Answers: Question 1

a. True:

$\begin{pmatrix}3\\5\end{pmatrix}$ - $\begin{pmatrix}1\\2\end{pmatrix}$ = $\begin{pmatrix}2\\3\end{pmatrix}$

$\begin{pmatrix}101\\-97\end{pmatrix}$ - $\begin{pmatrix}99\\-100\end{pmatrix}$ = $\begin{pmatrix}2\\3\end{pmatrix}$

b. False:

$\begin{pmatrix}-3\\-5\end{pmatrix}$ - $\begin{pmatrix}-1\\-2\end{pmatrix}$ = $\begin{pmatrix}-2\\-3\end{pmatrix}$

$\begin{pmatrix}-101\\-97\end{pmatrix}$ - $\begin{pmatrix}-99\\-100\end{pmatrix}$ = $\begin{pmatrix}-2\\3\end{pmatrix}$

… The length is the same, but the direction isn't.

Answers: Question 1 cont.

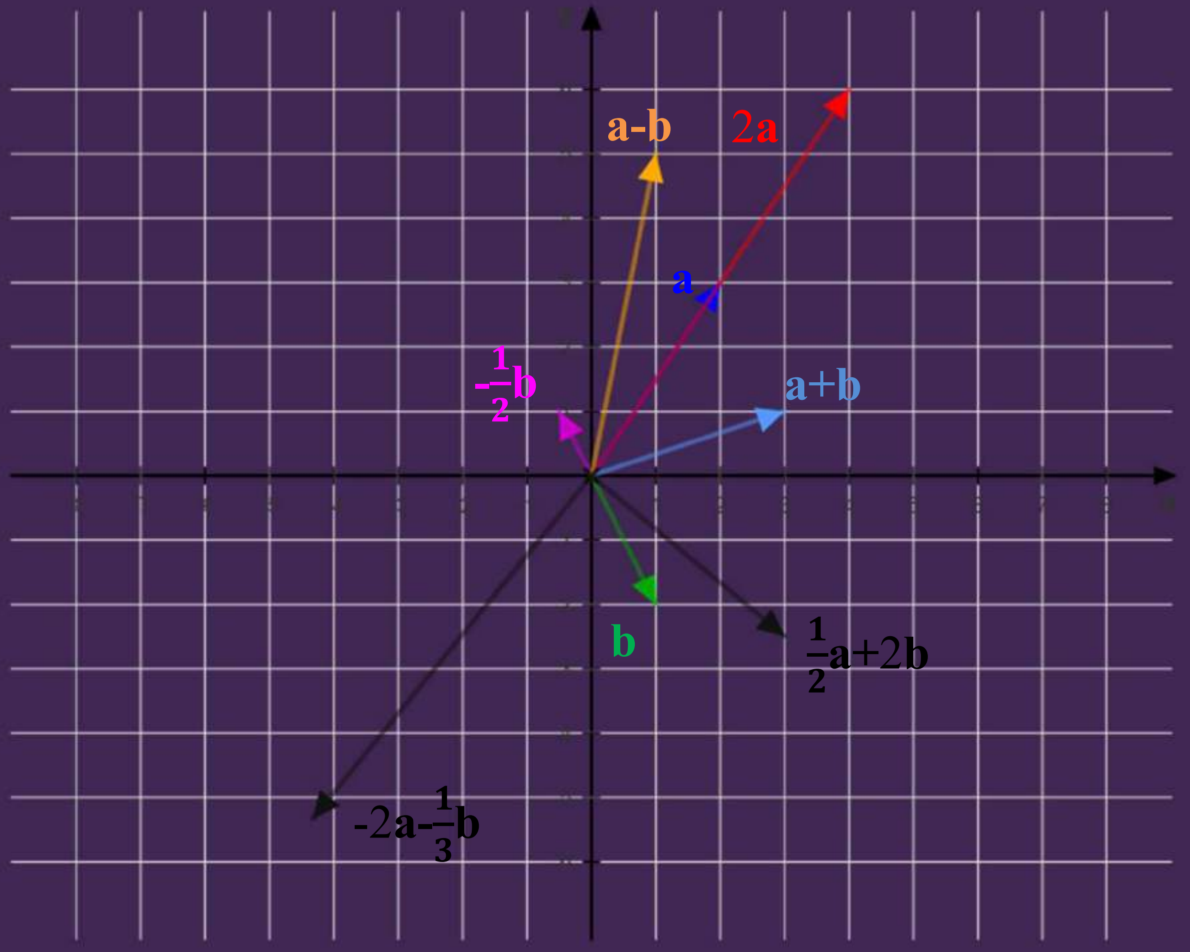
c. False: vectors have both direction **and** length.

d. True

e. False; addition is commutative

f. False! $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} - \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ is the displacement *from* the origin *to* (x, y).

Answers: Question 2



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Answers: Question 3

a. $\begin{pmatrix} 18 \\ -6 \end{pmatrix}$

b. $\begin{pmatrix} 2 \\ 2.5 \end{pmatrix}$

c. $\begin{pmatrix} 7 \\ -1 \end{pmatrix}$

d. $\sqrt{(-12)^2+5^2} = 13$

e. $\left\|\begin{pmatrix} 9 \\ -4 \end{pmatrix} + \begin{pmatrix} 3 \\ -12 \end{pmatrix}\right\| = \sqrt{12^2 + (-16)^2} = 20$

f. $\left\|\begin{pmatrix} -1 \\ \frac{-2}{\sqrt{2}} \end{pmatrix} + \begin{pmatrix} \frac{1}{2} \\ \frac{-1}{\sqrt{2}} \end{pmatrix}\right\| = \sqrt{\left(\frac{-1}{2}\right)^2 + \left(\frac{-3}{\sqrt{2}}\right)^2} = \frac{\sqrt{19}}{2}$

Answers: Question 4

a. (2, -2)

$$\begin{pmatrix}-3\\7\end{pmatrix}+\begin{pmatrix}5\\-9\end{pmatrix}-\begin{pmatrix}0\\0\end{pmatrix}=\begin{pmatrix}2\\-2\end{pmatrix}$$

b. (-9, 15)

$\boldsymbol{a}-\boldsymbol{b}=\begin{pmatrix}-3\\7\end{pmatrix}-\begin{pmatrix}5\\-9\end{pmatrix}=\begin{pmatrix}-8\\16\end{pmatrix}$ describes a displacement anywhere in space, but in this case we want to find the point relative to the origin we end up at if we travel along $\boldsymbol{a}-\boldsymbol{b}$ starting from (-1, -1):

$$\begin{pmatrix}-1\\-1\end{pmatrix}+\begin{pmatrix}-8\\16\end{pmatrix}=\begin{pmatrix}-9\\15\end{pmatrix}$$

c. (4, 6)

The length of the vector from $(1,2)$ to $(7,10)$ is $\left\|\begin{pmatrix}7\\10\end{pmatrix}-\begin{pmatrix}1\\2\end{pmatrix}\right\|=\left\|\begin{pmatrix}6\\8\end{pmatrix}\right\|=\sqrt{6^2+8^2}=10$

We want the vector that is half as long in the same direction, $\begin{pmatrix}3\\4\end{pmatrix}$, added to the starting point.

Answers: Question 4b visualised!

$$\begin{pmatrix}-4\\6\end{pmatrix}+\begin{pmatrix}-5\\9\end{pmatrix}=\begin{pmatrix}-9\\15\end{pmatrix}$$

$$\begin{pmatrix}-1\\-1\end{pmatrix}+\begin{pmatrix}-3\\7\end{pmatrix}=\begin{pmatrix}-4\\6\end{pmatrix}$$