Vector Product of Parallel Vectors

If **a** and **b** are parallel then $\theta = 0$

$\therefore \quad \mathbf{a} \times \mathbf{b} = |\mathbf{a}||\mathbf{b}|\sin\theta \,\hat{\mathbf{e}}$
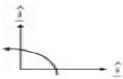
$\qquad \qquad = \mathbf{0}$

N.B. This is still a vector result $\mathbf{0} = 0\hat{\mathbf{i}} + 0\hat{\mathbf{j}} + 0\hat{\mathbf{k}}$

N.B. $\mathbf{a} \times \mathbf{b} = \mathbf{0}$ if **a** and **b** are anti-parallel (opposite directions).
Note also that $\hat{\mathbf{i}} \times \hat{\mathbf{i}} = \hat{\mathbf{j}} \times \hat{\mathbf{j}} = \hat{\mathbf{k}} \times \hat{\mathbf{k}} = \mathbf{0}$

Vector Product of $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$

$|\hat{\mathbf{i}} \times \hat{\mathbf{j}}| = |\hat{\mathbf{i}}||\hat{\mathbf{j}}|\sin 90° = 1$

The result is a unit vector and it has a direction perpendicular to $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$

The direction will be defined by the right-hand screw rule (i.e. out of the paper vertically) and is thus the direction of $\hat{\mathbf{k}}$. Hence $\hat{\mathbf{i}} \times \hat{\mathbf{j}} = \hat{\mathbf{k}}$

Similarly $\qquad \hat{\mathbf{j}} \times \hat{\mathbf{k}} = \hat{\mathbf{i}} \qquad \hat{\mathbf{k}} \times \hat{\mathbf{i}} = \hat{\mathbf{j}}$

Vector of n dimensions

The vectors considered so far have clear physical meaning in 2 or 3 dimensions.

It is sometimes necessary to generalise the ideas to higher dimensions but no convenient geometrical interpretation is possible then.

For example, we can define five dimensional vectors

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