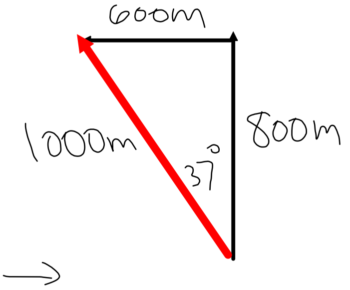
Section 6.2 Vector Addition

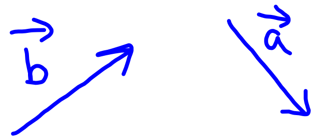
When you add 2 or more vectors, you are finding a single "resultant" vector.

ex Walk north 800m & then west 600m,



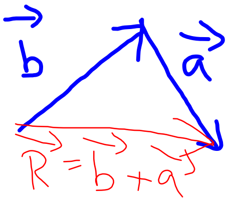
$\vec{R}$ - resultant: N37°W for 1000m

Consider 2 vectors: $\vec{a}$ and $\vec{b}$



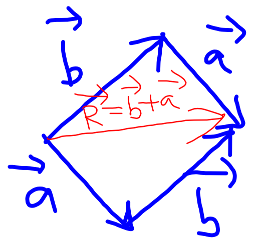
Add together using "Head to Tail"

"Triangle Method"



Add together using "Tail to Tail"

- draw tail to tail "Parallelogram method"
- Complete a parallelogram
- Resultant vector is the diagonal of the parallelogram.



Adding Parallel Vectors

Vectors $\vec{a}$ and $\vec{b}$ are parallel and have same direction

$\vec{b}$ 7Km/h East

$\vec{a}$ 5Km/h East

i) Find $\vec{a}+\vec{b}$:

$\vec{R} = \vec{a}+\vec{b} = 12$ Km/h East

The Zero Vector

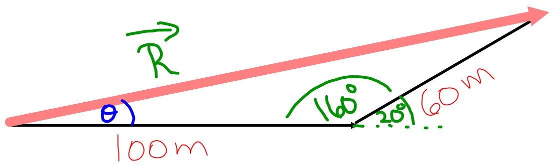
- When adding 2 opposite vectors with same magnitude
- written as $\vec{0}$
- has no specific direction
- magnitude of 0 ie: $|\vec{0}| = 0$

Subtracting Vectors:

- Subtracting $\vec{u}-\vec{v}$ is the same as adding its opposite.

$\therefore \vec{u}-\vec{v} = \vec{u}+(-\vec{v})$

ex: In an orienteering race, you walk 100m due East and then walk N70°E for 60 m. How far are you from the starting position, and at what bearing?



$$|\vec{R}|^2 = (100)^2 + (60)^2 - 2(100)(60)\cos 160°$$

$$|\vec{R}| = 157.7\text{m}$$

$$\frac{\sin 160°}{157.7} = \frac{\sin\theta}{60}$$

$$\theta = 7.5°$$

$\therefore$ bearing is 82.5° or N82.5°E

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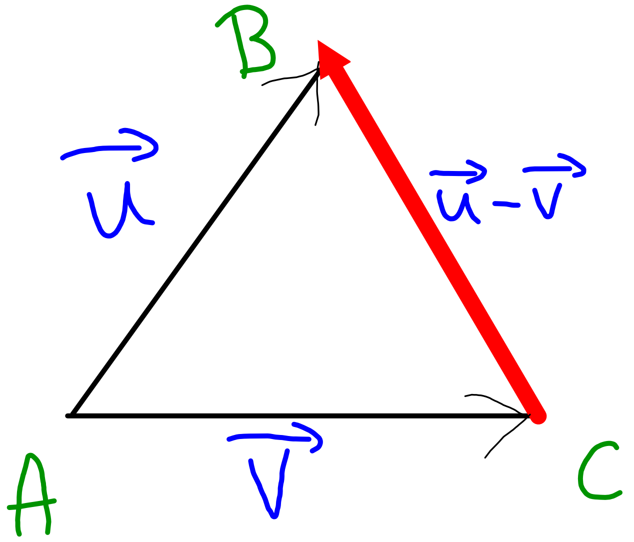


$\vec{u} - \vec{v}$

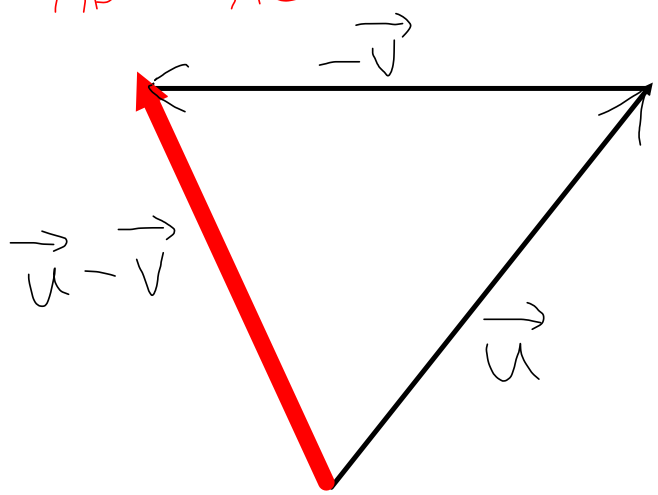
$= -\vec{v} + u$

$= \vec{CB}$

when the vectors are tail to tail, the resultant vector's head touches the head of the <u>first</u> vector, in the Subtraction Statement

ie: $\vec{u} - \vec{v} = \vec{CB}$

or $\vec{AB} - \vec{AC} = \vec{CB}$



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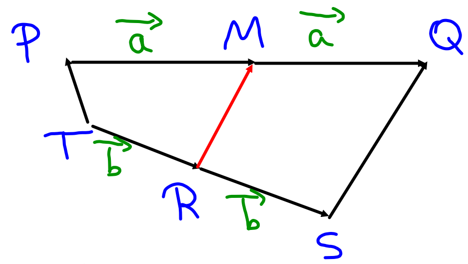


$$2\overrightarrow{RM} = \overrightarrow{TP} + \overrightarrow{SQ}$$

$$\overrightarrow{RM} = \overrightarrow{RT} + \overrightarrow{TP} + \overrightarrow{PM} \qquad \overrightarrow{RM} = \overrightarrow{RS} + \overrightarrow{SQ} + \overrightarrow{QM}$$

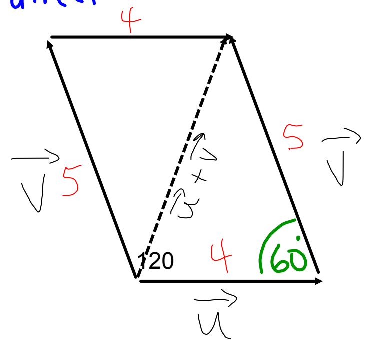
$$\overrightarrow{RM} = -\vec{b} + \overrightarrow{TP} + \vec{a} \qquad \overrightarrow{RM} = \vec{b} + \overrightarrow{SQ} + (-\vec{a})$$

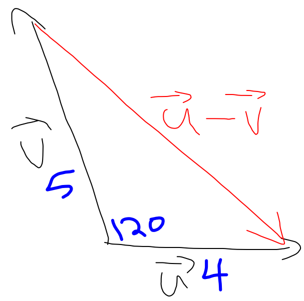
Adding the previous 2 equations yields,

$$2\overrightarrow{RM} = \cancel{-\vec{b}} + \overrightarrow{TP} \cancel{+\vec{a}} \cancel{+\vec{b}} + \overrightarrow{SQ} \cancel{-\vec{a}}$$

$$2\overrightarrow{RM} = \overrightarrow{TP} + \overrightarrow{SQ}$$

ex: Given that $|\vec{u}| = 4$ and $|\vec{v}| = 5$ and the angle between $\vec{u}$ and $\vec{v}$ is $120°$ determine the unit vector in the same direction as $\vec{u} + \vec{v}$.





$$|\vec{u}+\vec{v}|^2 = |\vec{u}|^2 + |\vec{v}|^2 - 2|\vec{u}||\vec{v}|\cos 60°$$

$$= (4)^2 + (5)^2 - 2(4)(5)\left(\tfrac{1}{2}\right)$$

$$= 16 + 25 - 20$$

$$|\vec{u}+\vec{v}|^2 = 21$$

$$|\vec{u}+\vec{v}| = \sqrt{21}$$

To create a unit vector in the same direction as $\vec{u}+\vec{v}$, multiply by the scalar equal to $\frac{1}{|\vec{u}+\vec{v}|}$. In this case, the unit vector is $\frac{1}{\sqrt{21}}(\vec{u}+\vec{v}) = \frac{1}{\sqrt{21}}\vec{u} + \frac{1}{\sqrt{21}}\vec{v}$

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