

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/s² 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

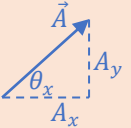
X	Y
(1) $v_x = v_{0x} + a_x t$	(1) $v_y = v_{0y} + a_y t$
(2) $v_x^2 = v_{0x}^2 + 2a_x \Delta x$	(2) $v_y^2 = v_{0y}^2 + 2a_y \Delta y$
(3) $\Delta x = v_{0x} t + \frac{1}{2} a_x t^2$	(3) $\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$
(4) $\Delta x = \left(\frac{v_x + v_{0x}}{2} \right) t$	(4) $\Delta y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

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/s²; along -x axis
- B) 1.8 m/s²; 51.8° below -x axis
- C) 2.7 m/s²; above -x axis
- D) 1.3 m/s²; 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)* $\Delta x = \frac{(v_0 + v)}{2}t$	 $A = \sqrt{A_x^2 + A_y^2}$ $\theta_x = \tan^{-1} \left(\frac{ A_y }{ A_x } \right)$ $A_x = A \cos(\theta_x)$ $A_y = A \sin(\theta_x)$