Displacement - FR

1.

Base your answer(s) to the following question(s) on the information and vector diagram below.

A dog walks 8.0 meters due north and then 6.0 meters due east.

Using a metric ruler and the vector diagram, determine the scale used in the diagram.

\[
\frac{8.0 \text{ m}}{4.35 \text{ cm}} \quad \text{or} \quad \frac{6.0 \text{ m}}{3.35 \text{ cm}}
\]

or

\[
\frac{1.0 \text{ m}}{0.54 \text{ cm}} \quad \text{or} \quad \frac{1.0 \text{ cm}}{1.84 \text{ m}}
\]

2.

On the diagram above, construct the resultant vector that represents the dog's total displacement.

MATHEMATICALLY: \[ R^2 = (8.0 \text{ m})^2 + (6.0 \text{ m})^2 = 100 \text{ m}^2 \]

\[ R = \sqrt{100 \text{ m}^2} = 10 \text{ m} \]

GRAPHICALLY: Measure $R$ in centimeters: \[ 5.40 \text{ cm} \times \frac{1.0 \text{ m}}{0.54 \text{ cm}} = 10 \text{ m} \]

or \[ 5.40 \text{ cm} \times \frac{1.84 \text{ m}}{1.0 \text{ cm}} = 9.9 \text{ m} \]
3.

Base your answer(s) to the following question(s) on the information below.

A river has a current flowing with a velocity of 2.0 meters per second due east. A boat is 75 meters from the north riverbank. It travels at 3.0 meters per second relative to the river and is headed due north. In the diagram below, the vector starting at point P represents the velocity of the boat relative to the river water.

\[
\begin{align*}
\vec{V} &= \frac{d}{t} \\
\vec{V} &= \frac{75\text{ m}}{3.0\text{ m/s}} = 25.0\text{ s}
\end{align*}
\]

4.

On the diagram, use a ruler and protractor to construct a vector representing the velocity of the river current. Begin the vector at point P and use a scale of 1.0 centimeter = 0.50 meter per second.

\[
2.0\text{ m/s} \times \frac{1\text{ cm}}{0.50\text{ m/s}} = 4.0\text{ cm}
\]

5.

Calculate or find graphically the magnitude of the resultant velocity of the boat. [Show all work, including the equation and substitution with units or construct the resultant velocity vector for question using a scale of 1.0 centimeter = 0.50 meter per second.]

**Mathematically:**

\[
V_{\text{resultant}} = \sqrt{(3.0\text{ m/s})^2 + (2.0\text{ m/s})^2} = 3.6\text{ m/s}
\]

**Graphically:**

\[
7.35\text{ cm} \times \frac{0.50\text{ m/s}}{1.0\text{ cm}} = 3.7\text{ m/s}
\]