

# 1.2.23

EE24BTECH11016 - Dhwanith M Doddahundi

## Question:

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

## Solution:

Variable	Description
$\mathbf{v}_b(0, 25)$	velocity vector of boat in north direction
$\mathbf{v}_c$	velocity vector of water current at $60^\circ$ east of south direction
$\mathbf{v}_r$	resultant velocity vector of boat
$\theta$	angle of resultant vector from north direction

TABLE 0: Input parameters

$$\mathbf{v}_c = 10 \begin{pmatrix} \sin 60^\circ \\ -\cos 60^\circ \end{pmatrix} \quad (1)$$

$$\Rightarrow v_c = 10 \begin{pmatrix} \frac{\sqrt{3}}{2} \\ -\frac{1}{2} \end{pmatrix} \quad (2)$$

$$\Rightarrow v_c = \begin{pmatrix} 5\sqrt{3} \\ -5 \end{pmatrix} \quad (3)$$

$$\Rightarrow \therefore v_r = v_b + v_c \quad (4)$$

$$\Rightarrow v_r = \begin{pmatrix} 0 \\ 25 \end{pmatrix} + \begin{pmatrix} 5\sqrt{3} \\ -5 \end{pmatrix} \quad (5)$$

$$\Rightarrow v_r = \begin{pmatrix} 5\sqrt{3} \\ 20 \end{pmatrix} \quad (6)$$

$$\Rightarrow \|v_r\| = \sqrt{v_r^T v_r} \quad (7)$$

$$\Rightarrow \|v_r\| = \sqrt{(5\sqrt{3})^2 + (20)^2} \quad (8)$$

$$\Rightarrow \|v_r\| = \sqrt{475} \approx 21.8\text{km/h} \quad (9)$$

$$\tan \theta = \frac{5\sqrt{3}}{20} \quad (10)$$

$$\Rightarrow \theta = \tan^{-1} \frac{\sqrt{3}}{4} \approx 23.4^\circ \quad (11)$$

So, the resultant velocity vector  $v_r$  is  $21.8\text{km/h}$  at an angle of  $23.4^\circ$  from north direction.

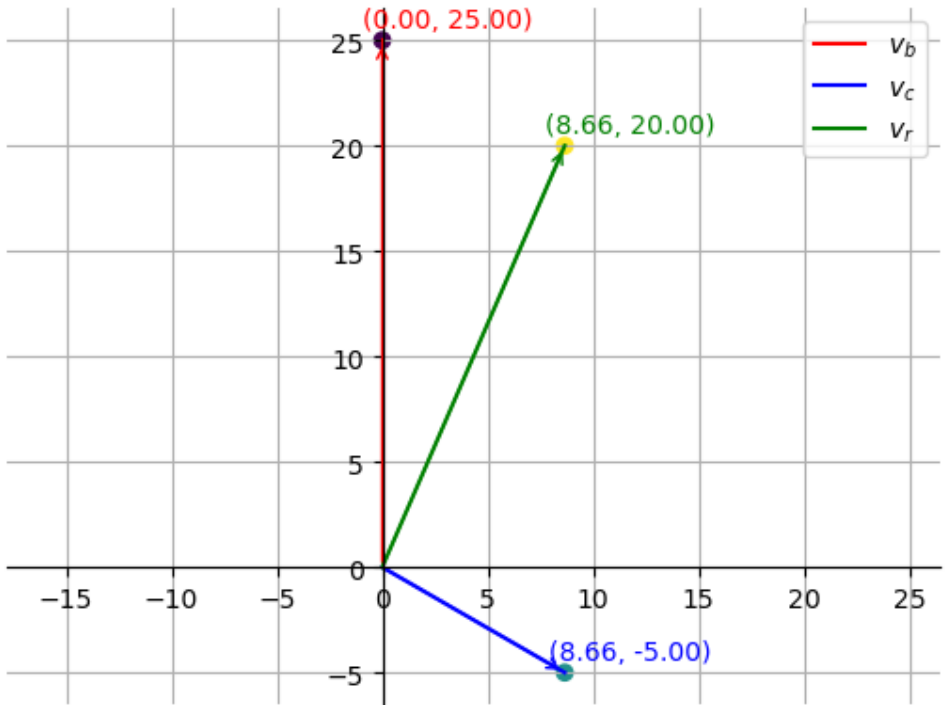


Fig. 0: Resultant velocity vector of boat