Objectives:

- Write forces as Cartesian vectors.
- Perform vector calculations, such as summation, dot and cross product.
- Write unit vectors.

1) For vectors $\mathbf{A} = 5\mathbf{i} - 6\mathbf{j}$ and $\mathbf{B} = -3\mathbf{i} + 1\mathbf{j}$, determine:
   a) an expression for the resultant vector $\mathbf{C} = \mathbf{A} + \mathbf{B}$.
   b) the magnitude and direction of the resultant vector $\mathbf{C}$.
   Make a graphical representation of your results.

2) For vectors $\mathbf{A} = -3\mathbf{i} + 2\mathbf{j}$ and $\mathbf{B} = 7\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$, what is the dot (scalar) product $\mathbf{A} \cdot \mathbf{B}$?

3) For vectors $\mathbf{A} = -3\mathbf{i} + 2\mathbf{j} - 8\mathbf{k}$ and $\mathbf{B} = 2\mathbf{i} - 7\mathbf{j} + 3\mathbf{k}$, what is the cross (vector) product $\mathbf{A} \times \mathbf{B}$?
4) What is the unit vector that points along $\mathbf{A} = -2i - 7j$?

5) For vectors $\mathbf{A} = -5i + 2j$ and $\mathbf{B} = 3i - 6j$, what is the cosine of the angle between $\mathbf{A}$ and $\mathbf{B}$?

6) For vectors $\mathbf{A} = -2i + 6j$ and $\mathbf{B} = 4i - 9j$, what is the projection of $\mathbf{A}$ onto $\mathbf{B}$?

7) For vectors $\mathbf{A} = 3i - 1j - 6k$ and $\mathbf{B} = -6i + 3j - 5k$, what is the cross (vector) product $\mathbf{B} \times \mathbf{A}$?
8) Two forces act on the hook as indicated below. Assume that the resultant force acts along the positive $z$-axis and has magnitude of 600 N.

![Diagram of forces acting on a hook](Image)

a) Express the force $F_1$ as a Cartesian vector

b) Express the force $F_2$ as a Cartesian vector

c) Write the unit vector that points along $F_R$
9) For the system below, express the force $\mathbf{F}$ as a Cartesian vector. Determine the projection of the force vector $\mathbf{F}$ along the $u$-axis.