

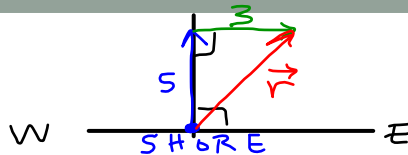
VECTOR APPLICATIONS

*** Use vectors in trig form!!! ***

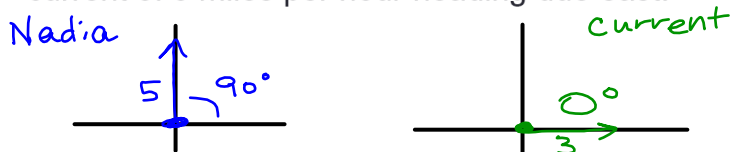
$$\vec{r} = \vec{a} + \vec{b}$$

$\|\vec{r}\| =$ resultant speed or resultant distance

Example 1



- Nadia is rowing across a river due north at a speed of 5 miles per hour perpendicular to the shore. The river has a current of 3 miles per hour heading due east.



- a) At what speed is she heading?

$$\vec{r} = 5 \langle \cos 90^\circ, \sin 90^\circ \rangle + 3 \langle \cos 0^\circ, \sin 0^\circ \rangle$$

$$\vec{r} = \langle 5 \cos 90^\circ + 3 \cos 0^\circ, 5 \sin 90^\circ + 3 \sin 0^\circ \rangle$$

$$\vec{r} = \langle 3, 5 \rangle$$

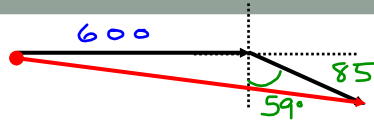
$$\|\vec{r}\| = \sqrt{9+25} = \sqrt{34} = 5.83 \text{ mph}$$

- b) What is her bearing with respect to the shore?

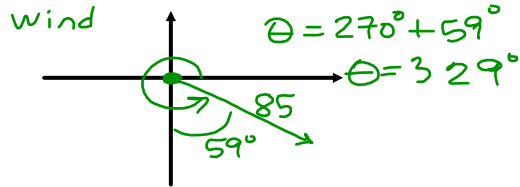
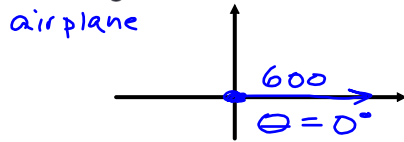
$$\vec{r} = \langle 3, 5 \rangle \quad \theta = \tan^{-1}\left(\frac{5}{3}\right) = 59.04^\circ$$

E 59.04° N
OR N 30.96° E

Example 2



- An airplane is traveling due east with a speed of 600 miles per hour. The wind blows at 85 miles per hour at an angle of S 59° E.



- a) What is the resulting speed of the airplane?

$$\vec{r} = 600\langle \cos 0^\circ, \sin 0^\circ \rangle + 85\langle \cos 329^\circ, \sin 329^\circ \rangle$$

$$\vec{r} = \langle 600\cos 0^\circ + 85\cos 329^\circ, 600\sin 0^\circ + 85\sin 329^\circ \rangle$$

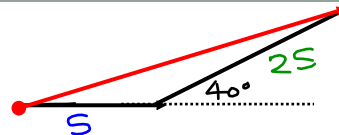
$$\vec{r} = \langle 672.86, -43.78 \rangle \quad \|\vec{r}\| = \boxed{674.28 \text{ mph}}$$

- b) What is the resulting bearing of the plane?

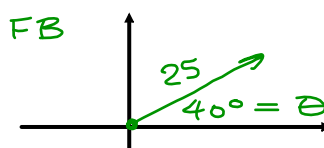
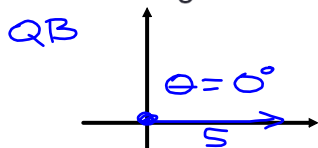
$$\theta = \tan^{-1}\left(\frac{-43.78}{672.86}\right) = 3.72^\circ$$

$$\boxed{\text{E } 3.72^\circ \text{ S}}$$

Example 3



- A quarterback running forward at 5 meters per second throws a football with a velocity of 25 meters per second at an angle of 40° with the horizontal.



- a) What is the resultant speed of the pass?

$$\vec{r} = 5\langle \cos 0^\circ, \sin 0^\circ \rangle + 25\langle \cos 40^\circ, \sin 40^\circ \rangle$$

$$\vec{r} = \langle 5\cos 0^\circ + 25\cos 40^\circ, 5\sin 0^\circ + 25\sin 40^\circ \rangle$$

$$\vec{r} = \langle 24.15, 16.07 \rangle \quad \|\vec{r}\| = \boxed{29.01 \text{ mps}}$$

- b) What is the resultant bearing of the pass?

$$\theta = \tan^{-1}\left(\frac{16.07}{24.15}\right) = \boxed{33.64^\circ \text{ with the ground}}$$