

VECTOR APPLICATIONS

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

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

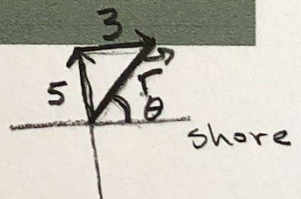
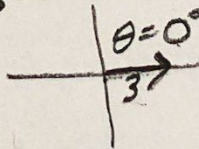
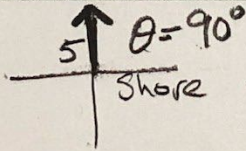
$\|\vec{r}\|$ = resultant speed or distance

* $\|\vec{r}\| \langle \cos \theta, \sin \theta \rangle$ Component form

* $\|\vec{r}\| (\cos \theta \mathbf{i}, \sin \theta \mathbf{j})$ Sum of vector form

W N E
S

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.

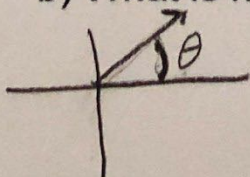
$$\vec{r} = 5 \langle \cos 90^\circ, \sin 90^\circ \rangle + 3 \langle \cos 0^\circ, \sin 0^\circ \rangle$$

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

- a) At what speed is she heading?

$$\|\vec{r}\| = \sqrt{3^2 + 5^2} = \sqrt{9 + 25} = \sqrt{34} \approx \boxed{5.83 \text{ mph}}$$

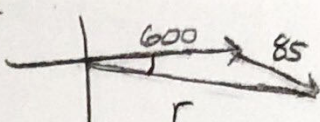
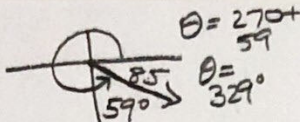
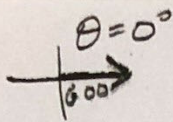
- b) What is her bearing with respect to the shore?



$$\theta = \tan^{-1} \left(\frac{5}{3} \right)$$

$$\theta = 59.04^\circ$$

$$\boxed{E 59.04^\circ N}$$



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.

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

$$\vec{r} = \langle 672.86, -43.78 \rangle$$

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

$$\|\vec{r}\| = \sqrt{(672.86)^2 + (-43.78)^2}$$

$$\|\vec{r}\| = 674.28 \text{ mph}$$

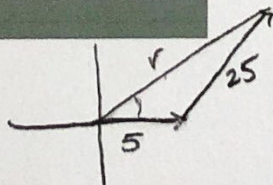
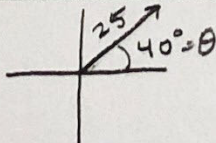
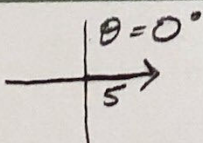
- b) What is the resulting bearing of the plane?

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

$$\boxed{E 3.72 S}$$

$$\theta = -3.72^\circ$$

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.

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

$$\vec{r} = \langle 24.15, 16.07 \rangle$$

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

$$\|\vec{r}\| = \sqrt{(24.15)^2 + (16.07)^2}$$

$$\|\vec{r}\| = 29.01 \text{ mps}$$

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

$$\theta = \tan^{-1} \left(\frac{16.07}{24.15} \right)$$

$$\boxed{E 33.64^\circ N}$$

$$\theta = 33.64^\circ$$