# 3.3.7

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# Question

A unit vector perpendicular to the plane determined by the points $P\,(1,-1,2)$, $Q\,(2,0,-1)$ and $R\,(0,2,1)$ is

# Solution

Let $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ be the position vector of point **B** and a,b and c be the sides opposite the vertices A,B and C, respectively in $\Delta ABC$.
Given a $=$8cm;

$$\mathbf{C} = \begin{pmatrix} 8 \\ 0 \end{pmatrix} \tag{1}$$

$$\therefore \mathbf{A} = \begin{pmatrix} c \cos \angle B \\ c \sin \angle B \end{pmatrix} = \begin{pmatrix} c \times 1/\sqrt{2} \\ c \times 1/\sqrt{2} \end{pmatrix} \tag{2}$$

# Solution

in $\Delta ABC$

$$b\cos\angle C + c\cos\angle B = 8 \tag{3}$$

$$b\sin\angle C - c\sin\angle B = 0 \tag{4}$$

Solving linear Equation in b and c:

$$\begin{pmatrix} \cos\angle C & \cos\angle B \\ \sin\angle C & -\sin\angle B \end{pmatrix}\begin{pmatrix} b \\ c \end{pmatrix} = \begin{pmatrix} a \\ 0 \end{pmatrix} \tag{5}$$

# Solution

using augmented matrix

$$\left(\begin{array}{cc|c} \cos\angle C & \cos\angle B & a \\ \sin\angle C & -\sin\angle B & 0 \end{array}\right) \tag{6}$$

putting $\angle C = 30°$ and $\angle B = 45°$

$$\left(\begin{array}{cc|c} \sqrt{3}/2 & 1/\sqrt{2} & 8 \\ 1/2 & -1/\sqrt{2} & 0 \end{array}\right) \tag{7}$$

Echelon form of the matrix is given by

$$\left(\begin{array}{cc|c} \sqrt{3}/2 & 1/\sqrt{2} & 8 \\ 0 & (-\sqrt{3}-1)/\sqrt{2} & -8 \end{array}\right) \tag{8}$$

# Solution

$$\frac{(-\sqrt{3}-1)}{\sqrt{2}} \times c = -8 \tag{9}$$

$$\implies c = \frac{8\sqrt{2}}{(\sqrt{3}+1)} = \sqrt{3}-1 \tag{10}$$

$$\therefore \mathbf{A} = \begin{pmatrix} \sqrt{3}-1 \\ \sqrt{3}-1 \end{pmatrix} \tag{11}$$

# plot