1.9 Adding Non-Right Angle Vectors

There are two methods for adding vectors which are not parallel or perpendicular to each other; Trig Laws or breaking vectors into x and y components.

Method 1: Trig Laws

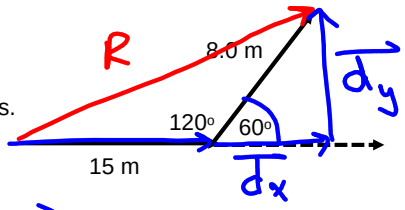
In order to use Sine and Cosine Laws, you need to have covered this in Math 20-1.

Method 2: Breaking vectors into x and y components.

We will focus on this method in Physics 20 as Math 20-1 is not a pre-requisite.

Ex.) Add the following vectors:

Step 1: Break each vector into its x and y components.



$\cos 60° = \frac{\vec{d}_x}{8.0}$ $\quad \vec{d}_x = +4.0\text{ m}$

$\sin 60° = \frac{\vec{d}_y}{8.0}$ $\quad \vec{d}_y = +6.928\ldots\text{ m}$

Step 2: Add the vectors going in the x and y directions.

x_{total} = $15m + 4.0m = 19m$

y_{total} = $6.9m$

Step 3: Using the new x and y components, find the new resultant.

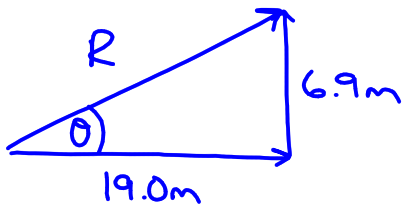
$R = \sqrt{19.0^2 + 6.982...^2}$

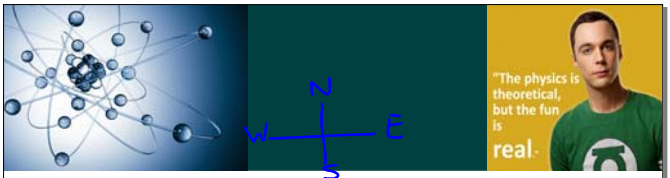
$R = 20m\ [20°]$

$\tan\theta = \frac{6.982...}{19.0}$

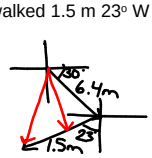
$\theta = 20°$ NofE

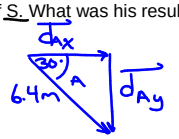
Step 4: Redraw the diagram.





Ex.) Scott walked his dog a distance of 6.4 m 30° S of E. He then stopped and walked 1.5 m 23° W of S. What was his resultant displacement?



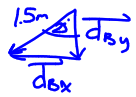


$\cos 30^\circ = \frac{\vec{d}_{Ax}}{6.4}$

$\vec{d}_{Ax} = +5.5\text{m}$

$\sin 30^\circ = \frac{\vec{d}_{Ay}}{6.4}$

$\vec{d}_{Ay} = -3.2\text{m}$



$\cos 23^\circ = \frac{\vec{d}_{By}}{1.5}$

$\vec{d}_{By} = -1.4\text{m}$

$\sin 23^\circ = \frac{\vec{d}_{Bx}}{1.5}$

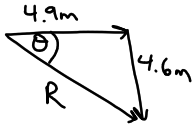
$\vec{d}_{Bx} = -0.6\text{m}$

$d_{x\,total} = +5.5\text{m} + -0.6\text{m}$

$= +4.9\text{m}$

$d_{y\,total} = -3.2\text{m} + -1.4\text{m}$

$= -4.6\text{m}$



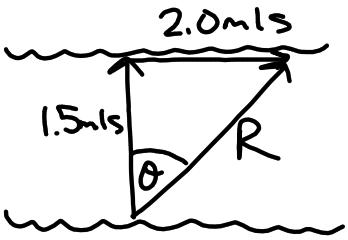
$R = \sqrt{4.9^2 + 4.6^2}$

$= 6.7\text{m}\ [43^\circ \text{S of E}]$

$\tan\theta = \frac{4.6}{4.9}\quad \theta = 43^\circ$

Now we will do Physics problems with these two-dimensional vectors:

Ex.) A swimmer whose swimming velocity in still water is 1.50 m/s travels north across a river. The river current is flowing 2.0 m/s East. What is the resultant velocity of the swimmer?

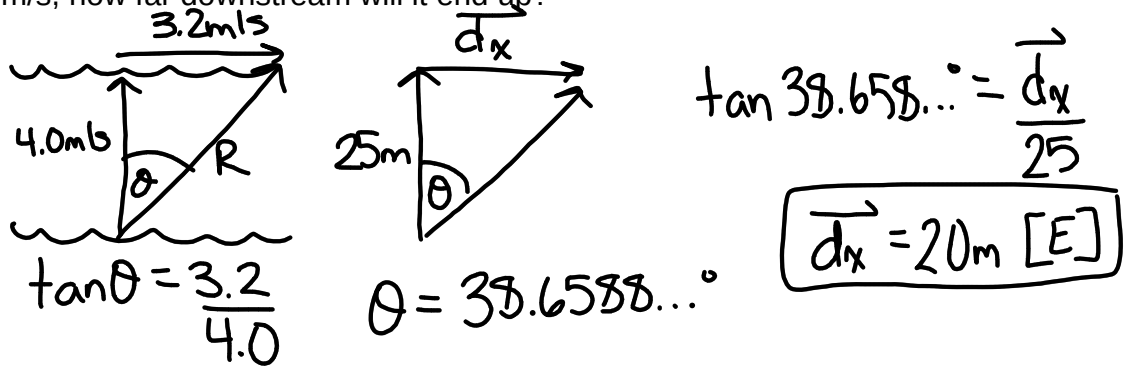


$R = \sqrt{1.5^2 + 2.0^2} = 2.5\text{m/s}\ [53^\circ \text{E of N}]$

$\tan\theta = \frac{2.0}{1.5}$

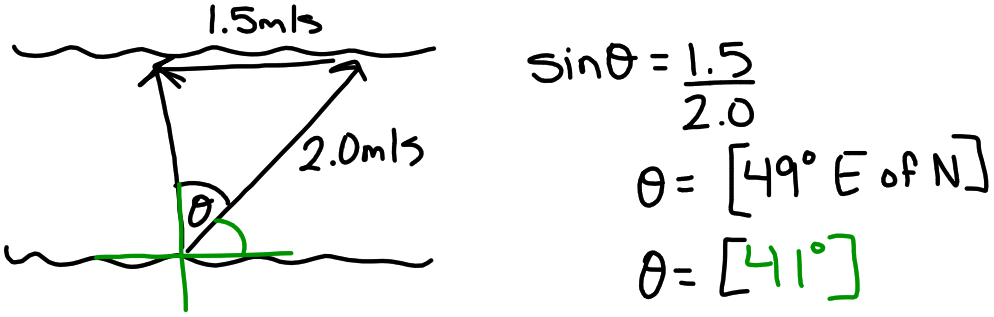
$\theta = 53^\circ$

Ex.) A canoe is paddling across a stream which is 25 m wide. The stream has a current of 3.2 m/s East. If the canoe paddles directly North with a velocity of 4.0 m/s, how far downstream will it end up?

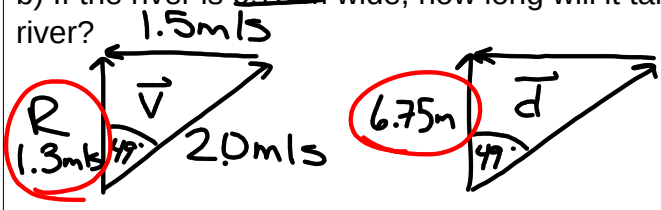


Ex.) Heather wants to swim across a river to a point directly North across from her starting point.

a) If Heather can swim at 2.0 m/s and the river has a current of 1.5 m/s West, what direction must she start off at?



b) If the river is 6.75 m wide, how long will it take until Heather crosses the river?



$R = \sqrt{2.0^2 - 1.5^2}$

$= 1.3 m/s$

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

$1.3 m/s = \frac{6.75 m}{t}$

$t = 5.1 s$

Pg. 90 # 4-10.