**6.*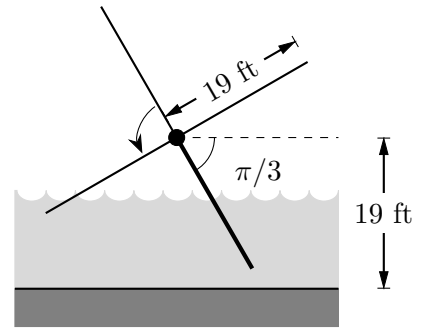* [14 points] You are standing by a river, watching two water wheels, each of which is rotating counterclockwise at a different but constant speed.

The first water wheel takes 24 seconds to complete a full revolution. Each blade of the wheel is 19 feet long, and when each blade is at its lowest point, it just barely scrapes the bottom of the river. One of the blades is painted red, shown as the thicker blade in the diagram to the right.

At the moment you begin watching, the red blade is exactly $\frac{\pi}{3}$ radians below the horizontal, as depicted. Let $r(t)$ be the height, in feet, of the tip of the red blade above the bottom of the river t seconds after you begin watching.

a. [1 point] How many seconds does it take the red blade to reach the horizontal position?

Answer: _____

b. [4 points] Sketch a graph of $y = r(t)$ on the interval $0 \le t \le 40$. Be sure the scales on your axes are clear, and pay careful attention to the shape of your graph.

c. [4 points] Find a formula for $r(t)$.

Answer: $r(t) =$ _____

This problem continues onto the following page.

This problem continues from the previous page and is restated for your convenience.

You are standing by a river, watching two water wheels, each of which is rotating counterclockwise at a different but constant speed.

d. [5 points] The second water wheel has a blade painted blue, and you have determined that the height, in feet, of the tip of this blade above the bottom of the river t seconds after you began watching is given by

$$20 + 15 \sin\left(\frac{\pi}{8}t\right).$$

Find the **first three** positive values t for which the height of the blade is 30 feet. **Show your work**, and give your answers in **exact** form.

Answers: _____

_____

_____