1. Consider the function \( f(x) = \frac{3}{5 - 2x} \).

(a) Is this function continuous on the interval \((-\infty, \infty)\)? Explain.

(b) Compute the average rate of change of \( f \) on \([2, 2.01]\).

(c) Using the limit definition of the derivative, compute \( f'(x) \).

(d) Find the equation of the tangent line to \( f \) at \( x = 2 \).

2. Given that \( f(0) = 2, g(0) = 3, f'(0) = 5, g'(0) = 7 \), and \( f'(3) = \pi \) compute the following.

(a) \( h'(0) \) if \( h(z) = f(z)g(z) \)

(b) \( j'(0) \) if \( j(z) = \frac{f(z)}{g(z)} \)

(c) \( k'(0) \) if \( k(z) = f(g(z)) \)
3. (a) Find $\frac{dy}{dt}$ if $y = t^5 + 5^t + e^5 + \frac{t}{5} + \frac{5}{\sqrt[5]{t}} + \ln(5t) + \arctan(5t) + \ln(5) + \sin 5$.

(b) Find $\frac{dy}{dx}$ if $y = \sqrt[3]{x}\cos(7x^3)$.

(c) Find $\frac{dy}{dz}$ if $y = \frac{e^z + e^\pi}{\tan 4 - 7z}$.

(d) Find $\frac{dy}{dr}$ if $y = \tan(e^{x^2\arcsin(5r)})$.

(e) Find $\frac{dy}{dx}$ if $y^3 + yx^2 + x^2 = 3y^2$.

(f) Find $\frac{dy}{dx}$ if $y = (1 + x^6)^8$.
4. Given the graph of $f$, sketch a graph of $f'$ and a graph of $F$, an antiderivative of $f$ such that $F(0) = -1$.

5. Shown below is a graph of $f'$ on its entire domain. The graph is NOT $f$.

At which $x$-value(s)

(a) does $f$ have a stationary point?
(b) does $f$ have a local max?
(c) does $f$ have a local min?
(d) does $f'$ have a stationary point?
(e) does $f'$ have a local max?
(f) does $f'$ have a local min?
(g) is $f$ greatest?
(h) is $f$ least?
(i) is $f'$ greatest?
(j) is $f'$ least?
(k) is $f''$ greatest?
(l) is $f''$ least?

On what interval(s) is

(a) $f$ increasing?
6. Is \( y = 7e^{3t} \) a solution to the differential equation \( y'' + 2y' - 15y = 0 \)? Explain.

7. Rewrite \( \sin(\arctan(5x)) \) as an algebraic expression. [Students in the 8:00, 9:30, and 1:10 sections may omit this problem.]

8. Evaluate the following limits.

   (a) \( \lim_{x \to \infty} \frac{x^2}{\ln x} \)

   (b) \( \lim_{z \to 0} \frac{\sin (12z) - 12z}{z^3} \)

   (c) \( \lim_{x \to 0} \frac{e^x - 1}{\cos x} \)

   (d) \( \lim_{r \to 2} \frac{r^3 - 8}{r - 2} \)

   (e) \( \lim_{x \to 0^+} x^3 \ln x \) [Students in the 8:00 and 9:30 sections may omit this problem.]