

$$\begin{aligned} &= \sqrt{m^2 v_1^2 + m^2 v_2^2 + m^2 v_3^2} \\ &= \sqrt{m^2 (v_1^2 + v_2^2 + v_3^2)} \\ &= |m| \sqrt{v_1^2 + v_2^2 + v_3^2} = |m| \|\vec{v}\| \end{aligned}$$

Examples Find the unit vector that has the same direction as $\vec{v} = 2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$

Sol ∴ $\vec{v} = (2, 2, -1) \Rightarrow \|\vec{v}\| = \sqrt{2^2 + 2^2 + (-1)^2} = \sqrt{9} = 3 \neq 0$

$\Rightarrow \|\vec{u}\| = \frac{1}{\|\vec{v}\|} (\vec{v}) = \frac{1}{3} (2, 2, -1)$

∴ $\vec{u} = \left(\frac{2}{3}, \frac{2}{3}, -\frac{1}{3}\right)$ is

the unit vector of v .

Q If \vec{v} is a non-zero vector then

$\vec{v} = \|\vec{v}\| \vec{u}$ where \vec{u} is the unit vector of \vec{v} .

Sol $\|\vec{v}\| \vec{u} \stackrel{\text{by def of } \vec{u}}{=} \|\vec{v}\| \left(\frac{\vec{v}}{\|\vec{v}\|}\right) = \vec{v}$