TAM 210/211 - Worksheet 2

Objectives:

- Write forces as Cartesian vectors.
- Perform vector calculations, such as summation, dot and cross product.
- Write unit vectors.
- Understand some important applications of vectors in engineering.

1) Mechanical equilibrium is a major focus of statics. Examples of equilibrium in everyday life include sitting in a chair and a stack of books resting on a table. What are examples of things that were designed to be in equilibrium?

2) For vectors $\mathbf{A} = 9\mathbf{i} - 5\mathbf{j}$ and $\mathbf{B} = -2\mathbf{i} + 4\mathbf{j}$, 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.

3) What is the unit vector that points along $\mathbf{A} = -1\mathbf{i} - 8\mathbf{j}$?
4) 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.

a) Express the force \( \mathbf{F}_1 \) as a Cartesian vector

b) Express the force \( \mathbf{F}_2 \) as a Cartesian vector

c) Write the unit vector that points along \( \mathbf{F}_R \)
d) Making sure that your designs are able to handle their required loads is an important aspect of engineering. Suppose that the hook only handles the force $\mathbf{F}_1$, and that the hook can withstand 100 N along the negative z-axis before failure. Does the hook fail? What are some potential improvements that could be made to the hook’s design?
5) Two forces act on the ring located at point A as indicated below.

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 indicates the direction of the resultant force, $\mathbf{F}_R$

d) Determine the coordinate direction angles for $\mathbf{F}_R$, assuming that the origin is located at A.
6) For vectors $\mathbf{A} = -5\mathbf{i} + 1\mathbf{j} - 8\mathbf{k}$ and $\mathbf{B} = 6\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$, what is the cross (vector) product $\mathbf{A} \times \mathbf{B}$?

7) For vectors $\mathbf{A} = -1\mathbf{i} + 6\mathbf{j}$ and $\mathbf{B} = 4\mathbf{i} - 4\mathbf{j}$, what is the component of $\mathbf{A}$ onto $\mathbf{B}$?