1. Let $\vec{a} = \langle 4, 3, -2 \rangle$ and $\vec{b} = \langle 2, -1, 1 \rangle$. Compute $\vec{a} \times \vec{b}$ and verify that the result is orthogonal to both $\vec{a}$ and $\vec{b}$.

2. Let $\vec{a} = \langle a_1, a_2, a_3 \rangle$ be any vector. Show that $\vec{a} \times \vec{a} = \vec{0}$

3. Let $\vec{a}$ be a vector that points north and $\vec{b}$ a vector that points southeast. Use the right hand rule to determine what direction $\vec{a} \times \vec{b}$ points. What about $\vec{b} \times \vec{a}$?

4. Let $\vec{a}$ be a vector that points north and up and $\vec{b}$ a vector that points west and up. Use the right hand rule to determine what direction $\vec{a} \times \vec{b}$ points.
5. Use the cross product to show that $4\vec{i} - 2\vec{j} + 6\vec{k}$ is parallel to $-6\vec{i} + 3\vec{j} - 9\vec{k}$.

6. Let $\vec{a}, \vec{b}, \vec{c}$ be vectors. Determine whether each of the following expressions is meaningful. If it is, state whether the result will be a vector or a scalar.

   $(\vec{a} \times \vec{b}) \times \vec{c}$

   $(\vec{a} \cdot \vec{b}) \times \vec{c}$

   $(\vec{a} \times \vec{b}) \cdot \vec{c}$

   $(\vec{a} \cdot \vec{b}) \cdot \vec{c}$

7. Find two unit vectors orthogonal to both $\langle 2, 3, 0 \rangle$ and $\langle 1, 0, 5 \rangle$. 

8. Find the area of the parallelogram with vertices \( P(1, 0, 2), Q(3, 3, 3), R(7, 5, 8) \) and \( S(5, 2, 7) \).

What is the area of the triangle \( PQR \)?

9. Find a nonzero vector orthogonal to the plane that contains the points \( P(0, 0, -3), Q(4, 2, 0) \) and \( R(3, 3, 1) \).
Remember that the scalar triple product is
\[
|\vec{a} \cdot (\vec{b} \times \vec{c})| = \left| \begin{array}{ccc}
a_1 & a_2 & a_3 \\
b_1 & b_2 & b_3 \\
c_1 & c_2 & c_3 \\
\end{array} \right|
\]

If \( |\vec{a} \cdot (\vec{b} \times \vec{c})| = 0 \), then the vectors \( \vec{a}, \vec{b}, \) and \( \vec{c} \) are coplanar.

10. Show that the vectors \( \langle 4, 3, -2 \rangle, \langle 5, 5, 1 \rangle, \) and \( \langle 1, 2, 3 \rangle \) are coplanar.

11. Determine whether or not the points \( A(1, 3, 2), B(3, -1, 6), C(5, 2, 0), \) and \( D(3, 6, -4) \) all lie in the same plane.