

## 12.330

EE25BTECH11004 - Aditya Appana

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### Question

If a weight of  $\mathbf{P} = 100\text{N}$  is supported by two massless strings connected to the walls as shown in the figure, the value of  $T_1$  is \_\_\_\_\_ N.

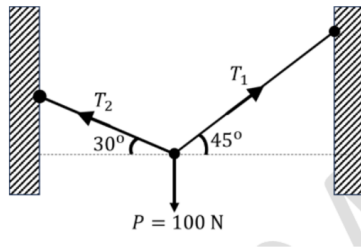


Figure 1: Figure

### Solution

$$\mathbf{T}_1 + \mathbf{T}_2 = -\mathbf{P} \quad (1)$$

$$\mathbf{T}_1 = \|T_1\| \begin{pmatrix} \cos 45^\circ \\ \sin 45^\circ \end{pmatrix} \quad (2)$$

$$\mathbf{T}_2 = \|T_2\| \begin{pmatrix} \cos 180 - 30^\circ \\ \sin 180 - 30^\circ \end{pmatrix} = \|T_2\| \begin{pmatrix} \cos 150^\circ \\ \sin 150^\circ \end{pmatrix} \quad (3)$$

$$\mathbf{P} = -\|P\| \begin{pmatrix} \cos -90^\circ \\ \sin -90^\circ \end{pmatrix} = -100 \begin{pmatrix} \cos(-90^\circ) \\ \sin(-90^\circ) \end{pmatrix} \quad (4)$$

Therefore:

$$\|T_1\| \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix} + \|T_2\| \begin{pmatrix} -\frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix} = 100 \begin{pmatrix} 0 \\ 1 \end{pmatrix} \quad (5)$$

$$\begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{2} \end{pmatrix} \begin{pmatrix} \|T_1\| \\ \|T_2\| \end{pmatrix} = \begin{pmatrix} 0 \\ 100 \end{pmatrix} \quad (6)$$

Organising the data into an augmented matrix and obtaining RREF:

$$\left( \begin{array}{cc|c} \frac{1}{\sqrt{2}} & -\frac{\sqrt{3}}{2} & 0 \\ \frac{1}{\sqrt{2}} & \frac{1}{2} & 100 \end{array} \right) \xrightarrow{R_2 \rightarrow R_2 - R_1} \left( \begin{array}{cc|c} \frac{1}{\sqrt{2}} & -\frac{\sqrt{3}}{2} & 0 \\ 0 & \frac{1}{2} + \frac{\sqrt{3}}{2} & 100 \end{array} \right) \quad (7)$$

$$\|T_2\| = \frac{200}{1 + \sqrt{3}} = 73.205N \quad (8)$$

$$\|T_1\| = \frac{\sqrt{3}}{\sqrt{2}} \|T_2\| = 89.658N \quad (9)$$

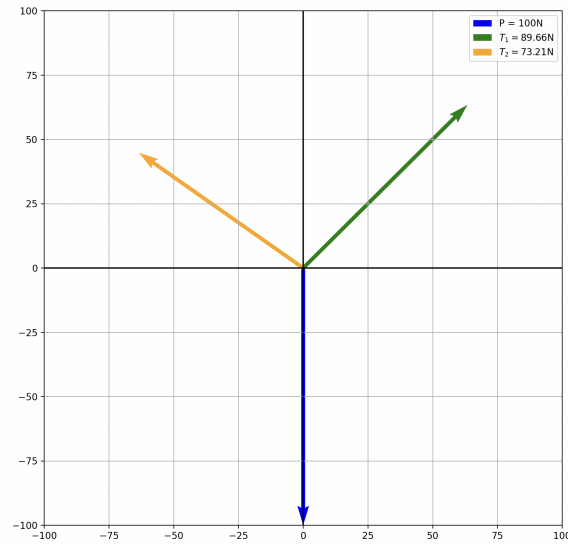


Figure 2: Plot