1. A frog hops from the origin of our coordinate system to a point 2 m away, at an angle of 32° to the +x axis. What is the displacement in the x direction (the x component of displacement)?

   \[ x = (2 \text{ m}) \cos(32°) = 1.69 \text{ m} \]

   --- if you used 32 radians (radian mode of the calculator), you got 1.67 m

2. The dead tree in my yard needs to come down. I'm going to use two ropes, and two people pulling on the ropes. As the tree is about to fall, a friend will pull directly east with 100 lbs of force, and my wife will pull directly south with 70 lbs. What is the total force? Give the magnitude and direction.

   \[ (100 \hat{i} + 70 \hat{j}) \text{ lbs} \]

   magnitude = \( \sqrt{(100^2 + 70^2)} = 122 \text{ lbs} \)

   direction: use arctan (70/100) = 35° S of E (not exactly southeast!)

3. The dead tree's trunk is 20 inches = 0.508 m across. What is its diameter? circumference? radius? cross-sectional area?

   \[
   \begin{align*}
   \text{diameter?} & \quad \text{circumference?} \\
   \text{radius?} & \quad C = 2 \pi \, r = \pi \, d = 62.8 \text{ in or } 1.60 \text{ m} \\
   \text{cross-sectional area?} & \quad A = \pi \, r^2 = 314 \text{ sq. in or } 0.203 \text{ m}^2
   \end{align*}
   \]

   {metric is preferred in most of this class!}

For problems 4–6, use these vectors:

\[ \vec{A} = 1\hat{i} + 2\hat{j} \quad \vec{B} = 1\hat{i} + 1\hat{j} + 1\hat{k} \quad \vec{C} = 10\hat{i} \]

4. What is the magnitude of vector \( \vec{B} \)? {Note that a vector can be indicated by boldface or an arrow, and a unit vector, of magnitude = 1, by a caret or hat.}

\[ |\vec{B}| = \sqrt{(1^2 + 1^2 + 1^2)} = \sqrt{3} = 1.73 \]

5. In component form (using unit vectors \( \hat{i}, \hat{j}, \hat{k} \)), what is

\[ \vec{A} + \vec{C} = 11\hat{i} + 2\hat{j} \quad \vec{B} \cdot \vec{C} = 10 \quad \text{since} \quad \hat{i} \cdot \hat{i} = 1 \text{ (scalar product!)} \]

\[ \vec{B} - \vec{A} = -1\hat{i} + 1\hat{j} \quad \vec{B} \times \vec{C} = 10\hat{i} \times \hat{i} + 10\hat{j} \times \hat{i} + 10\hat{k} \times \hat{i} \]

\[ \hat{i} \times \hat{i} = 0 \quad \hat{j} \times \hat{i} = -\hat{k} \quad \hat{k} \times \hat{i} = \hat{j} \]

\[ \vec{B} \times \vec{C} = -10\hat{k} + 10\hat{j} \]

6. What is the angle between vector \( \vec{A} \) and the +y axis?

   {one way to do this is to use the cosine:

   \[ \cos(\alpha) = \frac{\text{opp}}{\text{adj}} = \frac{2}{\sqrt{5}} \quad \text{then} \quad \arccos(2/\sqrt{5}) = 26.6° \]

   I used alpha instead of theta since this is the angle between the vector and the \( y \) axis.}
The pressure in a tank changes in time according to an equation:

\[ p(t) = 14 - 3.0t + 0.2t^2 \]

The notation \( p(t) \) means "pressure as a function of time" NOT \( p \) times \( t \). Use this equation to answer questions 7 & 8:

7. When (at what time) is the pressure zero?

The quadratic formula has a \( \sqrt{ } \) in it: I get \( \sqrt{(9.0-1.2}) \) so the only roots are imaginary. Since time can't be imaginary, we can say the pressure is \textit{never} zero.

8. What is the rate of change of pressure (the time derivative of this function)?

\[ \frac{dp}{dt} = -3.0 + 0.4t \]

9. A sled comes to a stop because of friction. Its position in the \( y \) direction (in meters) is

\[ y(t) = 24 \ln(2.0t) \]

where \( \ln() \) is the natural logarithm. Find the time when the sled is at 12 m.

My steps:

\[
\begin{align*}
12 &= 24 \ln(2.0t) \\
\frac{1}{2} &= \ln(2.0t) \\
e^{\frac{1}{2}} &= 2.0t \\
t &= \frac{e^{\frac{1}{2}}}{2.0} = 0.824 \\
\text{ seconds, I would imagine...}
\end{align*}
\]

Class Results (% who missed):

1. [---------------------] 74 %
2. [- - - - - - - - - - - - 35 %
3. [- - - - 20 %
4. [- - - 24 %
5. + [- - - 15 %
   - [- - - 24 %
      · [--------------------- 59 %
        x [- - - - - - 46 %
6. [- - - 30 %
7. [- - 11 %
8. [- - 15 %
9. [- - 22 %
   N = 46