Turn in the following problems:

1. Find y' if $\arctan(xy) = 1 + x^2 y$.

2. (a) Suppose f is a one-to-one differentiable function and its inverse function f^{-1} is also differentiable. Use implicit differentiation to show that
$$(f^{-1})'(x) = \frac{1}{f'(f^{-1}(x))}$$
provided that the denominator is not 0.
   (b) If $f(4) = 5$ and $f'(4) = \frac{2}{3}$, find $(f^{-1})'(5)$.

3. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. How fast is the tip of his shadow moving when he is 40 ft from the pole?
   (a) What quantities are given in the problem?
   (b) What is the unknown?
   (c) Draw a picture of the situation for any time t.
   (d) Write an equation that relates the quantities.
   (e) Finish solving the problem.

4. Determine where $f(x) = \arcsin(x^2 - 2x)$ is increasing.

5. Prove $\dfrac{d}{dx}(\text{arccot}(x)) = \dfrac{-1}{1+x^2}$ Be sure to provide a written justification for your work.

6. An airplane, flying at 450 km/hr at a constant altitude of 5 km, is approaching a camera mounted on the ground. Let θ be the angle of elevation above the ground at which the camera is pointed. When $\theta = \pi/3$, how fast does the camera have to rotate in order to keep the plane in view?

These problems will not be collected, but you might need the solutions during the semester:

7. The minute hand on a watch is 8 mm long and the hour hand is 4 mm long. How fast is the distance between the tips of the hands changing at one o'clock?

8. (a) Show that $f(x) = 2x + \cos(x)$ is one-to-one.
   (b) What is the value of $f^{-1}(1)$?
   (c) Use the formula from part (a) of Problem 2 to find $(f^{-1})'(1)$.

Optional Challenge Problems

Try this problem after you learn section 3.7.

Find the derivative of the function. Simplify where possible.

$$f(x) = x \ln(\arctan(x))$$