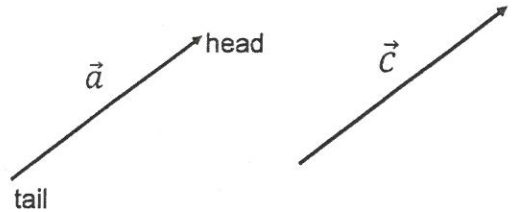


Section 6-6 Vector Addition

A **vector** is a directed line segment that has both **magnitude** and **direction**. It is customary to represent a vector by using an arrow. The length of the arrow represents the magnitude and the arrowhead represents direction.

The *absolute value*, or magnitude, is equal to its length.

$|\vec{x}|$

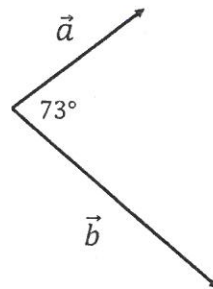


Two vectors are equal if and only if they have the same magnitude and the same direction.

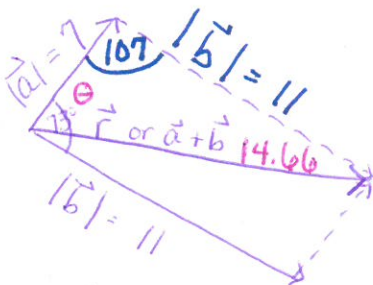
1. sum of two vectors - Resultant Vector

$|\vec{a}| = 7\text{cm}$ $|\vec{b}| = 11\text{cm}$

find $|\vec{a} + \vec{b}|$ and the angle the resultant vector makes with \vec{a}



Law of Cosines:



$$|\vec{r}|^2 = 7^2 + 11^2 - 2(7)(11)\cos 107$$

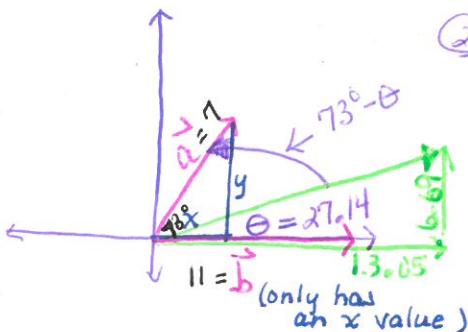
$|\vec{r}| = 14.66\text{cm}$

θ is angle resultant makes with \vec{a}

$$\frac{\sin 107}{14.66} = \frac{\sin \theta}{11} \quad \boxed{\theta = 45.85^\circ}$$

Components: (use right Δ 's)

① rotate vectors to put one vector on x-axis



② Draw a right Δ for each vector (can't do this for \vec{b}) and find the horizontal side (x) & the vertical side (y).

For \vec{a} $x = 7 \cdot \cos 73^\circ = 2.05$
 $y = 7 \cdot \sin 73^\circ = 6.69$

③ Write each vector with the horiz. & vert. components

$\vec{a} = 2.05\vec{i} + 6.69\vec{j}$ $\left\{ \begin{array}{l} \vec{i} = \text{horiz} \\ \vec{j} = \text{vert} \end{array} \right.$

$\vec{b} = 11\vec{i} + 0\vec{j}$

④ Find resultant by adding the 2

$\vec{a} + \vec{b} = 13.05\vec{i} + 6.69\vec{j}$

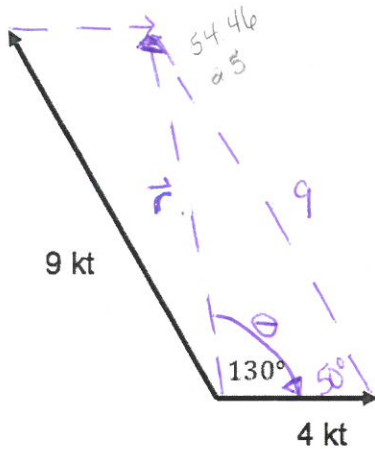
⑤ Draw resultant (in green) magnitude is hypotenuse

$13.05^2 + 6.69^2 = r^2$ $|\vec{r}| = 14.66$

⑥ Find angle resultant vector makes w/ \vec{a}

$73^\circ - \theta$; $\theta = \tan^{-1} \frac{6.69}{13.05}$ $\boxed{45.85^\circ}$

2. A ship near the coast is going 9 knots at an angle of 130° to a current of 4 knots. What is the ship's resultant velocity with respect to the current?



$$|\vec{r}|^2 = 9^2 + 4^2 - 2(9)(4)(\cos 50^\circ)$$

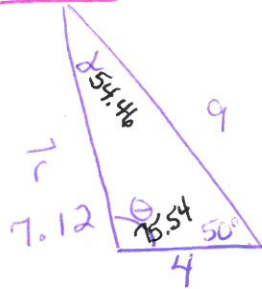
$$|\vec{r}| = 7.12 \text{ Knots}$$

$$\frac{\sin \theta}{9} = \frac{\sin 50^\circ}{7.12}$$

$$\theta = 75.54^\circ \text{ or } 104.46^\circ$$

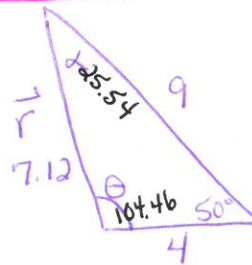
but which is it?

Option 1



$$\text{if } \theta = 75.54^\circ \\ \alpha = 54.46^\circ$$

Option 2



$$\text{if } \theta = 104.46^\circ \\ \alpha = 25.54^\circ$$

Look @ relationship b/w sides and angles
(smallest angle across from smallest side, etc.)

* Must choose option 2 so the smallest α will be across from the smallest side

$$\text{SO } |\vec{r}| = 7.12 \text{ Knots @ } 104.46^\circ \text{ w/ current}$$