Relative Motion

$\vec{V}_{pg} = \vec{V}_{pa} + \vec{V}_{ag}$

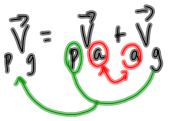
- $\vec{V}_{pg}$: w.r.t ground
- $\vec{V}_{pa}$: plane's airspeed + heading
- $\vec{V}_{ag}$: wind

SP1

$\vec{V}_{pa} = 200\ km/h\ [?]$

$\vec{V}_{ag} = 50.0\ km/h\ [E]$

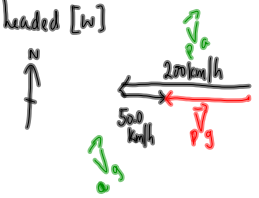
$\vec{V}_{pg} = ??$



a) headed [E]

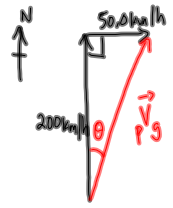
$\vec{V}_{pg} = 250\ km/h\ [E]$

b) headed [W]



$\vec{V}_{pg} = 150\ km/h\ [W]$

c) headed [N]



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

$c^2 = (200\ km/h)^2 + (50.0\ km/h)^2$

$c \doteq 206\ km/h$

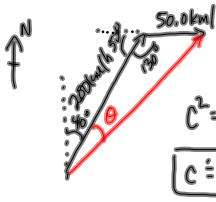
$\tan\theta = \frac{opp}{adj}$

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

$\theta \doteq 14.0°$

$\vec{V}_{pg} = 206\ km/h\ [N14.0°E]$

d) headed [N40°E]



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

$c^2 = 200^2 + 50.0^2 - 2(200)(50.0)\cos 130°$

$c \doteq 235\ km/h$

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

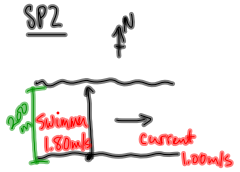
$\frac{50.0\ km/h}{\sin\theta} = \frac{235\ km/h}{\sin 130°}$

$\sin\theta = \frac{(50.0\ km/h)\sin 130°}{235\ km/h}$

$\theta \doteq 9.4°$

$\vec{V}_{pg} = 235\ km/h\ [N49°E]$

SP2



$\vec{V}_{sg} = \vec{V}_{sw} + \vec{V}_{wg}$

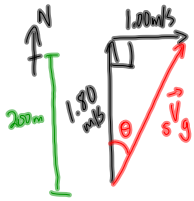
wrt riverbank — swimmer in still water + bis — current

a) $\vec{V}_{sg} = ?$

b) $\Delta t = ?$

c) $\vec{d}_{downstream} = ?$

a)



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

$c^2 = (1.80)^2 + (1.00)^2$

$c \doteq 2.06$ m/s

$\vec{V}_{sg} = 2.06$m/s [N29.1°E]

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

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

$\theta \doteq 29.1°$

b) $\vec{V} = \frac{\vec{\Delta d}}{\Delta t}$ ← directions must match!

$\vec{V}_{across} = \frac{\vec{\Delta d}_{across}}{\Delta t}$

$\Delta t = \frac{\vec{\Delta d}_{across}}{\vec{V}_{across}}$

$\Delta t = \frac{200\text{ m [across]}}{1.80\frac{\text{m}}{\text{s}}\text{ [across]}}$ > directions MUST match !!!

$\Delta t \doteq 111$ s

c) $\vec{V} = \frac{\vec{\Delta d}}{\Delta t}$

directions MUST match!

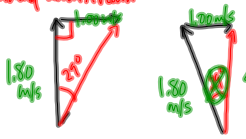
$\vec{V}_{downstream} = \frac{\vec{\Delta d}_{downstream}}{\Delta t}$

$1.00\text{m/s [downstream]} = \frac{\vec{\Delta d}_{downstream}}{111\text{s}}$

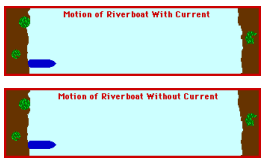
$\vec{\Delta d} \doteq 111\text{ m [downstream]}$

What direction would you head to land directly across from your starting point?

landing downstream



← this speed will be less than 1.80m/s, so the time will be greater than 111 s.



← Same time to cross with & without current as long as heading perpendicular to current

http://www.physicsclassroom.com/mmedia/vectors/rb.cfm