PreCalculus

Section 6.1

Combination of Vectors

Resultant Vectors

HPC/RPC 2017

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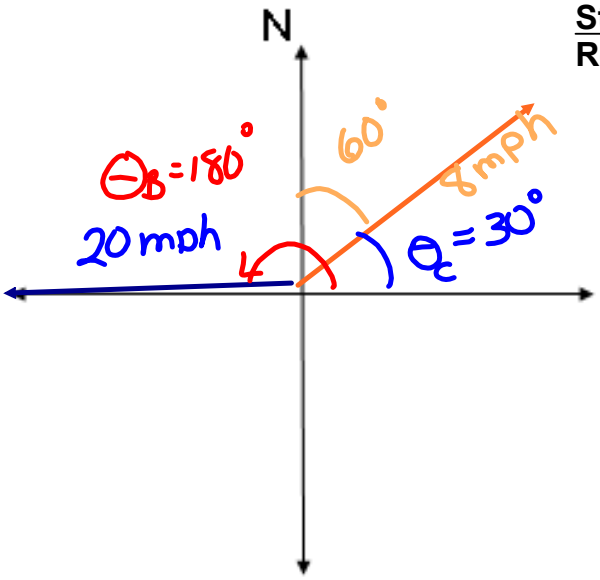
Example 1: A boat is traveling due West at a speed of 20 mph. There is an 8 mph current flowing at a bearing of 60º. What is the "true" speed of the boat?



Step 1:
Resolve each vector into its components

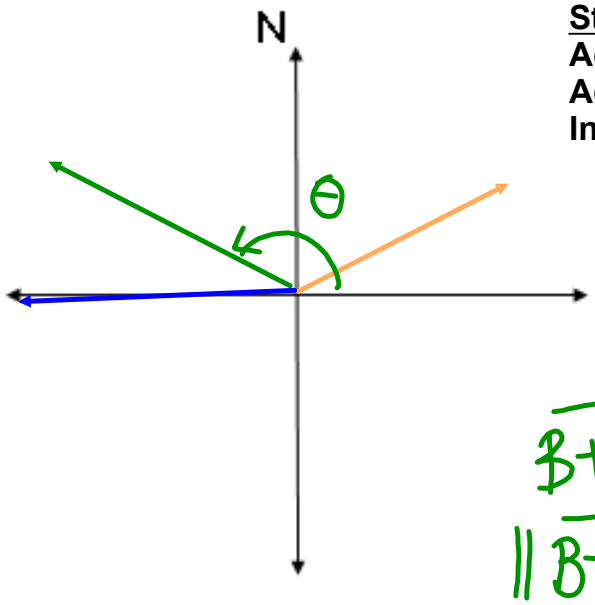
$\vec{B} = \langle 20\cos 180, 20\sin 180 \rangle$

$\vec{C} = \langle 8\cos 30, 8\sin 30 \rangle$

$\vec{B} = \langle -20, 0 \rangle$

$\vec{C} = \langle 6.928, 4 \rangle$

Example 1: A boat is traveling due West at a speed of 20 mph. There is an 8 mph current flowing at a bearing of 60º. What is the "true" speed of the boat?



Step 2:
Add horizontal components;
Add vertical components.
In other words; add the vectors

$\vec{B} = \langle -20, 0 \rangle$

$\vec{C} = \langle 6.928, 4 \rangle$

$\vec{B}+\vec{C} = \langle -13.072, 4 \rangle$

$\|\vec{B}+\vec{C}\| = \sqrt{(-13.072)^2 + (4)^2}$

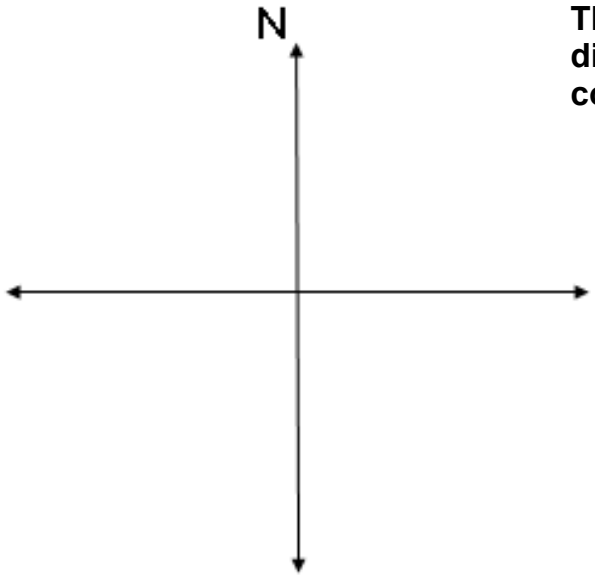
$\|\vec{B}+\vec{C}\| = 13.670$

So, the boat's "true" speed due West is

$\theta_{\vec{B}+\vec{C}} = \cos^{-1}\left(\frac{-13.072}{13.670}\right)$

$\theta_{\vec{B}+\vec{C}} = 162.99^\circ \approx 163^\circ$

Example 1: **A boat is traveling due West at a speed of 20 mph. There is an 8 mph current flowing at a bearing of 60º. What is the "true" speed of the boat?**



The resultant vector shows the actual direction of the boat, without compensating for the current

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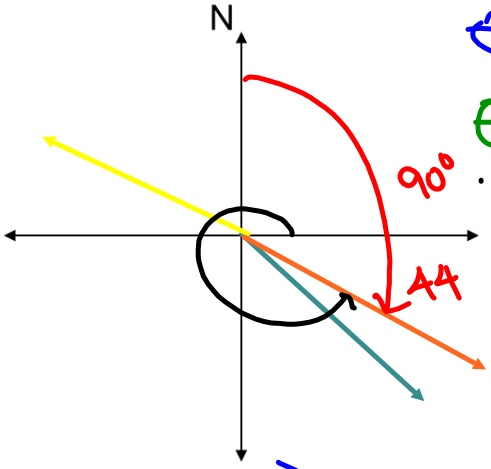
Example 2: An airplane is flying 350 mph at a bearing of 132°.
If the wind is blowing 47 mph at a bearing of 300°, find:

- the actual ("ground") speed of the plane and
- the bearing of the plane as a result of the wind



$\theta_P = 360 - 42^\circ = 318^\circ$

$\theta_W = 90 + 60 = 150^\circ$

$\theta_{Bearing} = 134^\circ$

$\theta_{P+W} = 316.16^\circ$

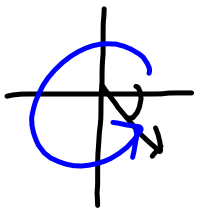
360 − 316. = 44

$\vec{P} = \langle 350\cos 318, 350\sin 318 \rangle = \langle 260.100, -234.193 \rangle$

$\vec{W} = \langle 47\cos 150^\circ, 47\sin 150 \rangle = \langle -40.703, 23.5 \rangle$

$\vec{P+W} = \langle 219.398, -210.696 \rangle$

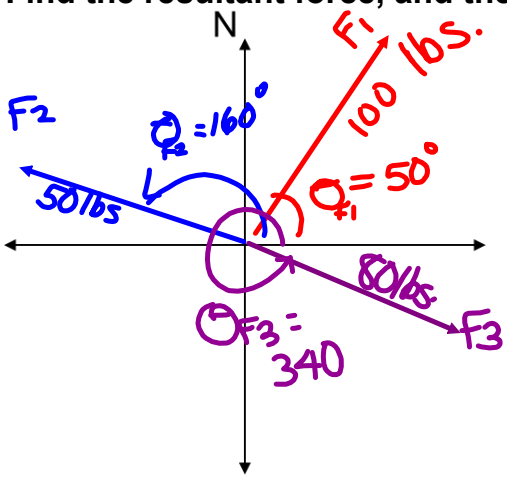
$||\vec{P+W}|| = \sqrt{(219.398)^2 + (-210.696)^2} = 304.184$



$\theta_{\vec{P+W}} = \cos^{-1}\left(\frac{219.398}{304.184}\right) = 43.84^\circ$

$\theta = 360 - 43.84 = 316.16^\circ$

Example 3: Three forces all work on the same object.
Force 1 = 100 lb at an angle of 50°
Force 2 = 50 lb at an angle of 160°
Force 3 = 80 lb at an angle of -20°
Find the resultant force, and the angle at which it acts.



$F_1 = \langle 100\cos 50, 100\sin 50 \rangle = \langle 64.279, 76.604 \rangle$

$F_2 = \langle 50\cos 160, 50\sin 160 \rangle = \langle -46.980, 17.101 \rangle$

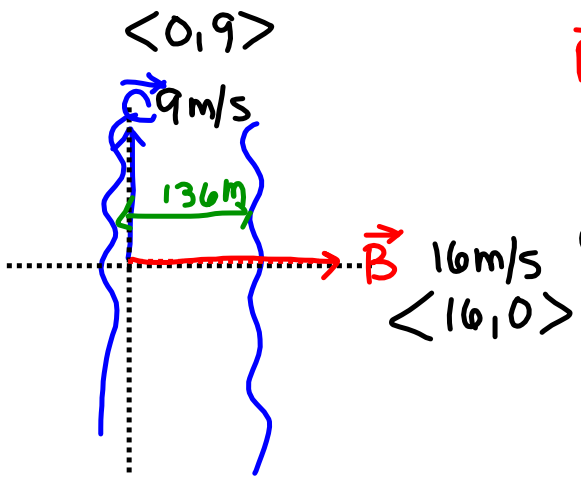
$F_3 = \langle 80\cos 340, 80\sin 340 \rangle = \langle 75.175, -27.362 \rangle$

$\overrightarrow{F_1 + F_2 + F_3} = \langle 92.465, 66.347 \rangle$

$\| F_1 + F_2 + F_3 \| = \sqrt{(92.465)^2 + (66.347)^2}$

$= 113.806$

$\theta_{F_1+F_2+F_3} = \cos^{-1}\left(\frac{92.465}{113.806}\right) = 35.66°$



$\vec{B} = \langle 16\cos 0^\circ, 16\sin 0^\circ \rangle = \langle 16, 0 \rangle$

$\vec{C} = \langle 9\cos 90, 9\sin 90 \rangle = \langle 0, 9 \rangle$

a) $\vec{B}+\vec{C}$ $= \langle 16, 9 \rangle$

$\|\vec{B}+\vec{C}\| = \sqrt{16^2+9^2} = \sqrt{337}$

≈ 18.358

$\theta_{B+C} = \cos^{-1}\left(\frac{16}{18.358}\right) = 29.36^\circ$

b. $d = rt$

$136\,m = 16\,m/s \cdot t$

$t = \frac{136}{16} = 8.5\,s$

c. $d = rt$

$d = \frac{9\,m}{1\,s} \cdot \frac{8.5\,s}{1}$

$d = 76.5\,m$