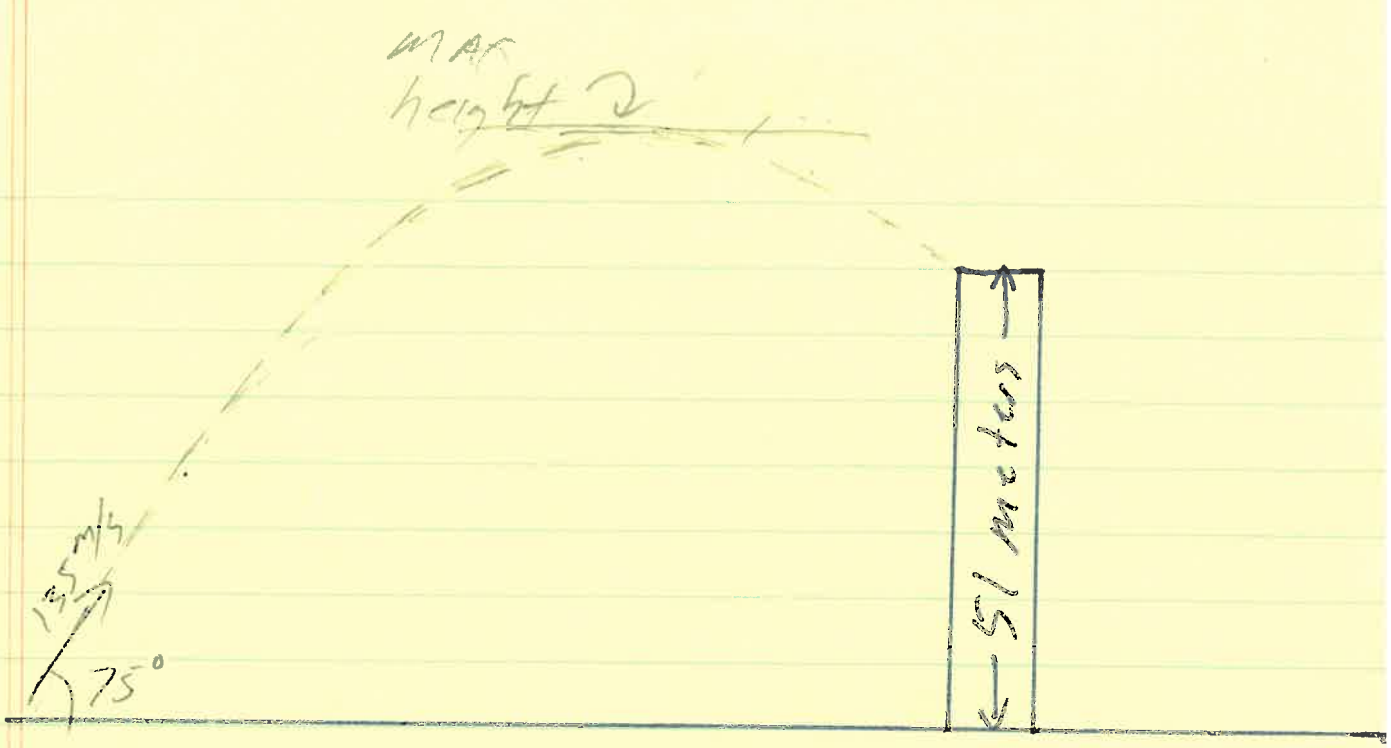
①



Concepts: Part 1a - going up

The object reaches max height at the point where its vertical motion stops (slope = 0!)

I can find max height if I know v_{iy} + the launch angle.

Concepts: Part 1b - going down

The object will accelerate downwards from rest according to gravity.

The object will fall a total distance = to max height − bldg height.

(2)

Concepts - Part 2 - Horizontal

The object will move horizontally at a constant rate.

Find initial velocity in x + y direction

$V_{ix} = V_i \cos\theta = (135\ m/s)(\cos 75^\circ) = 34.94\ m/s_x$

$V_{iy} = V_i \sin\theta = (135\ m/s)(\sin 75^\circ) = 130.40\ m/s_y$

Find max Height: (only use y velocity!)

$V_{fy} = 0$ $\quad y_i = 0\ m$ $\quad A = -9.81\ m/s^2$

$V_{iy} = 130.40\ m/s$ $\quad y_f = ?$ $\quad t = ?$

$V_{fy}^2 - V_{iy}^2 = 2A\Delta y$

$-V_{iy}^2 = 2A\Delta y$

$\frac{-V_{iy}^2}{2A} = \Delta y$

$\frac{-(130.40\ m/s)^2}{2(-9.81\ m/s^2)} = 866.67\ m$

$= 870\ m$ SF

Notes:

$V_{fy} = 0$ so

Solve for Δy

Subst initial cond + Solve

(3)

Now find time to reach max height:

$v_{iy} = 130.40 \text{ m/s} \uparrow \quad v_{fy} = 0 \quad t = ?$

$A = -9.81 \text{ m/s}^2 \quad y_f = 866.67 \text{ m}$ (From previous part)

$y_i = 0$

Now find time to max height:

	Notes
$v_f = v_i + At$	Choose motion eq
$\frac{-v_i}{A} = t$	rearrange Terms
	Solve for t

$$\frac{-130.40 \text{ m/s}}{-9.81 \text{ m/s}^2} = t$$

$t = 13.29 \text{ s} = 13.3 \text{ s}$ S.F.

$= 13.29 \text{ s}$

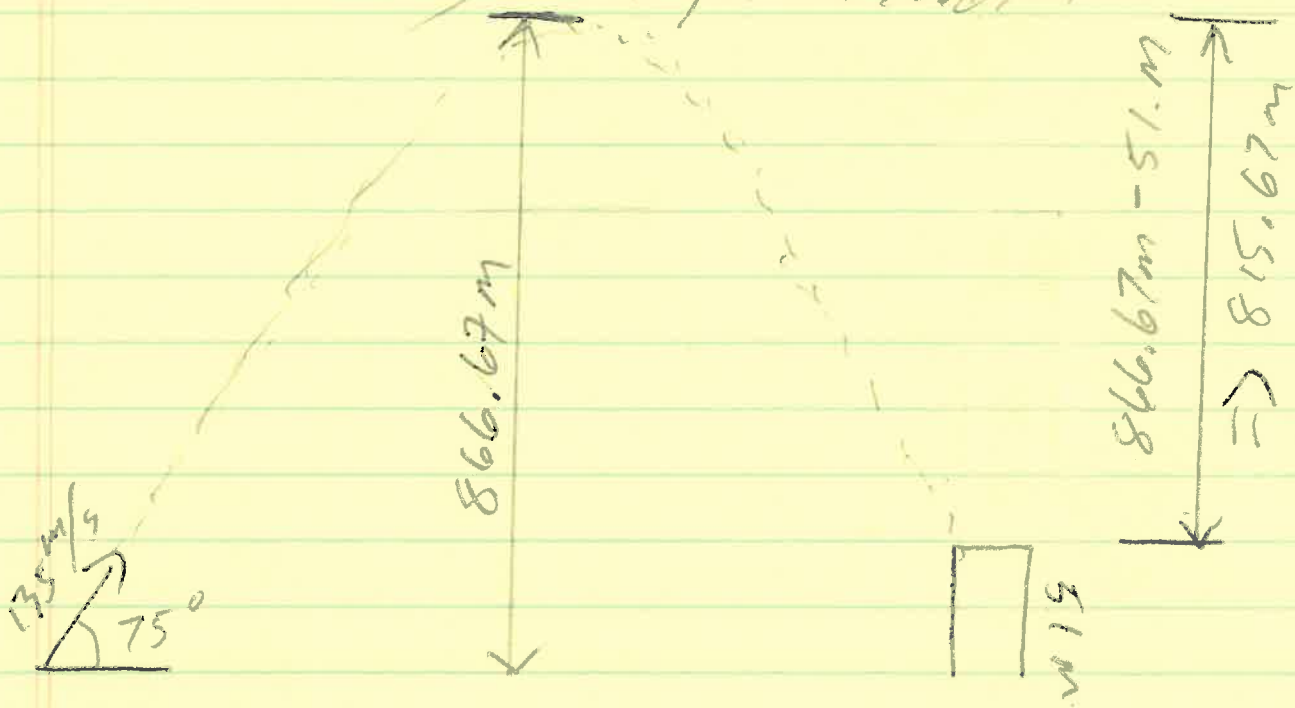
(4) Find distance object falls from Max → Bldg

From previous we know that

Max height = 866.67 m

time to reach max height = 13.29 s

Resketch



Max height = 866.67 m

Bldg height = 51. m

Vert displ. = 815.67 m

(5) Find Time for object to fall from Max height to top of building

$y_F = 815.67$ v_{iy} at max height $= 0.\ m/s$

$y_i = 0.\ m$ $A = -9.81\ m/s^2$ V_{Fy} = irrelevant

$$y_F = y_i + v_i t + \tfrac{1}{2} A t^2$$

$y_i = 0$, $v_i t = 0$

$$y_F = \tfrac{1}{2} A t^2$$

rearrange + solve for t

$$\frac{2y_F}{A} = t^2$$

$$\sqrt{\frac{2y_F}{A}} = t = 12.90\ sec$$

(6) Putting it all together

We found max height ✓
we found Time to Max height ✓
we still need to find total Time
we still need to find x displacmt

$\text{total Time} = \text{Time}_{up} + \text{Time}_{down}$

$\text{Total Time}_{up} = 13.29 \text{ sec}$

Now find total time down (remember the object is accelerating down)

$V_i = 0 \text{ m/s}$ $V_F = \text{unknown}$ $t = ?$
$Y_F = 815.67 \text{ m}$ $Y_i = 0$ $A = 9.81 \text{ m/s}^2$

$Y_F = Y_i + V_i t + \frac{1}{2} A t^2$ | $Y_i = 0, V_i = 0$

$Y_F = \frac{1}{2} A t^2$ | rearrange + solve for t

$\frac{2Y}{A} = t^2$

$\sqrt{\frac{2Y}{A}} = t \Rightarrow \sqrt{\frac{2(815.67 \text{ m})}{9.81 \text{ m/s}^2}} \Rightarrow 12.90 \text{ s}$

(7) Find Horizontal Disp

This is the easiest part since velocity in the horizontal direction is constant.

Therefore we do NOT have to use our equations of motion

$$(V_{ix})(t_{total}) = Disp_x$$

$V_{ix} = 34.94\ m/s$

$T_{up} = 13.29\ s$, $T_{down} = 12.90\ s$

$T_{up} + T_{down} = T_{total}$

$13.29\ s + 12.90\ s = 26.19\ s$

$(34.94\ m/s)(26.19\ s) = 915\ m$ in x dir

YEOW!