CONCEPT: SOLVING KINEMATICS PROBLEMS IN 2D

● Solving constant acceleration problems in 2D is done the *same* way as in 1D!

- **Remember**: Separate 2D motion into *two* 1D motions and solve.

EXAMPLE: A hockey puck slides along a lake at 8m/s east. A strong wind accelerates the puck at a constant 3 m/s^2 in a direction 37° northeast. What is the magnitude & direction of the hockey puck's displacement after 5s?

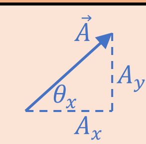
2D MOTION w/ ACCELERATION
1) Draw Diagram & decompose vectors into **x** & **y**
2) List 5 variables for **x** & **y**, identify known & target variables
3) Pick UAM Eq. ***without*** "Ignored" Variable
4) Solve

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

PROBLEM: A survey drone has just completed a scan at x,y coordinates (57m, 8m) at t=0. It needs to return to a lab located at (-115, 72) m. If its initial velocity is 16m/s in the +y-direction, and it has only 18s of battery life remaining, what constant acceleration (magnitude and direction) does it need to reach the lab?

A) 2.8 m/s^2; along –x axis
B) 1.8 m/s^2; 51.8° below –x axis
C) 2.7 m/s^2; above –x axis
D) 1.3 m/s^2; 24° above –x axis

2D MOTION w/ ACCELERATION
1) Draw Diagram & decompose vectors into **x** & **y**
2) List 5 variables for **x** & **y**, identify known & target variables
3) Pick UAM Eq. ***without*** "Ignored" Variable
4) Solve

MOTION EQs	VECTOR EQs
$v_{avg} = \frac{\Delta x}{\Delta t}$ $a_{avg} = \frac{\Delta v}{\Delta t}$	
UAM (1) $v = v_0 + at$ (2) $v^2 = v_0^2 + 2a\Delta x$ (3) $\Delta x = v_0 t + \frac{1}{2}at^2$ (4)* $\Delta x = \frac{(v_0+v)}{2}t$	$A = \sqrt{A_x^2 + A_y^2}$ $\theta_x = \tan^{-1}\left(\frac{\lvert A_y\rvert}{\lvert A_x\rvert}\right)$ $A_x = A\cos(\theta_x)$ $A_y = A\sin(\theta_x)$