Instructions

Make sure you have easy access to all three of these documents.

- Today's Notes and Learning Goals
- Tips for how to Create Your Own Variables.
- Tips on how to Describe Your Variables.
A hemispherical water tank is being filled with water at a constant rate.

The volume of the filled portion, as shown in the cross sectional diagram, is

\[ V = \pi h^2 \left( R - \frac{1}{3} h \right) \]

Suppose the radius of the tank is 7.5 feet, and it is being filled at a rate of 60 cubic feet per hour. At the instant when \( h = 2.8 \) feet, compute the following values. All answers must be accurate to 2 decimal places and include correct units.

\[ V = \underline{\quad} \quad \frac{dV}{dt} = \underline{\quad} \]

\[ R = \underline{\quad} \quad \frac{dR}{dt} = \underline{\quad} \]

\[ h = \underline{\quad} \quad \frac{dh}{dt} = \underline{\quad} \]

At the instant when \( h = 2.8 \) feet, how fast is the water level rising? [Hint: the answer is in one of the boxes above.]
A man of height 1.8 meters walks away from a 5-meter lamppost at a speed of 1.25 m/s.

Create a formula that relates $x$ and $y$.

\[
x = \frac{dx}{dt} = \frac{dy}{dt}
\]

Find the following values. All answers must be accurate to 3 decimal places and include correct units.

\[
\frac{dx}{dt} = \quad \frac{dy}{dt} =
\]

Find the rate at which his shadow is increasing in length. [Hint: the answer is in one of the boxes above.]
Water is poured into a conical tank at a rate of 15 cubic feet per minute. The tank is 12 feet deep and has a radius of 4 feet at the top as shown. The shaded region is the water. Its volume is
\[ V = \frac{1}{3} \pi r^2 h \]
Create a formula that relates \( r \) and \( h \).
[Hint: use similar triangles.]

At the instant when \( h = 6.5 \) feet, compute the following values. All answers must be accurate to 2 decimal places and include correct units.

\[ V = \quad \quad \frac{dv}{dt} = \quad \]
\[ r = \quad \quad \frac{dr}{dt} = \quad \]
\[ h = \quad \quad \frac{dh}{dt} = \quad \]

At the instant when \( h = 6.5 \) feet, how fast is the water level rising?
An airplane is flying level at an altitude of 3000 feet and a speed of 200 ft/sec. It is about to pass over a radar station on the ground, as shown below. The dashed line represents the line-of-sight from an operator in the radar station to the airplane.

Follow the steps below to determine how fast the radar dish is rotating at the instant when \( x = 2000 \) feet.

**Step 1.** Create an equation that relates \( x \) and \( \theta \).

**Step 2.** At the instant when \( x = 2000 \) feet, compute the following values. Answers must be exact or accurate to 3 decimal places. Include units, except for \( \theta \).

\[
\begin{align*}
    x &= \quad \quad \frac{dx}{dt} = \\
    \theta &= \quad \quad \frac{d\theta}{dt} = \\
\end{align*}
\]

**Step 3.** Answer the question. At the instant when \( x = 2000 \) feet, how fast is the radar dish rotating?
A police car traveling south toward Sioux Falls at 160 km/h pursues a truck traveling east away from Sioux Falls at 140 km/h. (See figure below.)

At time \( t = 0 \), the police car is 40 km north and the truck is 50 km east of Sioux Falls. Calculate the rate of change of the distance between the vehicles at the instant \( t = 0 \).

**Step 1.** You will have to create a new variable. [Click here for tips](#) on how to do that.

**Step 2.** Write a one sentence description of what your new variable measures. Get feedback on this if possible.

**Step 3.** Create an equation that involves your new variable.

**Step 4.** Solve the problem. It may help to [organize your variables and data](#). Be accurate to 2 decimal places and include units.
An airplane is flying level at an altitude of 3000 feet and a speed of 200 ft/sec. It is about to pass over a radar station on the ground, as shown below. The dashed line represents the line-of-sight from an operator in the radar station to the airplane.

How fast is the distance between the station and the airplane changing at the instant when \( x = 2000 \) feet? If you are unsure how to proceed, follow the steps listed below.

**Step 1.** You must create a new variable. [Click here for tips.]

**Step 2.** Write a one sentence description of what your new variable measures. Get feedback on this if possible.

**Step 3.** Create an equation that involves your new variable.

**Step 4.** Solve the problem. It may help to organize your variables and data. Be accurate to one decimal place and include units.