$\mathbf{a} = (1, 1)$  $\mathbf{b} = (0, k)$

$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos \theta$

$k = \sqrt{2} |k| \frac{1}{\sqrt{2}}$

$k = |k|$

$\therefore k > 0$
\[ p \cdot \mathbf{\vec{a}} = 13 \]

\[ |\mathbf{\vec{a}}| = 10 \quad |\mathbf{\vec{b}}| = 12 \quad \angle = 135^\circ \]

S. p. of \( \triangle ABC \) = 12 \cdot 10 \cdot \cos 135^\circ

\[ = 10 \cdot \cos 135^\circ \]

S. p. of \( \triangle BDE \) = 16 \cdot 12 \cdot \cos 135^\circ

\[ = 12 \cdot \cos 135^\circ \]
\[ \mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos \theta \]

\[ (2q + 4p + 96) = |\mathbf{a}| |\mathbf{b}| \]

Torque \[ \Delta \text{bun} = 0 \]

1, 2, 3

\[ \frac{2}{n} = \frac{8}{12} \]

\[ \frac{p}{4} = \frac{8}{12} \]
The cross product of two vectors, \( \vec{u} \) and \( \vec{v} \), results in a new vector perpendicular to both \( \vec{u} \) and \( \vec{v} \). For this reason, we can only apply the cross product in three dimensions.

Given \( \vec{a} = (a_1, a_2, a_3) \) and \( \vec{b} = (b_1, b_2, b_3) \):
\[
\vec{a} \times \vec{b} = (a_2b_3 - a_3b_2, a_3b_1 - a_1b_3, a_1b_2 - a_2b_1)
\]
Ex1: a) Find the cross product between the vector $\vec{u} = (2, 1, 4)$ and $\vec{v} = (1, 5, 6)$.

Let me show you a trick for calculating the cross product...........

$$\vec{u} \times \vec{v} = \begin{vmatrix} i & j & k \\ 2 & 1 & 4 \\ 1 & 5 & 6 \end{vmatrix} = (6 - 20, 4 - 12, 10 - 1) = (-14, -8, 9)$$

b) Find $\vec{v} \times \vec{u}$. Discuss what you notice.

$$\vec{v} \times \vec{u} = \begin{vmatrix} i & j & k \\ 5 & 6 & 15 \\ 1 & 4 & 2 \end{vmatrix} = (14, 8, -9)$$

NOTE:
1- The cross product is not commutative.
2- The cross product is distributive. (use in #13 of homework)

$$\vec{u} \times \vec{v} = \begin{vmatrix} 2 & 1 & 4 \\ 1 & 5 & 6 \end{vmatrix} = (-14, -8, 9)$$
Ex2: Find a vector perpendicular to both $\vec{a} = (4, -3, -7)$ and $\vec{b} = (2, -1, 5)$.

$$\vec{a} \times \vec{b} = \begin{vmatrix} 4 & -3 & -7 \\ 2 & -1 & 5 \end{vmatrix}$$

$$= (-22, -34, 2)$$

Can you give me another possible answer to this question?

$$\vec{b} \times \vec{a} = (22, 34, -2)$$

.... any others: $$(11, 17, -1)$$

To summarize $n = (11, 17, -1)$, not $n = 0$. 

The Magnitude of the Cross Product

\[ | \vec{a} \times \vec{b} | = | \vec{a} || \vec{b} | \sin \theta \quad 0 \leq \theta \leq 180 \degree \]

Proof on page 411
Area of a Parallelogram

The usual formula for area of a parallelogram is:

\[ A = bh \]

We can find the area of a parallelogram formed by two vectors:

\[
\begin{align*}
\text{since } h &= |\vec{u}|\sin\theta, \text{ we can express the area formula as:} \\
A &= |\vec{v}|h \\
&= |\vec{v}||\vec{u}|\sin\theta
\end{align*}
\]

recognize this formula as the magnitude of the cross product:

\[ A = |\vec{v} \times \vec{u}| \text{ or } |\vec{u} \times \vec{v}| \]

\[ \therefore \text{The area of a parallelogram formed by the vectors } \vec{u} \text{ and } \vec{v} \text{ can be found using the formula} \]

\[ A = |\vec{v} \times \vec{u}| = |\vec{v}||\vec{u}|\sin\theta \]
Assigned Work

p.407-408 #1, 2, 3, 4abc, 5, 7, 9a, 13
p. 415 #5b, 6, 7