Vector Test Name:
17 January 2020

1. Find a value for n that will give vector $\vec{a}$ a magnitude of 7:

$$\vec{a} = \begin{pmatrix} -3 \\ 2 \\ n \end{pmatrix}$$

2. Find values for b_x, b_y, and b_z that will make $\vec{b}$ perpendicular to $\vec{a}$ regardless of the value of m in $\vec{a}$:

$$\vec{a} = \begin{pmatrix} -2 \\ 1 \\ m \end{pmatrix} \qquad \vec{b} = \begin{pmatrix} b_x \\ b_y \\ b_z \end{pmatrix}$$

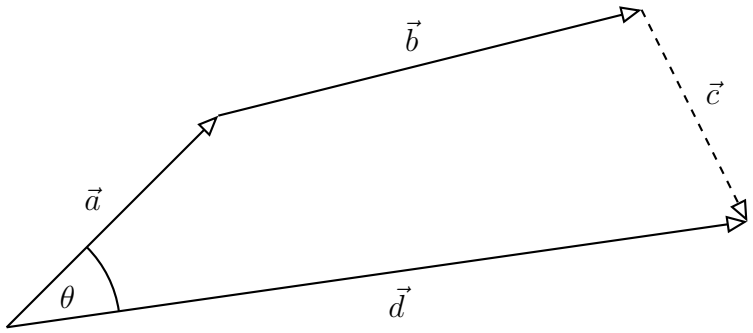
3. Let $\vec{a} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$:

   (a) Find the unit vector for $\vec{a}$:

   (b) Consider some vector $\vec{b} = k\vec{a}$ for some positive value of k (that is, $\vec{b}$ is parallel to $\vec{a}$). What is the unit vector of $\vec{b}$:

   (c) Consider some vector $\vec{b}$ which is perpendicular to $\vec{a}$. Find a possible value for the unit vector of $\vec{b}$:

4. Consider the path formed by the 4 vectors in the diagram below:



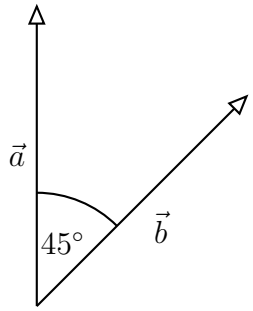
(a) Write an equation for $\vec{c}$ in terms of $\vec{a}$, $\vec{b}$, and $\vec{d}$:

(b) Given the following values for $\vec{a}$, $\vec{b}$, and $\vec{d}$, calculate the value of $\vec{c}$:

$$\vec{a} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} \qquad \vec{b} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \qquad \vec{d} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

(c) For the above values vector values, calculate the angle θ between the $\vec{a}$ and $\vec{d}$:

5. In the diagram below, $\vec{a}$ and $\vec{b}$ are both unit vectors with a 45° angle between them. Find the value of the dot product $\vec{a} \cdot \vec{b}$:



6. Mark each of the following statements as either True or False:

   (a) For a given vector $\vec{a}$, there are infinitely many vectors $\vec{b}$ such that $\vec{b}$ is parallel to $\vec{a}$. True or False?

   (b) For a given vector $\vec{a}$, there are infinitely many *unit* vectors $\vec{b}$ such that $\vec{b}$ is parallel to $\vec{a}$. True or False?

   (c) If $\vec{a}$ and $\vec{b}$ are perpendicular, then the unit vectors for $\vec{a}$ and $\vec{b}$ are also perpendicular. True or False?

   (d) If $\vec{a}$ and $\vec{b}$ are parallel and $\vec{a} \cdot \vec{b} = |\vec{a}|^2$ (the magnitude of $\vec{a}$ squared), then $\vec{a}$ must $\vec{b}$ must have the same magnitude. True or False?

   (e) If the angle between $\vec{a}$ and $\vec{b}$ is $30°$, then the angle between $2\vec{a}$ and $2\vec{b}$ must be $60°$. True or False?

7. Challenge Problem (extra credit):

Consider the following three vectors:

$$\vec{a} = \begin{pmatrix} 1 \\ 2 \\ -3 \end{pmatrix} \qquad \vec{b} = \begin{pmatrix} 5 \\ -1 \\ 1 \end{pmatrix} \qquad \vec{c} = \begin{pmatrix} 1 \\ c_y \\ c_z \end{pmatrix}$$

Find the values for c_y and c_z that make $\vec{c}$ perpendicular to both $\vec{a}$ and $\vec{b}$ at the same time: (*hint: start by setting up the dot-product equations*)