

# 1.2.25

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## Question:

A motorboat is racing towards north at 25km/h and the water current in that region is 10km/h in the direction of  $60^\circ$  east of south. Find the resultant velocity of the boat

## Solution:

Let us solve the given equation theoretically and then verify the solution computationally

According to the question,

Given velocity vectors,

$$\mathbf{v}_b = \begin{pmatrix} 0 \\ 25 \end{pmatrix} \quad \mathbf{v}_w = \begin{pmatrix} \sqrt{75} \\ -5 \end{pmatrix} \quad (0.1)$$

To find the resultant velocity of the boat, we add  $\mathbf{v}_b, \mathbf{v}_w$ .

$$\mathbf{v}_r = \mathbf{v}_b + \mathbf{v}_w \quad (0.2)$$

$$\mathbf{v}_r = \begin{pmatrix} 0 \\ 25 \end{pmatrix} + \begin{pmatrix} \sqrt{75} \\ -5 \end{pmatrix} \quad (0.3)$$

$$\therefore \mathbf{v}_r = \begin{pmatrix} \sqrt{75} \\ 20 \end{pmatrix} \quad (0.4)$$

The magnitude of  $\mathbf{v}_r$  is given by

$$\|\mathbf{v}_r\|^2 = \mathbf{v}_r^T \mathbf{v}_r \quad (0.5)$$

$$\therefore \|\mathbf{v}_r\|^2 = \begin{pmatrix} \sqrt{75} & 20 \end{pmatrix} \begin{pmatrix} \sqrt{75} \\ 20 \end{pmatrix} \quad (0.6)$$

$$\|\mathbf{v}_r\|^2 = (475) \quad (0.7)$$

$$\therefore \|\mathbf{v}_r\| = (21.79) \text{ units} \quad (0.8)$$

From the figure it is clearly verified that the theoretical solution matches with the computational solution.

