Dot Product and Cross Product

L18

3.7.16

Section 8.4

Warm-up

1) Find the determinant of $a = \begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix}$

2) Find the determinant of $b = \begin{vmatrix} 0 & -2 \\ 1 & 4 \end{vmatrix}$

Given $\vec{a} = \langle a_1, a_2 \rangle, and\ \vec{b} = \langle b_1, b_2 \rangle$
$\vec{a} \cdot \vec{b} = a_1 b_1 + a_2 b_2$.

When the dot product of two vectors equals 0. They are considered perpendicular.

I Try:
Find the inner product if
$\vec{p} = \langle 7,14 \rangle, \vec{q} = \langle 2, -1 \rangle, and\ \vec{m} = \langle 3,5 \rangle$.
Identify if they are perpendicular.

$\vec{p} \cdot \vec{q}$

Plug into equation.	$\vec{p} \cdot \vec{q} = (7 \cdot 2) + (14 \cdot -1)$
Simplify	$14 + (-14)$ 0
Identify if it is perpendicular	Yes, because dot product =0

We Try:
$\vec{m} \cdot \vec{q}$

Plug into equation.	
Simplify	

Identify if it is perpendicular	

You Try with your partner:

$\vec{m} \cdot \vec{p}$

Plug into equation.	
Simplify	
Identify if it is perpendicular	

Cross Product

If $\vec{\mathbf{a}} = \langle a_1, a_2, a_3 \rangle$ and $\vec{\mathbf{b}} = \langle b_1, b_2, b_3 \rangle$, then the cross product of $\vec{\mathbf{a}}$ and $\vec{\mathbf{b}}$ is defined as follows.

$$\vec{\mathbf{a}} \times \vec{\mathbf{b}} = \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} \vec{\mathbf{i}} - \begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} \vec{\mathbf{j}} + \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} \vec{\mathbf{k}}$$

Another way to visualize:

$$\begin{vmatrix} \vec{\mathbf{i}} & \vec{\mathbf{j}} & \vec{\mathbf{k}} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$$

I Try:

Given $\vec{m} = \langle 0,3,1 \rangle$ *and* $\vec{q} = \langle 0,1,2 \rangle$,

solve for $\vec{m}\ x\ \vec{q}$

Set up the matrix!	$\begin{vmatrix} i & j & k \\ 0 & 3 & 1 \\ 0 & 1 & 2 \end{vmatrix}$
Plug into equation	$\vec{m}\ x\ \vec{q} = \begin{vmatrix} 3 & 1 \\ 1 & 2 \end{vmatrix} \vec{\imath} - \begin{vmatrix} 0 & 1 \\ 0 & 2 \end{vmatrix} \vec{\jmath} + \begin{vmatrix} 0 & 3 \\ 0 & 1 \end{vmatrix} \vec{k}$
Simplify	$5\vec{\imath} - 0\vec{\jmath} + 0\vec{k}$

We Try:

Given $\vec{m} = \langle -1,2,1 \rangle$ *and* $\vec{q} = \langle 1,1,0 \rangle$,

solve for $\vec{m}\ x\ \vec{q}$

Set up the matrix!	$\begin{vmatrix} i & j & k \\ & & \\ & & \end{vmatrix}$
Plug into equation	$\vec{m}\ x\ \vec{q} = \Big\vert \quad {}_2 \Big\vert \vec{i} - \Big\vert \quad \Big\vert \vec{j} + \Big\vert \quad \Big\vert \vec{k}$
Simplify	

You Try:

You Try:

Given $\vec{m} = \langle 1,0,3 \rangle$ and $\vec{q} = \langle -1,1,0 \rangle$,
$solve\ for \quad \vec{m}\ x\ \vec{q}$

Exit Ticket

1) Given $\overrightarrow{m} = \langle 1,0,1 \rangle$ and $\vec{q} = \langle 1,2,0 \rangle$,
$solve\ for \quad \overrightarrow{m}\ x\ \vec{q}$

2) $\vec{p} = \langle 3\ ,2 \rangle, \vec{q} = \langle 2, -1 \rangle, and\ \overrightarrow{m} = \langle 3,5 \rangle$.
Identify if they are perpendicular.

$\vec{p} \cdot \vec{q}$