Problem 3.11

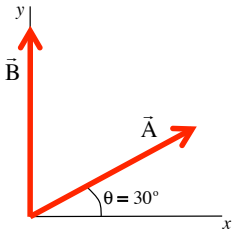
As shown, the magnitude of both vectors is 3. Determine:

a.) $\vec{A}+\vec{B}$

b.) $\vec{A}-\vec{B}$

c.) $\vec{B}-\vec{A}$

d.) $\vec{A}-2\vec{B}$



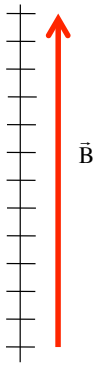
To graphical add vectors:
--pick a scale;
--use a centimeter stick (or some measuring device) to draw each vector to scale, reproducing each vector as they are spatially related to one another (that is, if they are at right angles to one another in the problem, they must be reproduced at right angles to one another);
--reproduce one of the vectors, drawn to scale;
--draw the second vector to scale and such that it's tail is placed at the head of the first vector.
--If there are more than two vectors, simply continue this process over and over again.

--To graphically subtract vectors, draw the vector to be subtracted as the negative of the original vector (that is produce –A), then use the *addition* process.
--The resultant's *magnitude* will always be determined using the centimeter stick in conjunction with the scale; its angle with a protractor.

The scale we will use is such that 4 spaces denotes one centimeter. The vector B is drawn next to the scale.

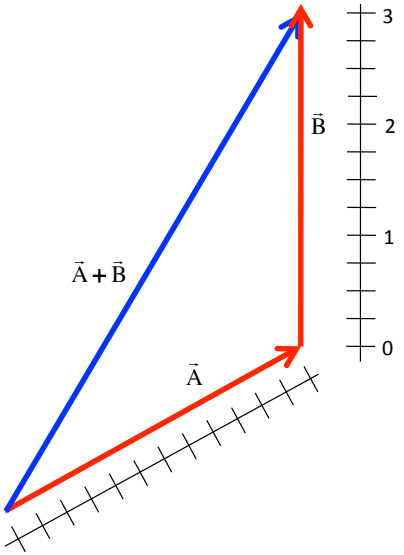
Note that vector A will have the same length.

Note also that I'm doing this on a computer, which means my angles may not be quite right, etc. Accepting there may be a little slop in the process, you should at least be able to see what you *should* have done, even if my execution of that is not flawless from an accuracy standpoint.



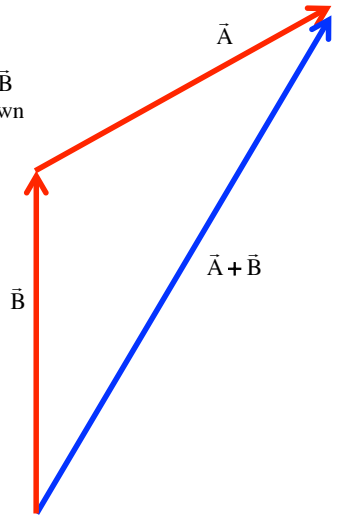
a.) $\vec{A}+\vec{B}$

Start by drawing $\vec{A}$ to scale, then draw $\vec{B}$ to scale with its tail at the head of $\vec{A}$ and oriented appropriately relative to $\vec{A}$. The resultant starts at $\vec{A}$'s tail and ends at $\vec{B}$'s head.



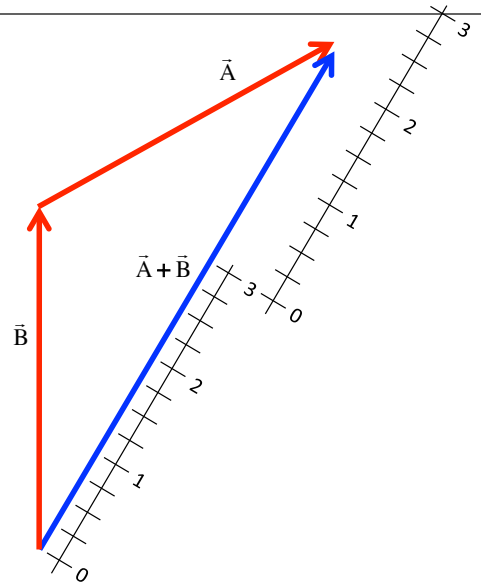
A + B

Notice that you could start with $\vec{B}$ drawn to scale with $\vec{A}$ being drawn (to scale) second. The resultant would be the same.



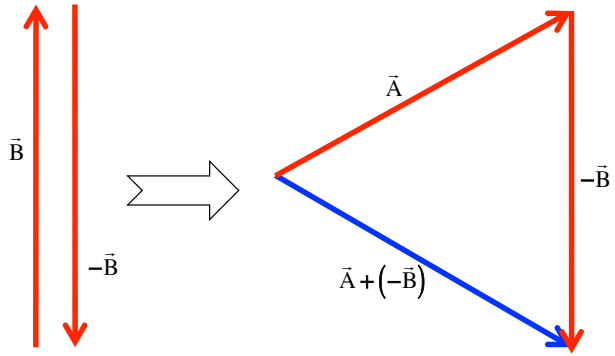
A + B

Measuring the resultant with our centimeter stick gives us a magnitude of approximately 5.2 centimeters.



5.)

b.) $\vec{A}-\vec{B}$ Start by drawing $-\vec{B}$ (this is done by flipping over $\vec{B}$), then execute $\vec{A}+(-\vec{B})$ graphically.

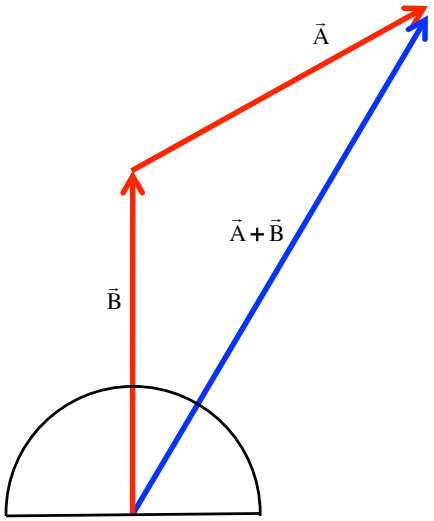


7.)

Using a protractor, measured relative to the horizontal, the angular displacement is approximately 60°.

In other words:

$\vec{A}+\vec{B}=(5.2\text{ cm})\angle 60^\circ$



6.)

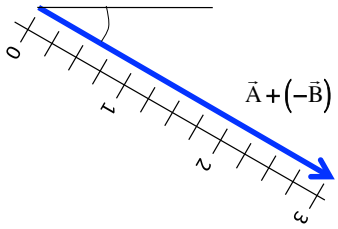
Measuring the resultant with our centimeter stick gives us a magnitude of approximately 3 centimeters.

Using a protractor, measured relative to the horizontal, the angular displacement is approximately -30°.

In other words:

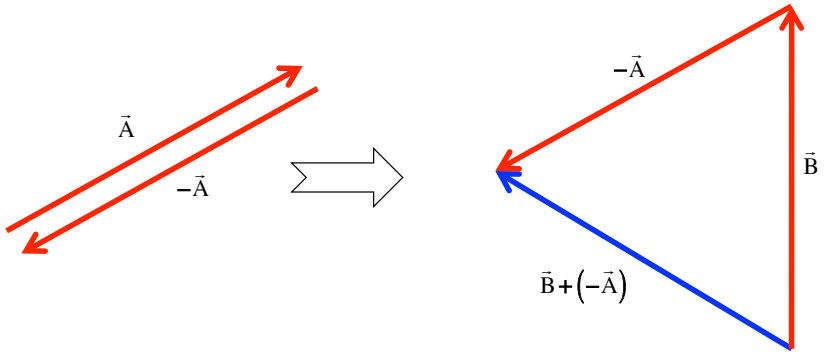
$\vec{A}-\vec{B}=3.0\angle -30^\circ$

(Note: this can also be written as: $\vec{A}-\vec{B}=3.0\angle 330^\circ$)



8.)

c.) $\vec{B}-\vec{A}$ Start by drawing $-\vec{A}$ (this is done by flipping over $\vec{A}$), then execute $\vec{B}+\left(-\vec{A}\right)$ graphically.

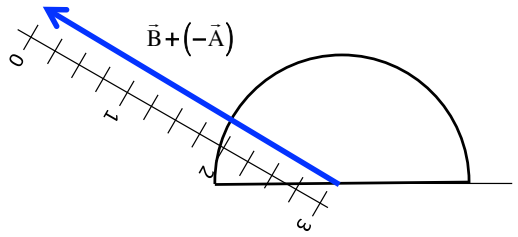


Measuring the resultant with our centimeter stick gives us a magnitude of approximately 3.0 centimeters.

Using a protractor, measured relative to the horizontal, the angular displacement is approximately 150°.

In other words:

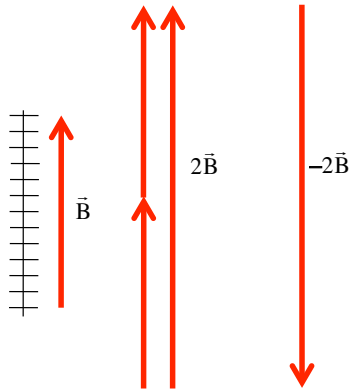
$\vec{B}-\vec{A}=\left(3.0\text{ cm}\right)\angle 150^{\circ}$



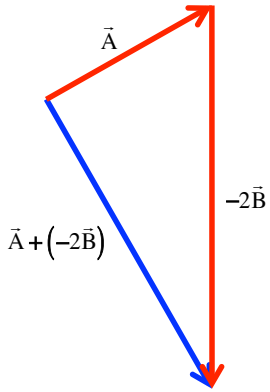
d.) $\vec{A}-2\vec{B}$

Note: To get this to fit on the page, I'm rescaling down the vectors and centimeter stick. This is not a big deal, it just means the picture will be smaller than it would otherwise have been.

Start by drawing $2\vec{B}$, then $-2\vec{B}$ (this is done by flipping over $2\vec{B}$).



Now execute $\vec{A}+\left(-2\vec{B}\right)$ graphically.

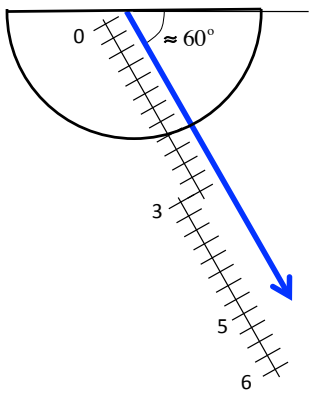


(As usual) using our scaling factor and protractor, we have a length of approximately 5.2 cm at an angle of approximately -60° so that:

$$\vec{A}+\left(-2\vec{B}\right)=\left(5.2\text{ cm}\right)\angle -60^\circ$$

(Note: this can also be written as:

$$\vec{A}+\left(-2\vec{B}\right)=\left(5.2\text{ cm}\right)\angle 300^\circ$$



13.)