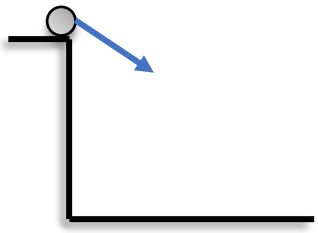
CONCEPT: SOLVING DOWNWARD LAUNCH PROBLEMS

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

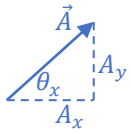
EXAMPLE**:** You throw a rock at 5m/s angled 37° downward from a building**.** It hits the ground 10m from the building**.** Calculate **a)** the height of the building and **b)** the magnitude & direction of its velocity just before hitting the ground**.**



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

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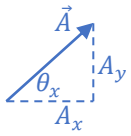

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PROBLEM: A cannon mounted on a tall fort fires a cannonball with 73 m/s at 49° below the horizontal. If the fort is 300m above the ground, what horizontal distance does the cannonball travel before hitting the ground?

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

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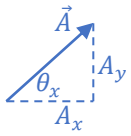

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