

# 2.7.8

AI25BTECH11033–SNEHAMRUDULA

Find  $|\mathbf{a} \times \mathbf{b}|$ , if  $\mathbf{a} = 2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$  and  $\mathbf{b} = 3\mathbf{i} + 5\mathbf{j} - 2\mathbf{k}$ .

**solution**

$$\mathbf{a} = \begin{pmatrix} 2 \\ 1 \\ 3 \end{pmatrix}, \quad \mathbf{b} = \begin{pmatrix} 3 \\ 5 \\ -2 \end{pmatrix}. \quad (0.1)$$

Using the triangle-area formula,

$$\text{ar}(\triangle OAB) = \frac{1}{2} \|(A - O) \times (B - O)\| = \frac{1}{2} \|\mathbf{a} \times \mathbf{b}\|. \quad (0.2)$$

from the vector cross product definition  $\mathbf{a} \times \mathbf{b} = \begin{pmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & 3 \\ 3 & 5 & -2 \end{pmatrix} = -17\hat{i} + 13\hat{j} + 7\hat{k}.$

(0.3)

$$\|\mathbf{a} \times \mathbf{b}\| = \sqrt{(-17)^2 + 13^2 + 7^2} = \sqrt{507} = 13\sqrt{3}. \quad (0.4)$$

$$\boxed{|\mathbf{a} \times \mathbf{b}| = 13\sqrt{3}}. \quad (0.5)$$

### 3D Representation of Vectors and Cross Product

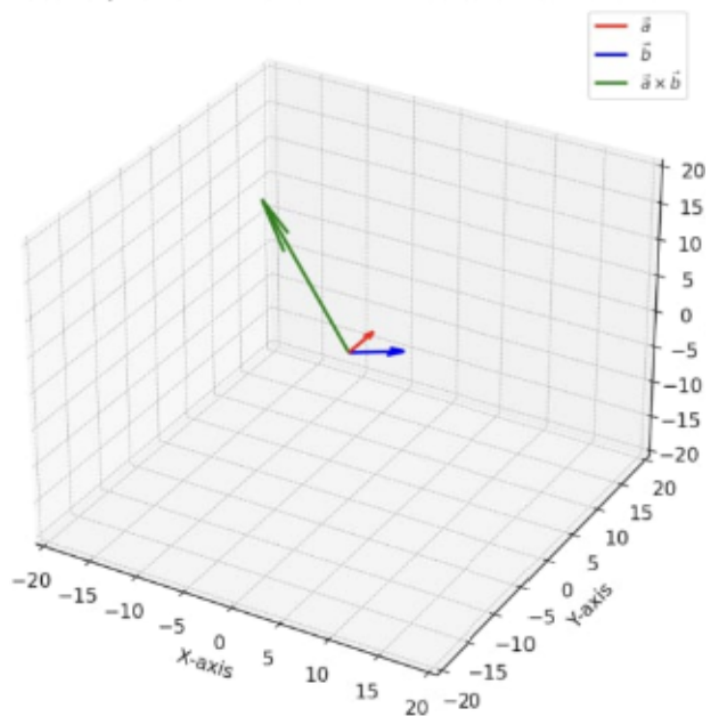


Fig. 0.1