Name: _____ Group Members: _____

Exploration 10-6a: Introduction to the Cross Product

Date: _____

Objective: Discover the meaning of and way of computing the cross product of two vectors.

Let $\vec{a} = 3\vec{i} + 5\vec{j} + 7\vec{k}$.

Let $\vec{b} = 11\vec{i} + 2\vec{j} + 13\vec{k}$.

The vector $\vec{c} = 51\vec{i} + 38\vec{j} - 49\vec{k}$ is the **cross product** of $\vec{a}$ and $\vec{b}$, written $\vec{a} \times \vec{b}$. In this Exploration, it is your objective to find out the meaning of *cross product* and how it is calculated.

1. Find $|\vec{a}|$, $|\vec{b}|$, and $|\vec{a} \times \vec{b}|$. Does the length of the cross product vector equal the product of the lengths of the two factors?

2. Find the angle θ between $\vec{a}$ and $\vec{b}$ when they are placed tail-to-tail. Show that
   $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$

3. Find $(\vec{a} \times \vec{b}) \cdot \vec{a}$ and $(\vec{a} \times \vec{b}) \cdot \vec{b}$. From the answers, what do you conclude about the direction of the cross product with respect to the direction of the two vectors being cross multiplied?

4. Look up the **right-hand rule** in Section 10-6. When all members of your group understand it, have one representative of your group demonstrate it to your instructor. _____

5. State the formal definition of *cross product*.

6. Explain why $\vec{i} \times \vec{i}$, $\vec{j} \times \vec{j}$, and $\vec{k} \times \vec{k}$ all equal zero.

7. Explain why $\vec{i} \times \vec{j} = \vec{k}$, $\vec{j} \times \vec{k} = \vec{i}$, and $\vec{k} \times \vec{i} = \vec{j}$.

8. Explain why $\vec{j} \times \vec{i}$ is the *opposite* of $\vec{i} \times \vec{j}$.

(Over)