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Question-1

$K = \frac{1}{\sqrt{3}}(1,1,1)^T$ $\theta = 90°$ Find $R_{K\theta} = ?$

$$K = \frac{1}{\sqrt{3}}\begin{bmatrix}1\\1\\1\end{bmatrix}$$

For $\theta = 90°$

Rotational matrix $R = \begin{bmatrix}\cos\theta & -\sin\theta & 0\\ \sin\theta & \cos\theta & 0\\ 0 & 0 & 1\end{bmatrix}$

$$R(\theta) = R\left(\frac{\pi}{2}\right) = \begin{bmatrix}\cos 90° & -\sin 90° & 0\\ \sin 90 & \cos 90° & 0\\ 0 & 0 & 1\end{bmatrix}$$

$$R(\pi/2) = \begin{bmatrix}0 & -1 & 0\\ 1 & 0 & 0\\ 0 & 0 & 1\end{bmatrix}$$

Calculating $R_{K\theta} = R(\pi/2)K$

$$R_{K\theta} = \frac{1}{\sqrt{3}}\begin{bmatrix}1\\1\\1\end{bmatrix}\begin{bmatrix}0 & -1 & 0\\ 1 & 0 & 0\\ 0 & 0 & 1\end{bmatrix}$$

$$R_{K\theta} = \frac{1}{\sqrt{3}}\begin{bmatrix}(1\times0 - 1\times1 + 1\times0)\\ (1\times1 + 1\times0 + 1\times0)\\ (1\times0 + 1\times0 + 1\times1)\end{bmatrix} = \frac{1}{\sqrt{3}}\begin{bmatrix}-1\\1\\1\end{bmatrix}$$

$$\boxed{R_{K\theta} = \frac{1}{\sqrt{3}}\begin{bmatrix}-1\\1\\1\end{bmatrix}}$$