1. [3.7/42] A water trough is 2 ft deep and 10 ft long. It has a trapezoidal cross section with base lengths 2 ft and 5 ft, as shown in Figure 3.55 (page 164).
   (a) Find a relationship between the volume of water in the trough at any given time and the depth of the water at that time.
   (b) If water enters the trough at the rate of 10 ft³/min, how fast is the water level rising (to the nearest \( \frac{1}{2} \) in/min) when the water is 1 ft deep?

2. [3.7/46] A lighthouse is located 2 km directly across the sea from a point \( S \) on the shoreline. A beacon in the lighthouse makes 3 complete revolutions \((6\pi \text{ radians})\) each minute, and during part of each revolution, the light sweeps across the face of a row of cliffs lining the shore.
   (a) Show that \( t \) minutes after it passes point \( S \), the beam of light is at a point \( P \) located \( s(t) = 2 \tan 6\pi t \) km from \( S \).
   (b) How fast is the beam of light moving at the time it passes a point on the cliff located 4 km from the lighthouse?

3. [3.7/47] A car is traveling at the rate of 40 ft/s along a straight level road that parallels the seashore. A rock with a family of seals is located 50 yd offshore.
   (a) Model the angle \( \theta \) between the road and the driver’s line of sight as a function of the distance \( x \) to the point \( P \) directly opposite the rock.
   (b) As the distance \( x \) in Figure 3.8 (page 165) approaches 0, what happens to \( \frac{d\theta}{dt} \)?
   (c) Suppose the car is traveling at \( v \) ft/s. Now what happens to \( \frac{d\theta}{dt} \) as \( x \to 0 \)? What effect does this have on a passenger looking at the seals if the car is traveling at a high rate of speed?