1) Give the geometric description of the cross product, including explanatory diagrams.
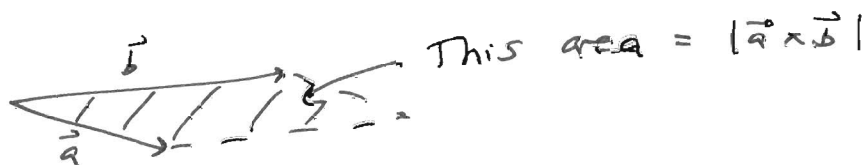
<u>Direction</u>: The cross product $\vec{a} \times \vec{b}$ is perpendicular to $\vec{a}$ and to $\vec{b}$ and satisfies the right-hand rule:
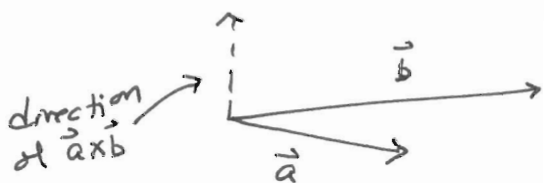
<u>Length</u>: The length of $\vec{a} \times \vec{b}$ is $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}|\sin\theta$ where θ is the smallest angle between $\vec{a}$ and $\vec{b}$. This equals the area of the parallelogram spanned by $\vec{a}$ and $\vec{b}$:

This area $= |\vec{a} \times \vec{b}|$

2) At the Boy Scout ~~boxcar~~ soxcar derby, a model car weighing .25 kg is placed on a 3 meter ramp making a 30° angle with the horizontal. With what force does gravity act along the ramp? How much work does gravity do on the car getting it from the top to the bottom?

$|\vec{g}| = 9.8 \, m/s^2 \cdot .25 kg$

$$\vec{g} = \langle 0, -9.8 \cdot .25 \rangle = \langle 0, -2.45 \rangle$$

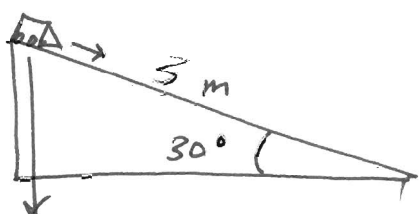We need force acting along ramp.

Ramp vector is $\langle \cos 30°, \sin 30° \rangle = \langle \frac{\sqrt{3}}{2}, \frac{1}{2} \rangle$

$\begin{array}{l}\text{magnitude} \\ \text{of force} \\ \text{along ramp}\end{array} = \left| \text{comp}_{\langle \frac{\sqrt{3}}{2}, \frac{1}{2} \rangle} \langle 0, -2.45 \rangle \right| = \left| \frac{\langle \frac{\sqrt{3}}{2}, \frac{1}{2} \rangle \cdot \langle 0, -2.45 \rangle}{|\langle \frac{\sqrt{3}}{2}, \frac{1}{2} \rangle|} \right|$

$= 1.225$ Newtons

Work = Force · distance $= 1.225 \times 3 = 3.675$ Joules