Homework Section 12.5
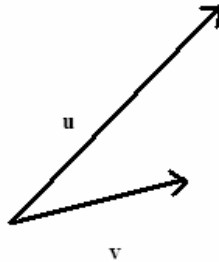
1. Let $\mathbf{u} = \langle -1, 2 -1 \rangle$ and $\mathbf{v} = \langle 2,1,1 \rangle$. Find $\mathbf{u} \times \mathbf{v}$ and verify that it is orthogonal to both $\mathbf{u}$ and $\mathbf{v}$.

2. Let $\mathbf{v} = 2\mathbf{i} + \mathbf{j} + \mathbf{k}$ and $\mathbf{w} = 3\mathbf{i} - \mathbf{k}$. Find two vectors that are orthogonal to both $\mathbf{v}$ and $\mathbf{w}$.

3. Let $\mathbf{u} = 3\mathbf{i} - \mathbf{k}$ and $\mathbf{v} = 2\mathbf{j} + \mathbf{k}$. Find $\mathbf{u} \times \mathbf{v}$ and graph $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{u} \times \mathbf{v}$ in component form.

4. In the following picture, is $\mathbf{u} \times \mathbf{v}$ directed towards you or away from you?

5. Suppose $|\mathbf{u}| = 3$, $|\mathbf{v}| = 12$, and the angle between u and v is $\pi/6$ radian. Find $|\mathbf{u} \times \mathbf{v}|$.

6. Use the cross product to determine the area of a parallelogram that has vertices (2, 0), (4, 2), (6, 1), (4, -1).

7. Find the volume of the parallelpiped determined by $\mathbf{u} = -\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{v} = 2\mathbf{i} + \mathbf{j} + \mathbf{k}$ and $\mathbf{w} = 3\mathbf{i} - \mathbf{k}$.

8. A ten inch long wrench grips a bolt located at the origin. A force of magnitude 20 pounds is applied to the end of the wrench at an angle of 30 degrees to the handle. Find the magnitude of the torque on the bolt.
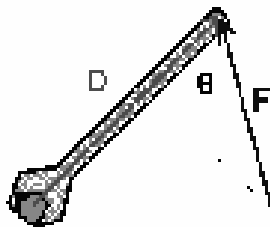
9. Refer to the last problem. Find the magnitude of the force needed to apply 420 foot-pounds of torque on the bolt if length of the wrench remains unchanged, but the force is applied in the direction of $\langle 1, 2, 0 \rangle$. (**Hint**: Let $\mathbf{D}$ lie on the positive x-axis. Note that you are looking for $|\mathbf{F}|$).