LENGTH OF A VECTOR - ANSWERS

1. Find the length of $\vec{v} = \hat{i} - 5\hat{j} + \hat{k}$.

   $\|\vec{v}\| = \sqrt{27} \approx 5.1962$

2. Find a unit vector pointing in the opposite direction as $\vec{v} = \hat{i} - 5\hat{j} + \hat{k}$.

   $$-\frac{\vec{v}}{\|\vec{v}\|} = -\frac{1}{\sqrt{27}}\hat{i} + \frac{5}{\sqrt{27}}\hat{j} - \frac{1}{\sqrt{27}}\hat{k} = -\frac{\sqrt{27}}{27}\hat{i} + \frac{5\sqrt{27}}{27}\hat{j} - \frac{\sqrt{27}}{27}\hat{k}$$

3. Find a vector of length 2 in the direction of $\vec{v} = \hat{i} - 5\hat{j} + \hat{k}$.

   $$2 \cdot \frac{\vec{v}}{\|\vec{v}\|} = \frac{2}{\sqrt{27}}\hat{i} - \frac{10}{\sqrt{27}}\hat{j} + \frac{2}{\sqrt{27}}\hat{k} = \frac{2\sqrt{27}}{27}\hat{i} - \frac{10\sqrt{27}}{27}\hat{j} + \frac{2\sqrt{27}}{27}\hat{k}$$

4. Find a vector of length 10 in the opposite direction of $\vec{w} = -3\hat{i} - 2\hat{j} - 8\hat{k}$.

   $$-10 \cdot \frac{\vec{w}}{\|\vec{w}\|} = -\frac{30}{\sqrt{77}}\hat{i} + \frac{20}{\sqrt{77}}\hat{j}\frac{80}{\sqrt{77}}\hat{k} = \frac{30\sqrt{77}}{77}\hat{i} - + \frac{20\sqrt{77}}{77}\hat{j} + \frac{80\sqrt{77}}{77}\hat{k}$$

5. Find a unit vector pointing in the same direction as $\vec{w} = -3\hat{i} - 2\hat{j} - 8\hat{k}$.

   $$\frac{\vec{w}}{\|\vec{w}\|} = -\frac{3}{\sqrt{77}}\hat{i} - \frac{2}{\sqrt{77}}\hat{j} - \frac{8}{\sqrt{77}}\hat{k} = -\frac{3\sqrt{77}}{77}\hat{i} - \frac{2\sqrt{77}}{77}\hat{j} - \frac{8\sqrt{77}}{77}\hat{k}$$