2.2.5.31

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Question:
The two adjacent sides of a parallelogram are represented by $2\hat{i}+4\hat{j}+-5\hat{k}$ and $\hat{i}+2\hat{j}+3\hat{k}$.find the unit vectors parallel to its diagonals.using diagonal vectors find the area of parallelogram
Solution

vector	Name
$\begin{pmatrix}2\\4\\-5\end{pmatrix}$	Vector **a**
$\begin{pmatrix}1\\2\\3\end{pmatrix}$	Vector **b**

TABLE 0: Variables Used

The diagonals of the parallelogram are given by

$$\mathbf{a}+\mathbf{b}=\begin{pmatrix}3\\6\\-2\end{pmatrix} \quad \text{and} \quad \mathbf{a}-\mathbf{b}=\begin{pmatrix}1\\2\\-8\end{pmatrix} \tag{1}$$

The corresponding unit vectors parallel to diagonals are

$$\frac{\mathbf{a}+\mathbf{b}}{\|\mathbf{a}+\mathbf{b}\|}=\begin{pmatrix}\frac{3}{7}\\\frac{6}{7}\\\frac{-2}{7}\end{pmatrix} \quad \text{and} \quad \frac{\mathbf{a}-\mathbf{b}}{\|\mathbf{a}-\mathbf{b}\|}=\begin{pmatrix}\frac{1}{\sqrt{69}}\\\frac{2}{\sqrt{69}}\\\frac{-8}{\sqrt{69}}\end{pmatrix} \tag{2}$$

If **d1** and **d**2 are the diagonals of a parallelogram then area of parallelogram is $=\frac{1}{2}\|\mathbf{d1}\times\mathbf{d2}\|$

$$\rightarrow \text{area of parallelogram} = \frac{1}{2}\|(\mathbf{a}+\mathbf{b})\times(\mathbf{a}-\mathbf{b})\| \implies \text{area} = \frac{1}{2}\left\|\begin{pmatrix}-44\\22\\0\end{pmatrix}\right\| = \left\|\begin{pmatrix}-22\\11\\0\end{pmatrix}\right\| = \sqrt{605} = 24.59 \tag{3}$$