In parts (1a) through (1c), consider the two dimensionless vectors 
\( \vec{A} = (3.10, 2.40) \) and \( \vec{B} = (-3.60, +1.70) \).

(1a) Evaluate \( A \), the magnitude of \( \vec{A} \).

\[
A = |\vec{A}| = \sqrt{(3.10)^2 + (2.40)^2} = \sqrt{15.37} = 3.92
\]

(1b) Evaluate \( B \), the magnitude of \( \vec{B} \).

\[
B = |\vec{B}| = \sqrt{(-3.60)^2 + (1.70)^2} = \sqrt{15.85} = 3.98
\]

(1c) Sketch and label these two vectors on an appropriately-labeled coordinate system below, drawing them approximately to scale. Label the four quadrants in the usual way. Name the quadrant in which each vector is found.

\( \vec{A} \) is in the first quadrant and \( \vec{B} \) is in the second quadrant.
(2a) Suppose the vector $\vec{F}$ in the $xy$ plane has a magnitude of 6.40 N (6.40 newtons) and lies in the third quadrant, making an angle of 60° with the negative $x$ axis. Make a sketch of the coordinate system and draw the vector, showing the 60° angle. Then determine the components of this vector and express the vector in the form $(x \text{ component}, y \text{ component})$.

The vector is shown in the diagram. Since it lies in the third quadrant, it must have an $x$-component $F_x$ that is negative, and a $y$-component $F_y$ that is negative. $\vec{F}$ is at an angle $\theta = 240°$ (measured counterclockwise from the positive $x$-axis).

Using trigonometry we see that

$F_x = F \cos(240°) = (6.40 \text{ N})(-0.5000) = -3.20 \text{ N}$

and $F_y = F \sin(240°) = (6.40 \text{ N})(-0.8660) = -5.54 \text{ N}$

Thus $\vec{F} = (F_x, F_y) = (-3.20 \text{ N}, -5.54 \text{ N})$.

(2b) Verify that your vector expression in part (2a) has the correct magnitude.

We expect to find $F = |\vec{F}| = \sqrt{F_x^2 + F_y^2} = 6.40 \text{ N}$. Let’s check it out.

$F = \sqrt{(3.20 \text{ N})^2 + (5.54 \text{ N})^2} = \sqrt{(10.24 \text{ N}^2) + (30.69 \text{ N}^2)} = \sqrt{40.93 \text{ N}^2} = 6.40 \text{ N}$.
(3) Consider these two vectors:

\( \vec{A} \) has a length of 7.4 m and is directed 31° N of E

\( \vec{B} \) has a length of 5.8 m and is directed 67° S of W

Determine the components, magnitude, and direction of \( \vec{A} - \vec{B} \). Draw a sketch to accompany your solution.

The easiest way to do this is to determine the components of the two vectors. From the sketch we expect \( \vec{A} \) to have positive components and \( \vec{B} \) to have negative components, as shown in the sketch. Calculating the components:

\[
\vec{A} = ((7.4 \text{ m})(\cos 31°), (7.4 \text{ m})(\sin 31°)) = (6.3 \text{ m, } +3.8 \text{ m})
\]

\[
\vec{B} = ((5.8 \text{ m})(\cos 247°), (5.8 \text{ m})(\sin 247°)) = (-2.3 \text{ m, } -5.3 \text{ m})
\]

Then \( \vec{A} - \vec{B} = (8.6 \text{ m, } 9.1 \text{ m}) \)

whose magnitude is \( |\vec{A} - \vec{B}| = \sqrt{(8.6 \text{ m})^2 + (9.1 \text{ m})^2} = \sqrt{156.77 \text{ m}^2} = 12.5 \text{ m} \) which should probably be written as 13 m, to 2 significant figures.

The direction of \( \vec{A} - \vec{B} \) is at an angle \( \theta = \tan^{-1} \left( \frac{9.1 \text{ m}}{8.6 \text{ m}} \right) = \tan^{-1} (1.06) = 47° \). This is in the first quadrant, as seems correct when you check the sketch for the vectors \( \vec{A} \) and \( -\vec{B} \).