Many of the solutions to these problems are in the back of the book. You may check your work there. However, do not look at a solution until you have done the problem.

0. (0 pts. T Oct 20) Read 4.1-4.9. Skim if you already know this stuff.

1. (10 pts. T Oct 20) Do the following problems from Apostol §4.9.
   (a) (3 pts. each) #4, #10. Exercise 10 fails when \( c \leq 0 \). Explain why.
   (b) (3 pts. each) #15, #16. For 16a, just derive the formula for a product.

2. (12 pts. T Oct 20) We saw in class that the derivative of a constant function is always 0. Prove the converse, i.e. that if \( f'(x) = 0 \), then \( f(x) = c \), for some \( c \in \mathbb{R} \). This problem is harder than it looks - if you need a hint, go to http://math.mit.edu/~gracelyo/18014/PSets/hints.html.

3. (12 pts. R Oct 22) Do the following problems from Apostol §4.6
   (a) (2 pts. each) #2, #9, #23
   (b) (2 pts.) Compute the derivative of \( f(x) = \sin(2009) \).
   (c) (4 pts. each) #24, #38. Let \( f(x) \) be the solution to 38a. In 38b, write your solution in terms of \( f(x) \) and \( f'(x) \) (do not compute \( f'(x) \)).

4. (10 pts. R Oct 22) Do the following problems from Apostol §4.12
   (a) (2 pts.) #16
   (b) (2 pts. each) #19a, #19d
   (c) (4 pts.) #30

**Bonus.** Suppose that \( f \) is continuous on \([a, b]\) and \( f^{(n)} \) is differentiable on \([a, b]\) for all \( n \leq p + q \) (i.e. the \((p + q + 1)\)st derivative of \( f \) exists). If

\[
\begin{align*}
f(a) &= f'(a) = \ldots = f^{(p)}(a) = 0 \\
f(b) &= f'(b) = \ldots = f^{(q)}(b) = 0,
\end{align*}
\]

then there is some \( c \in (a, b) \) such that \( f^{(p+q+1)}(c) = 0 \). Prove that this is true when \( p = 1 \) and \( q = 2 \).