1. (28 pts) The following problems are not related.
   
   (a) Let \( y = \cos^4(3u^2) \). Find \( dy/du \).

   (b) Let \( x\sqrt{y+4} = y^2 - 4^2 \). Find \( dy/dx \) at the point \((3, 5)\).

   (c) Suppose that \(-2 \leq f'(x) \leq 10\) for all values of \( x \). Find the smallest and largest possible values of \( f(15) - f(6) \).

   (d) Let \( y = \frac{10x^3 - 6x^2 + 15x}{2x^2 + 3} \). Find an equation for the slant asymptote of \( y \).
   
   (It is not necessary to evaluate any limits when justifying your answer.)

2. (15 pts) Beatrice takes a 36\( \pi \) cm\(^3\) lump of clay and shapes it into a cylinder of length \( L \) and radius \( r \). As she rolls the clay the cylindrical shape is maintained. How fast is the radius \( r \) changing when \( L = 9 \) cm and \( L \) is increasing at a rate of \( \frac{1}{2} \) cm/sec?

3. (27 pts) Consider the function \( y = \frac{1}{x(x-3)} \) with \( y' = \frac{3(1-x)}{x^2(x-3)^3} \) and \( y'' = \frac{6(2x^2 - 4x + 3)}{x^3(x-3)^4} \).

   (a) Find the domain of the function in interval notation.

   (b) Does the function have vertical asymptotes? Justify your answer using appropriate limits.

   (c) Does the function have horizontal asymptotes? Justify your answer using appropriate limits.

   (d) On what intervals is \( y \) increasing? decreasing?

   (e) Find the \( x \) and \( y \) coordinates of the local maximum and minimum extrema, if any.

   (f) On what intervals is \( y \) concave up? concave down?

   (g) Sketch a graph of \( y \). Clearly label any asymptotes and local extrema.
4. (14 pts) Find the $x$ and $y$ coordinates of the absolute maximum and minimum values (if any) of 
\[ f(x) = \frac{3\sin(x)}{5 + 2\sin(x)} \] on $[-\pi, \pi]$. 

5. (16 pts) Shown below is the tangent line to a function $y = f(x)$ at $x = 6$.

(a) Use the graph to find an equation for the tangent line.
(b) Find the values of $f(6)$ and $f'(6)$.
(c) Use a linear approximation to estimate the value of $f(6.02)$.
(d) Now suppose $f(x)$ is a cubic function $ax^3 + bx^2 + cx + d$ where $a, b, c,$ and $d$ are constants. If the value of $f''(6)$ is 0, find the ratio $a/b$. 

\[ y = f(x) \]

\[ 6 \quad 10 \]

\[ x \]

\[ y \]