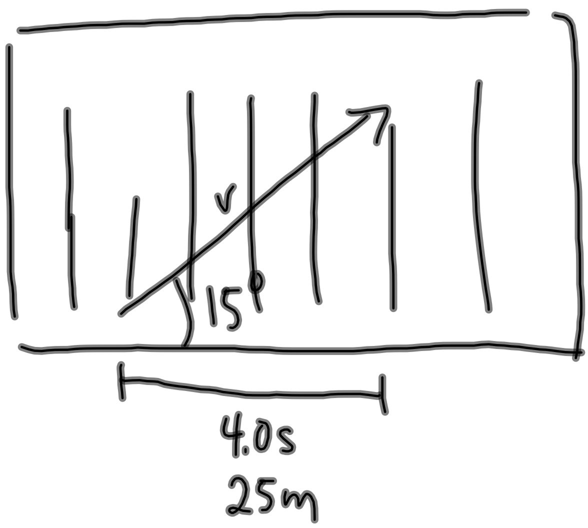
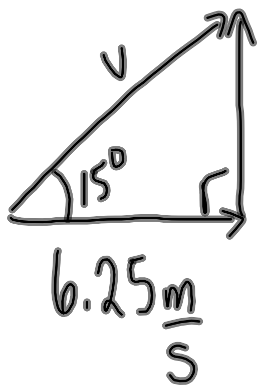
Components of Vectors





No Current	With current
1) 2.47s	1) 2.57s
2) 2.34s	2) 2.41s
3) 2.43s	3) 2.47s

The "boat" took basically the same time to cross the river when it was "headed" directly across the river.

Relative Motion

$$_{p}\vec{V}_{g} = {_{p}\vec{V}_{a}} + {_{a}\vec{V}_{g}}$$

- $_{p}\vec{V}_{g}$ ← to an observer on the ground (stationary)
- $_{p}\vec{V}_{a}$ ← airspeed + heading
- $_{a}\vec{V}_{g}$ ← windspeed + direction

SP1

$_{p}\vec{V}_{a} = 200\text{ km/h [?]}$

$_{a}\vec{V}_{g} = 50.0\text{ km/h [E]}$

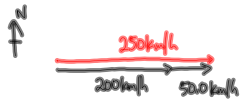
$_{p}\vec{V}_{g} = ?$

$$_{p}\vec{V}_{g} = {_{p}\vec{V}_{a}} + {_{a}\vec{V}_{g}}$$

a) heading [E]

$_{p}\vec{V}_{g} = 200\text{ km/h [E]} + 50.0\text{ km [E]}$

$_{p}\vec{V}_{g} = 250\text{ km/h [E]}$



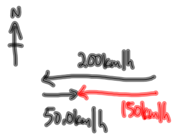
b) heading [W]

$_{p}\vec{V}_{g} = {_{p}\vec{V}_{a}} + {_{a}\vec{V}_{g}}$

$_{p}\vec{V}_{g} = 200\text{ km/h [W]} + 50.0\text{ km/}$

$_{p}\vec{V}_{g} = 200\text{ km/h [W]} - 50.0\text{ km/}$

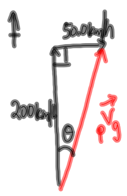
$_{p}\vec{V}_{g} = 150\text{ km/h [W]}$



c) heading [N]

$_{p}\vec{V}_{g} = {_{p}\vec{V}_{a}} + {_{a}\vec{V}_{g}}$

$_{p}\vec{V}_{g} = 200\text{ km/h [N]} + 50.0\text{ k}$



To find the magnitude:

$c^2 = a^2 + b^2$

$c^2 = (200\text{ km/h})^2 + (50.0\text{ k}$

$c = 206\text{ km/h}$

To find the direction:

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

$\tan\theta = \frac{50.0\text{ km/h}}{200\text{ km/h}}$

$\theta = \tan^{-1}\left(\frac{50.0}{200}\right)$

$\theta = 14.0^\circ$

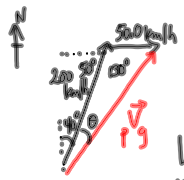
$_{p}\vec{V}_{g} = 206\text{ km/h [N}$

d) heading [N40°E]

$_{p}\vec{V}_{g} = {_{p}\vec{V}_{a}} + {_{a}\vec{V}_{g}}$

$_{p}\vec{V}_{g} = 200\text{ km/h [N40°E]}$

50.0 km/



Law of Cosines (find the side

$c^2 = a^2 + b^2 - 2ab\cos C$

$c^2 = (200)^2 + (50.0)^2 - 2(200)(50.0$

$c = 235\text{ km/h}$

Law of Sines

$\frac{a}{\sin A} = \frac{b}{\sin B}$

$\frac{235\text{ km/h}}{\sin 130^\circ} = \frac{50.0\text{ km/h}}{\ldots}$

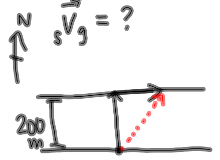
2. $_s\vec{V}_w = 1.80\,m/s\ [N]$

$_w\vec{V}_g = 1.00\,m/s\ [E]$

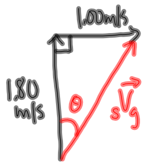
$_s\vec{V}_g = ?$

$_s\vec{V}_g = {_s\vec{V}_w} + {_w\vec{V}_g}$

$_s\vec{V}_g$: swimmer wrt ground; $_s\vec{V}_w$: swimmer in still water; $_w\vec{V}_g$: current



$_s\vec{V}_g = 1.80\,m/s\,[N] + 1.00\,m/s\,[E]$



a) $c^2 = a^2 + b^2$

$c^2 = (1.80\,m/s)^2 + (1.00\,m/s)^2$

$c = 2.06\,m/s$

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

$\tan\theta = \frac{1.00}{1.80}$

$\theta = 29.1°$

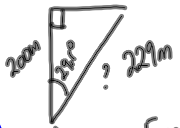
$_s\vec{V}_g = 2.06\,m/s\ [N29.1°E]$

b) $\vec{v} = \frac{\Delta\vec{d}}{\Delta t}$

$1.80\,m/s\,[N] = \frac{200\,m\,[N]}{\Delta t}$

$\Delta t = \frac{200\,m\,[N]}{1.80\,m/s\,[N]}$

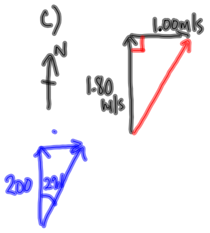
$\Delta t = 111\,s$



$\Delta\vec{d}_{swimmer} = 229\,m\,[N29.1°E]$

~~X~~ The displacement and velocity **must** match in direction

c)



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

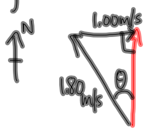
$\Delta\vec{d} = \vec{v}\,\Delta t$

$\Delta\vec{d} = (1.00\,m/s\,[E])(111\,s)$

$\Delta\vec{d} = 111\,m$

In what direction should the swimmer head in order to go straight across the river?

Some of you say [N29.1°W]



$_s\vec{V}_g$ (resultant)

$\sin\theta = \frac{opp}{hyp}$

$\sin\theta = \frac{1.00\,m/s}{1.80\,m/s}$

$\theta = \sin^{-1}\left(\frac{1.00}{1.80}\right)$

$\theta = 33.7°$

The swimmer must head [N33.7°W] in order to swim straight across the river