1. Differentiate each of the following. Pay close attention to your notation.

   (a) $f(x) = (x^2 + 5x + 7)^3$

   (b) $g(x) = \cos(\sqrt{x})$

   (c) $y = \sin^2(\theta) + \cos(\theta)$

   (d) $z = t^2 - \frac{a}{t^2}$

   (e) $v = \frac{u^3}{u^2 - u}$

2. Consider $f(x) = x^3 - \frac{1}{x}$ on the interval $[0.5, 2]$. Find the global max and the global min for $f(x)$ on this interval.

3. Find the intervals on which $f(x) = \frac{x^2}{x-1}$ is increasing.

4. Find a so that $x^3 - ax^2 + bx + 9$ has a relative maximum at $x = 1$ and a relative minimum at $x = 7$.

5. Describe how to find the point on the circle $x^2 + y^2 = 1$ that is closest to the point $(3, 1)$. Note: you need not actually carry out this operation. I'm looking for a set-up of the problem. How would you find the point farthest from $(3, 1)$?

6. A fence 8 feet tall runs parallel to a tall building at a distance of 4 feet from the building. What is the length of the shortest ladder that will reach the ground over the fence to the wall of the building?

7. Find a formula for $\cos(2x)$ using differentiation, and the fact that $\sin(2x) = 2\sin(x)\cos(x)$.