$\Delta y =$

$V_{iy} = V \sin \theta_{ic}$

$V_f = 0\frac{m}{s}$

$a_y = -9.8\frac{m}{s^2}$

$$V_{fy}^2 = V_{iy}^2 + 2a_y\Delta y \Rightarrow \Delta y = \frac{-(V_{iy}^2)}{2a_y}$$

$$\Delta y = \frac{-(V \sin \theta_{ic})^2}{2a_y}$$

Part 2 double y max

$$2\Delta y = \frac{-(V \sin \theta_0)^2}{2a_y}$$

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Note θ_u - unknown θ & θ_k Known θ

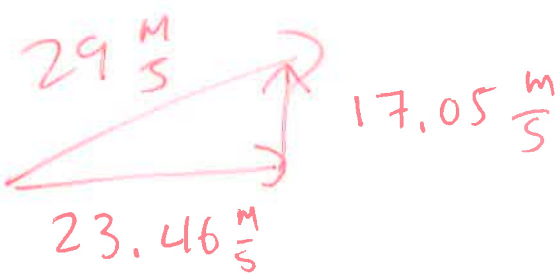
$$2\Delta y = \frac{-(V\sin\theta_u)^2}{2a_y} = 2 \cdot \frac{-(V\sin\theta_k)^2}{2a_y}$$

$$\Rightarrow (\theta_u)^2 = 2(\theta_k)^2$$

$$\boxed{\theta_u = \sqrt{2}\,\theta_k}$$

3) $V = 29\,\frac{m}{s}$ $\theta^\circ = 36$

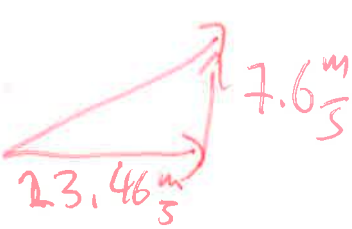
$\theta = 36^\circ$



$a_x = 0\,\frac{m}{s}$, V_x doesn't change

y direction is where change occurs.

$\theta = 18$



Δy

$V_{iy} = 17.05\,\frac{m}{s^2}$

$V_f = 7.6\,\frac{m}{s}$

$a_y = -9.8\,\frac{m}{s^2}$

$t = ?$

$V_f = V_i + at$

$\Rightarrow t = \frac{V_f - V_i}{a}$

$$t = \frac{7.6\frac{m}{s} - 17.05\frac{m}{s}}{-9.8\frac{m}{s^2}} = \boxed{0.96s}$$

4) $V = 15\,\frac{m}{s}$ $\theta = 50°$

V: Velocity Average

$\bar{V} = \frac{\Delta x}{t}$

$\Delta x = \cancel{x_f} - \cancel{x_i}$
for you

$V_{ix} = V\cos\theta = 9.64\,\frac{m}{s}$

$\Delta y = 2.1\,m$

$V_{iy} = V\sin\theta = 11.49\,\frac{m}{s}$

$g = -9.8\,m/s^2$

$a_x = 0\,\frac{m}{s^2}$

$t =$

Note there are two Δx in this problem. One for you & one for your opponent.

Solve for t: $\Delta y = V_i t + \frac{1}{2} a t^2$

Quadratic: $a = -4.9\,\frac{m}{s^2}$ $b = 11.49\,\frac{m}{s}$ $c = -2.1\,m$

$t = 2.15\,s$

$\Delta x = 9.64\,\frac{m}{s} \cdot 2.15\,s = \boxed{20.7\,m}$ for ball

For guy:

$\Delta x = 20.7\,m - 10\,m = 10.7$

$V_{ix} = ?$

$t = 2.15\,s - 0.3\,s = 1.85\,s$

$\bar{V} = \frac{\Delta x}{t} = \frac{10.7\,m}{1.85\,s} = \boxed{5.8\,\frac{m}{s}}$

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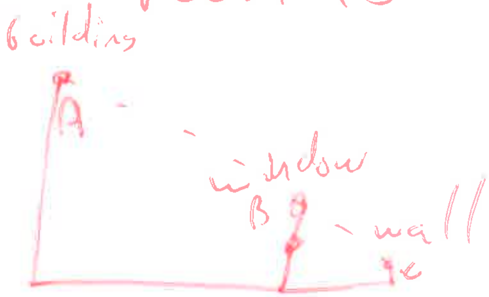
5) Use the info from inside the house to determine Vix, Viy. Viy in the room is Vfy from the building to window.



B to C

$\Delta x = 6.9m$

$V_{ix} = 340 \frac{m}{s}$

$t = \frac{V_{ix}}{t} = 0.02s$

$\Delta y = 0.5m$

$V_{iy} =$

$a = -9.8 \frac{m}{s^2}$

$t = 0.02$

$\Delta y = V_i t + \frac{1}{2} a t^2 \Rightarrow \frac{\Delta y - \frac{1}{2} a t^2}{t} = V_{iy} = 24.9 \frac{m}{s}$

A to B

$\Delta x =$

$V_{ix} = 340 m/s$

t

$\Delta y =$

$V_{iy} = 0 m/s$

$V_{fy} = 24.9 m/s$

$a_y = -9.8 \frac{m}{s^2}$

$t =$

$V_f = V_i + at \Rightarrow t = \frac{V_f - V_i}{a}$

$t = 2.54s$

You know time, Now solve for Δx & Δy

$\Delta y = \cancel{V_i t}^{0} + \frac{1}{2} a t^2$ $\quad \Delta y = \boxed{32.1m} = H$

$\Delta x = 340 \frac{m}{s} \cdot 2.54s = \boxed{863.6m} = D$

Stone w $\Delta x = x$ Stone w/ $\Delta x = 2x$

Concept: a_x doesn't change. Must mean that building w/ $\Delta x = 2x$ allows rock to fall for twice as long.

for x
$\Delta y =$
$v_{iy} = 0 \, m/s$
$g = g$
$t = t$

for $2x$
$\Delta y =$
$v_{iy} = 0 \, m/s$
$g = g$
$t = 2t$

$\Delta y = \cancel{v_i t} + \frac{1}{2} a t^2$

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

$\Delta y = \frac{1}{2} g (2t)^2$

$\frac{1}{2} g \, 2t^2$

for x : t^2 : $4t^2$ for $2x$

taller building is 4 times taller

7) Δx

$v_{ix} = 31.9\,\frac{m}{s}$

$a_x = 0\,m/s$

$t =$

$\Delta y = 0\,m$

$v_{iy} = 16.35\,\frac{m}{s}$

$v_{fy} = -16.35\,m/s$

$a_y = -9.8\,m/s^2$

$t =$

solve for t in y: $v_f = v_i + at$

$t = 2.12\,s.$

Use this to solve for Δx

$\Delta x = v_{ix} t = 67.6\,m$

How many busses?

$$\frac{67.6\,\cancel{m}}{1} \cdot \frac{1\ bus}{2.74\,\cancel{m}} = 24.68\ bus = \boxed{24\ busses}$$