

# Cross Product

The vector which is perpendicular to both vector  $a$  and vector  $b$ , the sides of a parallelogram is the cross product, is the cross product of  $a$  and  $b$  ( $a \times b$ )

$$a \times b = \|a\| \|b\| \sin \theta \, n$$

$\theta$  is the angle between  $a$  and  $b$ , and  $n$  is the **unit vector** perpendicular to the plane containing  $a$  and  $b$ .

$$\begin{aligned} a \times b &= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix} \\ &= \begin{bmatrix} u_2 & u_3 \\ v_2 & v_3 \end{bmatrix} \mathbf{i} - \begin{bmatrix} u_1 & u_3 \\ v_1 & v_3 \end{bmatrix} \mathbf{j} + \begin{bmatrix} u_1 & u_2 \\ v_1 & v_2 \end{bmatrix} \mathbf{k} \end{aligned}$$

## Area of a parallelogram

To find it cross 2 parallel sides.

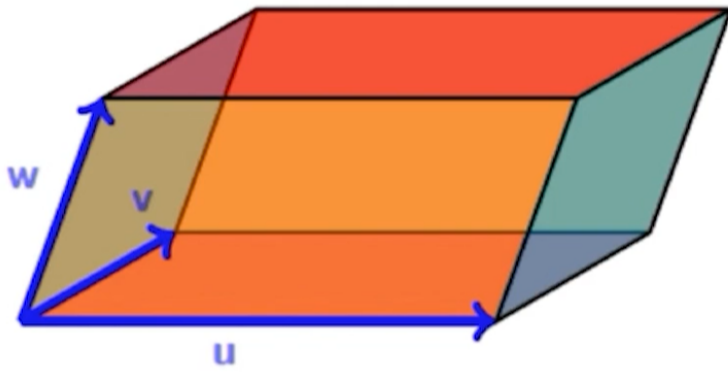
Say you have parallelogram  $ABCD$  the area =  $|\vec{AB} \times \vec{AD}|$

## Area of a parallelepiped

Find the triple scalar product,

$$(\vec{u} \times \vec{v}) \cdot \vec{w} = \begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix}$$

$\vec{u}, \vec{v}, \vec{w}$  are given by:



[Properties](#)