1. A television camera is positioned 4000 feet from the base of a rocket launching pad. The angle of elevation of the camera has to change at the correct rate in order to keep the rocket in sight. Also, the mechanism for focusing the camera has to take into account the increasing distance from the camera to the rising rocket. Assume that the rocket rises vertically and its speed is 600 feet per second when it has risen 3000 feet.

   (a) How fast is the distance from the television camera to the rocket changing at that moment?

   (b) If the television camera is always kept aimed at the rocket, how fast is the camera's angle of elevation changing at that same moment?

2. Two sides of a triangle are 4 meters and 5 meters in length and the angle between them is increasing at a rate of 0.006 radians per second. Find the rate at which the area of the triangle is increasing when the angle between the sides of fixed length is $\pi/3$.

3. A plane flying with a constant speed of 300 kilometers per hour passes over a ground radar station at an altitude of 1 kilometer and climbs at an angle of $30°$. At what rate is the distance from the plane to the radar station increasing a minute later?

4. A woman at point A on the shore of a circular lake with radius 2 miles wants to arrive at the point C diametrically opposite A on the other side of the lake in the shortest possible time. She can walk at the rate of 4 miles per hour and row a boat at 2 miles per hour. How should she proceed?
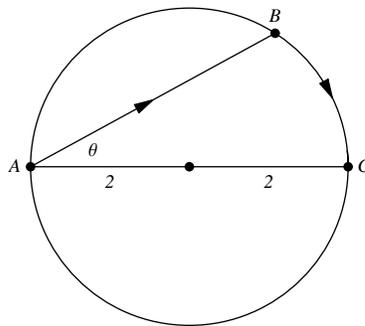
5. Find the area of the largest rectangle that can be inscribed in a semicircle of radius r. (Hint: Write the area of the rectangle as a function of θ.)
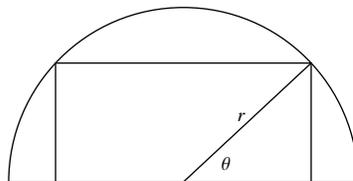
6. Let $f(\theta) = \sin^2 \theta, \ \ 0 \le \theta \le 2\pi.$

   (a) Find the intervals on which f increases and decreases.
   (b) Find the local maximum and minimum values of f.
   (c) Find the intervals on which f is concave up and concave down.
   (d) Find the inflection points of f.
   (e) Use your answers to parts (a–d) to sketch the graph of f. Use your graphing calculator to check your work.

7. Follow the instructions in the previous question for $f(t) = t + \cos t, \ \ -2\pi \le t \le 2\pi.$