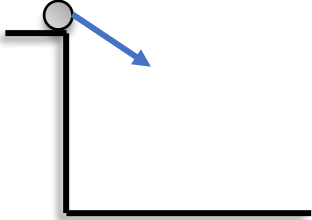


CONCEPT: SOLVING DOWNWARD LAUNCH PROBLEMS

- When an object is launched **downward**, v_{0y} will always be [**POSITIVE** | **NEGATIVE**].

EXAMPLE: You throw a rock at 5m/s angled 37° downward from a building. It hits the ground 10m from the building. Calculate **a)** the height of the building and **b)** the magnitude & direction of its velocity just before hitting the ground.



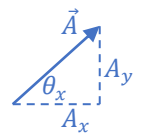
PROJECTILE MOTION

- 1) Draw paths in X&Y and points of interest
(Points of Interest: initial, final, max height, etc.)
- 2) Determine target variable
- 3) Determine interval and UAM equation
- 4) Solve

UAM EQUATIONS

X	Y
$\Delta x = v_x t$	$(1) v_y = v_{0y} + a_y t$ $(2) v_y^2 = v_{0y}^2 + 2a_y \Delta y$ $(3) \Delta y = v_{0y} t + \frac{1}{2} a_y t^2$ $*(4) \Delta y = \frac{1}{2} (v_{0y} + v_f) t$

VECTOR EQs



$$A = \sqrt{A_x^2 + A_y^2}$$

$$\theta_x = \tan^{-1} \left(\frac{|A_y|}{|A_x|} \right)$$

$$A_x = A \cos(\theta_x)$$

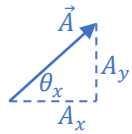
$$A_y = A \sin(\theta_x)$$

- Remember!** If you get stuck and can't solve using X axis equation, try to solve it with a Y axis equation, and vice versa.

PROBLEM: Water pours from a spout at the end of a gutter with a speed of 3.5 m/s, where the spout is angled 45° downwards. The magnitude of the water's velocity when it hits the ground is 14 m/s. How high is the spout from the ground?

- A) 18.8 m
- B) 10.6 m
- C) 10 m
- D) 9.4 m

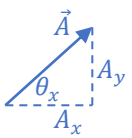
PROJECTILE MOTION
1) Draw paths in X&Y and points of interest <i>(Points of Interest: initial, final, max height, etc.)</i> 2) Determine target variable 3) Determine interval and UAM equation 4) Solve

UAM EQUATIONS		VECTOR EQs
X	Y	 $A = \sqrt{A_x^2 + A_y^2}$ $\theta_x = \tan^{-1} \left(\frac{ A_y }{ A_x } \right)$ $A_x = A \cos(\theta_x)$ $A_y = A \sin(\theta_x)$
$\Delta x = v_x t$	(1) $v_y = v_{0y} + a_y t$ (2) $v_y^2 = v_{0y}^2 + 2a_y \Delta y$ (3) $\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$ *(4) $\Delta y = \frac{1}{2} (v_{0y} + v_f) t$	

PROBLEM: A cannon mounted on a tall fort fires a cannonball with 73 m/s at 49° below the horizontal. If the fort is 300m above the ground, what horizontal distance does the cannonball travel before hitting the ground?

- A) 292 m
- B) 192 m
- C) 220 m
- D) 374.4 m

PROJECTILE MOTION
1) Draw paths in X&Y and points of interest <i>(Points of Interest: initial, final, max height, etc.)</i> 2) Determine target variable 3) Determine interval and UAM equation 4) Solve

UAM EQUATIONS		VECTOR EQs
X	Y	 $A = \sqrt{A_x^2 + A_y^2}$ $\theta_x = \tan^{-1} \left(\frac{ A_y }{ A_x } \right)$ $A_x = A \cos(\theta_x)$ $A_y = A \sin(\theta_x)$
$\Delta x = v_x t$	(1) $v_y = v_{0y} + a_y t$ (2) $v_y^2 = v_{0y}^2 + 2a_y \Delta y$ (3) $\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$ *(4) $\Delta y = \frac{1}{2} (v_{0y} + v_f) t$	