# Adding Vectors by Components and Adding Velocities in 2-Dimensions

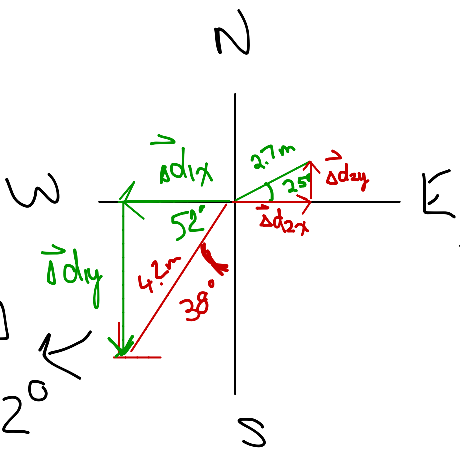
SPH3U – Motion in 2 Dimensions

# As complicated as it gets – Neither Vector is Due North, South, East, or West $\vec{\Delta d}_1$

A hockey puck travels a displacement of 4.2 m [S 38° W]. It is then struck by a hockey player's stick and undergoes a displacement of 2.7 m [E 25° N]. What is the puck's total displacement?

$\vec{\Delta d}_2$

$$\vec{\Delta d}_R = \vec{\Delta d}_1 + \vec{\Delta d}_2$$




**$\vec{\Delta d}_1$**

$\vec{\Delta d}_{1x} = 4.2\cos 52°$

$\vec{\Delta d}_{1x} = 2.59\text{m [W]}$

$\vec{\Delta d}_{1y} = 4.2\sin 52°$

$= 3.31\text{m [S]}$

**$\vec{\Delta d}_2$**

$\vec{\Delta d}_{2x} = 2.7\cos 25°$

$= 2.45\text{m [E]}$

$\vec{\Delta d}_{2y} = 2.7\sin 25°$

$= 1.14\text{m [N]}$

$\vec{\Delta d}_{Rx} = \vec{\Delta d}_{1x} + \vec{\Delta d}_{2x}$

$= 2.59\text{m [W]} + 2.45\text{m [E]}$

$= 2.59\text{m [W]} - 2.45\text{ [W]}$

$\vec{\Delta d}_{Rx} = 0.14\text{m [W]}$

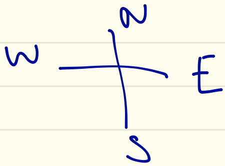
$\vec{\Delta d}_{Ry} = \vec{\Delta d}_{1y} + \vec{\Delta d}_{2y}$

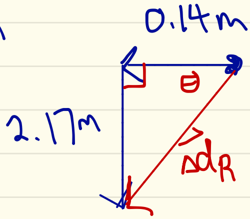
$= 3.31\text{m [S]} + 1.14\text{m [N]}$

$= 3.31\text{m [S]} - 1.14\text{m [S]}$

$\vec{\Delta d}_{Ry} = 2.17\text{m [S]}$

$\vec{\Delta d_R}$




$$|\vec{\Delta d_R}| = \sqrt{(2.17)^2 + (0.14)^2}$$

$$= \sqrt{4.7285}$$

$$|\vec{\Delta d_R}| = 2.2\,m$$

$$\tan\theta = \frac{opp}{adj}$$

$$\theta = \tan^{-1}\left(\frac{2.17}{0.14}\right)$$

$$\theta = 86^\circ$$

$$\therefore \vec{\Delta d_R} = 2.2\,m\ [W\ 86^\circ\ S]$$

# Adding Velocities in 2-Dimensions

- Video – The River Boat Problem

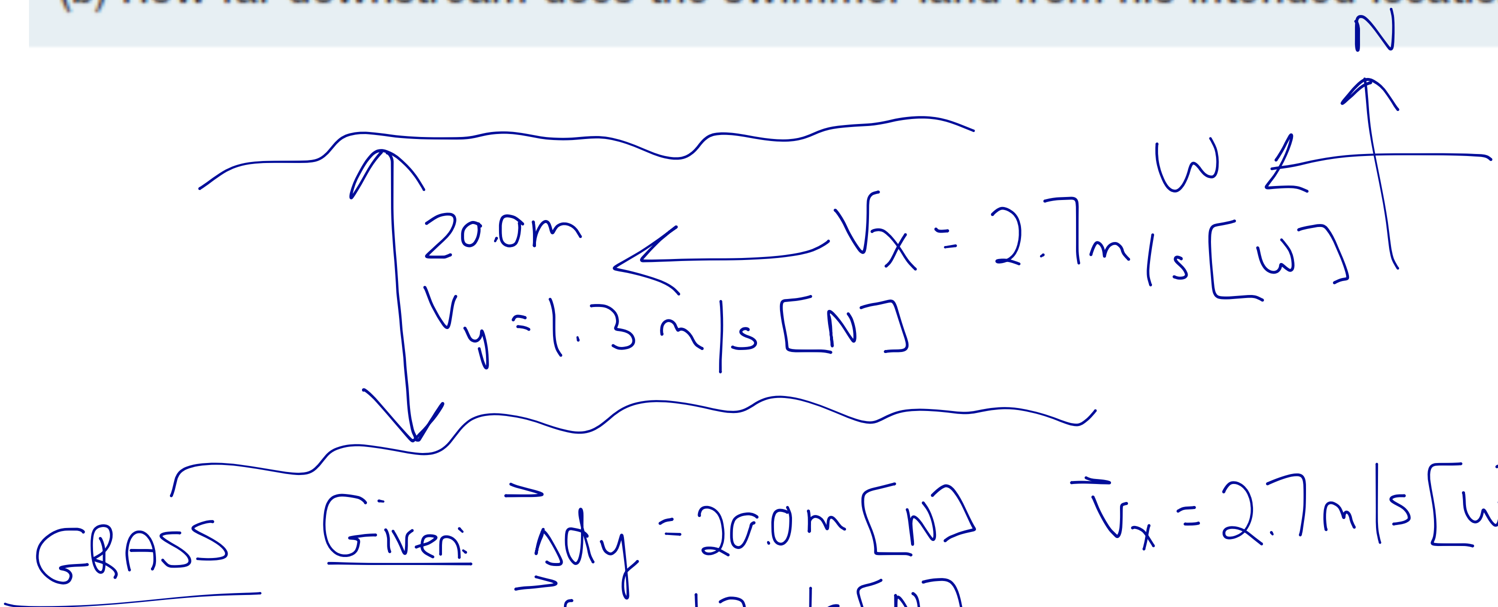
- The keys to these types of problems:
  - Treat the x and y components independently
  - The same time is taken for each motion !!!!!

# Pg. 74 – Practice #2

A swimmer swims perpendicular to the bank of a 20.0 m wide river at a velocity of 1.3 m/s. Suppose the river has a current of 2.7 m/s [W]. T/I

(a) How long does it take the swimmer to reach the other shore? [ans: 15 s]

(b) How far downstream does the swimmer land from his intended location? [ans: 42 m [W]]




**Given:** $\vec{\Delta d_y} = 20.0\text{ m [N]}$  $\vec{V_x} = 2.7\text{ m/s [W]}$

$\vec{V_y} = 1.3\text{ m/s [N]}$

**Required:** time $= \Delta t$

distance downstream $= \vec{\Delta d_x}$

**Analysis**

No acceleration

$V = d/t$

$\Delta t_x = \Delta t_y$

**Steps**

$$V_y = \frac{\vec{\Delta d_y}}{t}$$

$$t = \frac{\vec{\Delta d_y}}{\vec{V_y}}$$

$$t = \frac{20.0\text{ m [N]}}{1.3\text{ m/s [N]}}$$

t = 15.4 s

t = 15 s

2 sig digs

In $\underline{x}$

$\vec{v}_x = 2.7\,m/s\,[W]$

$t = 15.4\,s$

$\vec{\Delta d}_x = ?$

$\vec{v}_x = \frac{\vec{\Delta d}_x}{t}$

$\vec{\Delta d}_x = \vec{v}_x\, t$

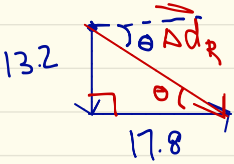
$= 2.7\,m/\cancel{s}\,[W] \times 15.4\,\cancel{s}$

$\vec{\Delta d}_x = 41.58\,m$

$\vec{\Delta d}_x = 42\,m\,[W]$

Pg. 67 #2.

$\vec{\Delta d}_1 = 13.2\,m\,[S]$
$\vec{\Delta d}_2 = 17.8\,m\,[E]$




$|\vec{\Delta d}_R| = \sqrt{(13.2)^2 + (17.8)^2}$

$|\vec{\Delta d}_R| = \sqrt{491.08}$

$|\vec{\Delta d}_R| = 22.2\,m$

$\tan\theta = \dfrac{13.2}{17.8}$ $\quad\therefore \vec{\Delta d}_R = 22.2\,m\,[E\,37^\circ S]$

$\theta = \tan^{-1}\left(13.2/17.8\right)$
$\theta = 37^\circ$

# Work for the Day

- Pg. 69 – go over Sample Problem #1
- Pg. 71 #1 (similar to Sample problem #1), #2 (similar to the first example in today's note)
- Pg. 72 – 74 go over the river crossing examples in the text.
- Pg. 75 #2,3,7,8
- Quiz ~~Thursday~~ Friday.