Q2

Thursday, October 29, 2020 8:31 AM

a) $\vec{v} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

$x = \sqrt{x^2+y^2+z^2}\cos\alpha \qquad y = \sqrt{x^2+y^2+z^2}\cos\beta$

$z = \sqrt{x^2+y^2+z^2}\cos\gamma$

$\therefore \left(\frac{x}{\sqrt{x^2+y^2+z^2}}\right)^2 + \left(\frac{y}{\sqrt{x^2+y^2+z^2}}\right)^2 + \left(\frac{z}{\sqrt{x^2+y^2+z^2}}\right)^2 = \cos^2\alpha + \cos^2\beta + \cos^2\gamma$

$= \frac{x^2+y^2+z^2}{x^2+y^2+z^2} = 1$ QED

b) $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} = \vec{v}$ → unit vector pointing other way

$\vec{v'} = \frac{-1}{\sqrt{7}}\vec{v} = \frac{+1}{\sqrt{7}}\begin{bmatrix} -1 \\ -1 \\ -1 \\ -1 \\ -1 \\ -1 \\ -1 \end{bmatrix}$

b) unit vector orthogonal to

$\vec{v''} = \frac{1}{\sqrt{6}}\begin{bmatrix} -1 \\ 1 \\ -1 \\ 1 \\ -1 \\ 1 \\ 0 \end{bmatrix}$

check: $(-1)(1) + (1)(1) + (-1) - 1 + 0 = 0$

alternating 1s lead to cancellation.