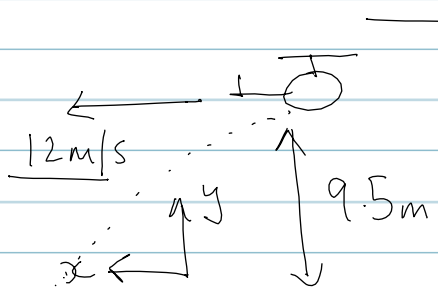
Tutorial 2 : projectiles

1. Helicopter



a) $\vec{V}_{PG} = \vec{V}_{PH} + \vec{V}_{HG}$

$= 12 - 9.2 = \boxed{2.8 \text{ m/s}}$

b) t_F $s_y = \frac{1}{2} a t^2 \Rightarrow t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2 \times -9.5}{-9.81}}$

$= 1.39 \text{ s}$

$x = t_F \times \vec{V}_{PH}$

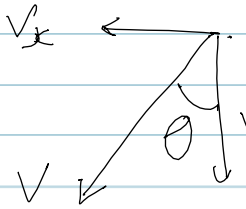
$= 17 \text{ m}$

$x_P = t_F \times V_{PG} = 1.39 \times 2.8$

$x_H = t_F \times V_{HG} = 1.39 \times 9.2$

1.39×12

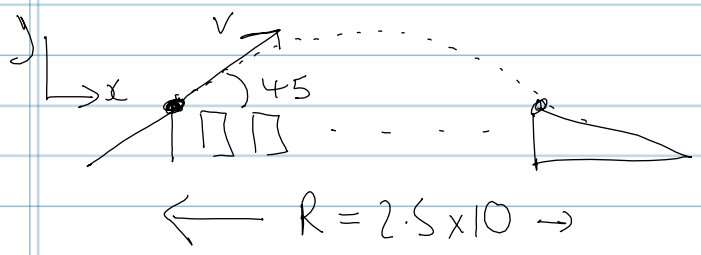
c) Bonus: velocity at point of impact.



$v = \sqrt{13.65^2 + 2.8^2} \simeq 13.9 \text{ m/s}$

$\tan\theta = \frac{V_x}{V_y} \Rightarrow \theta = 11.6$

Jonny A



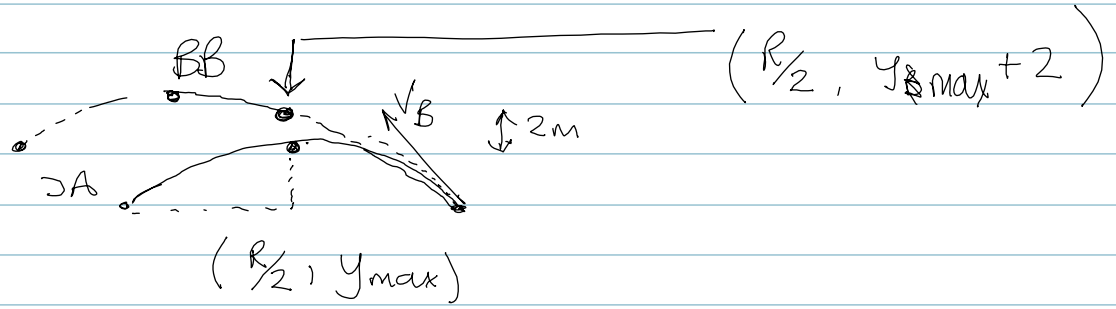
$$R = \frac{V_0^2 \sin 2\theta}{g}$$

$\leftarrow R = 2.5 \times 10 \rightarrow$

$= 25\text{m}$

Angle : $\sin 2\theta = 1 \Rightarrow 2\theta = 90 \Rightarrow \theta = 45^\circ$

$$V_0 = \sqrt{\frac{gR}{\sin 2\theta}} = \underline{15.8 \text{ m/s}} \quad (\approx 57 \text{ kmh})$$



(1) figure out y_{max} for JA.

(2) Know point on BB's trajectory → traj eqn, to solve V.

for JA y_{max} $\quad v_y^2 = u_y^2 + 2as_y \Rightarrow s_y = \frac{v^2 - u^2}{2a} = \frac{0^2 - V_B^2 \sin^2\theta}{-2g}$

$= \underline{6.37\text{m}}$

So, coords for BB $(12.5, 8.37)$.

$$y = x\tan\theta - \frac{gx^2}{2V_B^2\cos^2\theta}$$

$\tan\theta = 1$

$\cos\theta = \frac{1}{\sqrt{2}}$

$\cos^2\theta = \frac{1}{2}$

$$y = x - \frac{gx^2}{2V_B^2}$$

$$V_B = \sqrt{\frac{-gx^2}{y-x}} \qquad \frac{m^3 s^{-2}}{m} \qquad \sqrt{m^2 s^{-2}} \qquad m/s$$

$$= 19.3 \text{ m/s} \quad (\sim 70 \text{ km/h}).$$