1. Differentiate the following:

   a. $f(x) = \frac{2x^2 - k}{c + x^3}$ where c and k are constants
   b. $y = \frac{2(2 - \sin x)}{\cos x}$
   c. $g(x) = (7 + x^3)^5$
   d. $y = \ln\left(\frac{1 + e^x}{1 - e^x}\right)$
   e. $h(x) = \sin(e^{\cos x})$
   f. $g(t) = \sqrt{\frac{t}{t - 2}}$
   g. $p(x) = e^{2x}\cos(x)$

2. Find the first and second derivatives of $f(t) = e^t \sin(t^2)$.

3. Find the equation of the tangent to the curve $y(x) = x^2\ln(x)$ at the point where $x = e$.

4. If $g(x) = \sin 2x - \cos 4x$, find $g`\left(\frac{\pi}{4}\right)$ and explain what your value means.

5. Find the extrema of $h(x) = 3x^2e^x$ and then use the second derivative to classify the extrema.

6.

If f and g are differentiable functions such that $f(2) = 3$, $f'(2) = -1$, $f'(3) = 7$, $g(2) = -5$ and $g'(2) = 2$, find the numbers indicated in problems 43 – 48.

43. $(g - f)'(2)$ 44. $(fg)'(2)$ 45. $\left(\frac{f}{g}\right)'(2)$

46. $(5f + 3g)'(2)$ 47. $(f \circ f)'(2)$ 48. $\left(\frac{f}{f + g}\right)'(2)$

7. (CI) The spread of a virus at school is modeled by the equation $P(t) = \frac{200}{1 + e^{5 - t}}$, where $P(t)$ is total number of students infected t days after the virus first started to spread.

   a. To predict $\lim_{t \to \infty} P(t)$, estimate the value of P(100). Explain what this means about the graph and about the spread of the virus.
   b. Estimate the initial number of students infected with the virus.
   c. Evaluate P(5).
   d. How fast will the virus spread after 4 days?
   e. When will the virus spread at its maximum rate?