12.150

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Question

Two sides of a triangle are represented by vectors $\mathbf{a} = \hat{i} + \hat{j} + \hat{k}$ and $\mathbf{b} = \hat{-i} + \hat{-j} + \hat{k}$. The area (magnitude) of the triangle is

1. $\frac{1}{\sqrt{2}}$
2. 1
3. $\sqrt{2}$
4. $2\sqrt{2}$

Theoretical Solution

Given ,

$$\mathbf{a} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, \quad \mathbf{b} = \begin{pmatrix} -1 \\ -1 \\ 1 \end{pmatrix} \tag{1}$$

Area of Trianle

$$\frac{1}{2} \left\| \mathbf{a} \times \mathbf{b} \right\| \tag{2}$$

Theoretical Solution

Also,

$$\mathbf{a} \times \mathbf{b} = \begin{pmatrix} \begin{vmatrix} \mathbf{a}_{23} & \mathbf{b}_{23} \\ \mathbf{a}_{31} & \mathbf{b}_{31} \end{vmatrix} \\ \begin{vmatrix} \mathbf{a}_{12} & \mathbf{b}_{12} \end{vmatrix} \end{pmatrix} \tag{3}$$

$$= \begin{pmatrix} 1 \cdot 1 - 1 \cdot (-1) \\ 1 \cdot (-1) - 1 \cdot 1 \\ 1 \cdot (-1) - 1 \cdot (-1) \end{pmatrix} = \begin{pmatrix} 2 \\ -2 \\ 0 \end{pmatrix} \tag{4}$$

Theoretical Solution

$$Ar\left(\Delta\right) = \frac{1}{2}\left\|\begin{pmatrix}2\\-2\\0\end{pmatrix}\right\| \tag{5}$$

$$= \frac{1}{2}2\sqrt{2} \tag{6}$$

$$= \sqrt{2} \tag{7}$$

Hence, Answer : Option 3

Plot

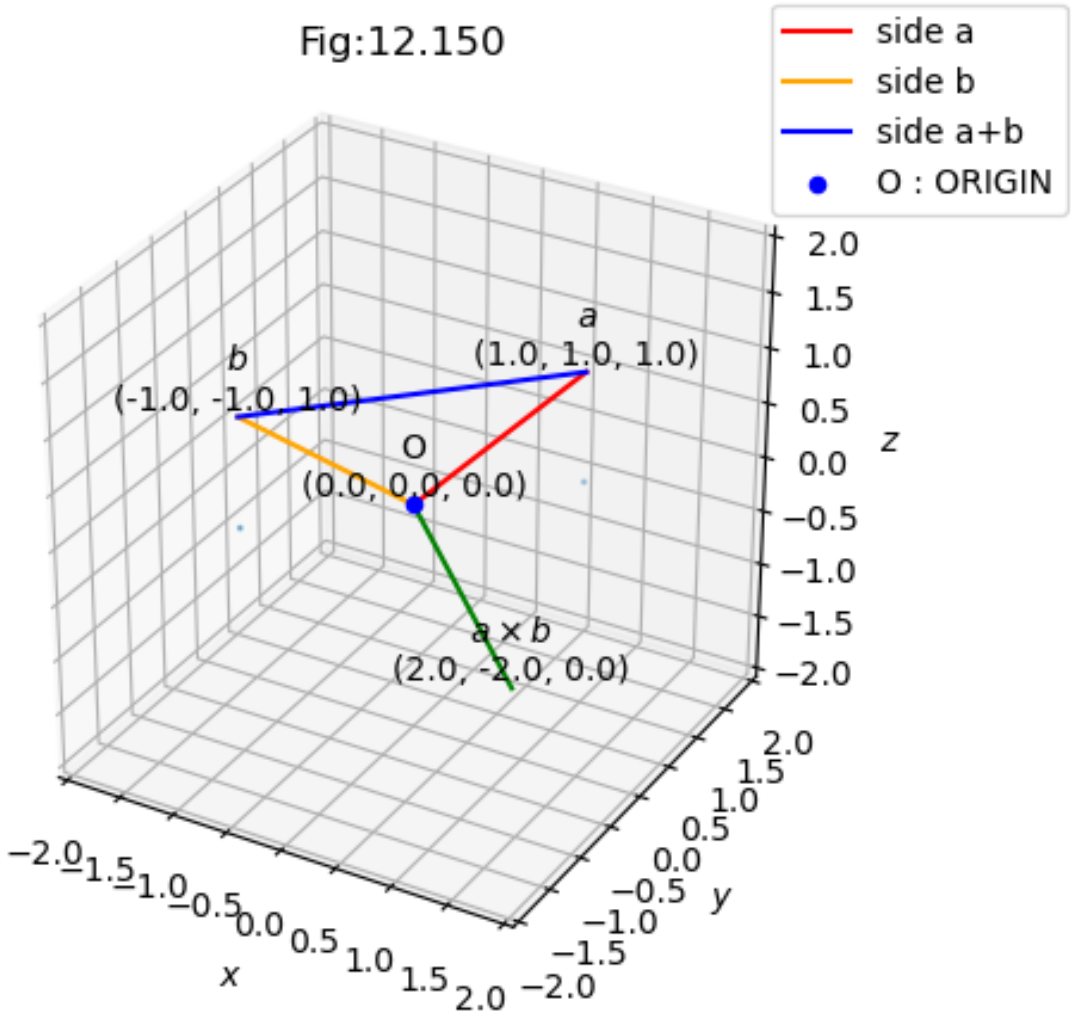
Fig:12.150
side a
side b
side a+b
O : ORIGIN
a
(1.0, 1.0, 1.0)
b
(-1.0, -1.0, 1.0)
O
(0.0, 0.0, 0.0)
a × b
(2.0, -2.0, 0.0)
x
y
z