Unit: Vectors

I. Drawing Vectors
   A. Addition
   B. Subtraction

II. Vector Components
   A. Cartesian
   B. Polar
   C. Normal and Tangential

today
A child is flying a kite on the end of a 25m string. Write a mathematical expression for the kite if it makes a 35° angle to the horizontal.
The boat shown below heads straight across the lake to point B, 20m away. Due to the current the boat ends up at point C, 15m downstream.

Write out a mathematical expression for the path of the boat.
A dog searching for a bone walks 5 m south, then 9 m at an angle 30° north of east.

1. Graphically determine the dog’s resultant displacement.

2. Write a mathematical vector expression for the dog's resultant displacement.
John pushes a box north with a force of 100N, Sally pushes 50° south of west with a force of 80N.

1. Graphically determine the total force on the box.

2. Write a mathematical vector expression for total force on the box.
The door shown in A (from the top view) has a dart sticking straight out of it. The vector representing the position of the dart’s tail is:

\[ \vec{T} = 3.0 \hat{n} \]

What vector represents the position of the dart’s tail in B?
Given the vectors shown below, write out vector \( \mathbf{X} \) (length 4m) in terms of vector \( \mathbf{F} \).
The blue vector shown below is 320 units long and represents the velocity of the wind on the wing (in mph). Write a mathematical expression for the velocity of the wind with respect to the wing.
The blue vector shown below is 320 units long and represents the velocity of the wind on the wing (in mph). Write a mathematical expression for the velocity of the wind with respect to the wing of a plane headed straight up.
The electric field always points normal to the surface of a metal. Draw several vectors representing the field just outside the spherical surface shown below.
The merry-go-round shown below is 6 feet in diameter. One child is hanging on at the outside while the other is half way in. Write the two sets of polar coordinates representing the children’s positions.
The merry-go-round shown below is 6 feet in diameter. One child is hanging on at the outside while the other is half way in. The merry-go-round rotates one half turn, causing the latter child to slide to the outside. Write the two new set of polar coordinates describing the children’s positions.
The radius of the track below is 20m. A racecar is driving around the track. At some given moment, the car’s position in polar coordinates is (15 m, 0.25π rad).

Draw the car on the track.
A ball rotates in a vertical circle. The force due to gravity is 1N. When the ball is in the position shown, the force due to the string is:

$$\mathbf{F} = -(2N)\mathbf{r}$$

Find a vector expression for the total force on the ball in terms of $\mathbf{r}$ and $\dot{\theta}$. 