1. **Simple related Rates:** The volume and surface area of a sphere are $V = \frac{4}{3}\pi r^3$ and $S = 4\pi r^2$.
   (a) If the radius of the sphere is increasing at a constant rate, at what rate is the volume increasing?
   (b) If the volume is increasing at a constant rate, is the radius also increasing at a constant rate? (Explain, by actually computing $dr/dt$.)

2. Use implicit differentiation to find the slope of the tangent line to the circle $x^2 + y^2 = 1$ at the point $x = 1/2$ in the first quadrant.
   Hint: write the equation in the form
   
   $$x^2 + [y(x)]^2 = 1$$
   
   (where we have indicated that $y$ depends on $x$). Now differentiate each term with respect to $x$.

3. Consider the function $y = g(x) = x^{1/n}$ where $n > 1$ is an integer. [Note: this is the inverse function for $f(x) = x^n$.] Rewrite this in the form $y^n = x$ and use implicit differentiation to find the derivative of $f(x)$.
4. In the figure shown here, one person walks towards the corner at the rate 1 m/s and the other walks away at rate 2 m/s. The distances of the individuals from the corner at time $t$ are $x(t)$ and $y(t)$. At what rate is $L$ changing at the instant when $x = y = 10$ m?

![Diagram of two individuals walking towards or away from a corner.]

5. Find the slope of the tangent line at the point (1,1) on the curve

$$x^2 + xy + y^2 = 3$$

Hints: it may help you to first indicate that $y = y(x)$ depends on $x$, and then to differentiate each term in the equation. You will need to use the product rule on this problem.

6. Consider the circle given by $x^2 + y^2 = 1$, and the parabola

$$y = ax^2 - b.$$ 

For what values of the constants $a, b$ does the parabola touch the circle at two points?