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

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

(b) Compute the average rate of change of \( f \) on \([1.5, 2]\).

(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 \( h(x) = f(x)g(x) \)

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

(c) \( k'(0) \) if \( k(x) = f(g(x)) \)

3. Sketch a graph of a function which is always positive and decreasing and which satisfies the following:

\[
\lim_{x \to -\infty} f(x) = \infty; \quad \lim_{x \to \infty} f(x) = 2; \quad \lim_{x \to 1^-} f(x) = 5; \quad \lim_{x \to 1^+} f(x) = 4
\]
4. Compute $dy/dx$ for each of the following.

(a) $y = x^2 + 2^x + e^2 + \frac{x}{2} + \frac{2}{x} + \ln(2x) + \arctan(2x) + \ln(2) + \sin 2$

(b) $y = \sqrt{x} \cos(7x^3)$

(c) $y = \frac{e^x + \pi}{\tan 4 - 7x}$

(d) $y = \tan(e^{x^2} \arcsin(5x))$

(e) $y^3 + yx^2 + x^2 = 3y^2$

5. Consider the differential equation $y' = -3y$.

(a) Sketch the slope field for this DE.

(b) Verify that $y = Ce^{-3x}$ is a solution for all values of $C$.

(c) Find the solution that passes through $(1, 5)$. 
6. Given the graph of \( f \), sketch a graph of \( f' \) and a graph of \( F \), an antiderivative of \( f \) such that \( F(0) = -1 \).

7. The graph shown is \( f' \), NOT \( f \). Answer the questions below.

At which labeled point(s) does

(a) \( f \) have a stationary point?
(b) \( f \) have a local max?
(c) \( f \) have a local min?
(d) \( f' \) have a stationary point?
(e) \( f' \) have a local max?
(f) \( f' \) have a local min?
(g) \( f \) have a global max?
(h) \( f \) have a global min?
(i) \( f' \) have a global max?
(j) \( f' \) have a global min?
(k) \( f'' \) have a global max?
(l) \( f'' \) have a global min?

On what interval(s) is

(a) \( f \) increasing?
(b) \( f \) decreasing?
(c) \( f' \) increasing?
(d) \( f' \) decreasing
(e) \( f \) concave up?
(f) \( f \) concave down?
(g) \( f' \) concave up?
(h) \( f' \) concave down?

On the same set of axes, sketch a possible graph of \( f \).
8. Find all possible antiderivatives of the following.

(a) \( g'(t) = e^5 + t^5 + e^{5t} \)

(b) \( h'(r) = 3\sin(2r) + \frac{3}{\sqrt{r}} \)

9. Evaluate the following limits.

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

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

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

(d) \( \lim_{x \to 5} \frac{35 - 7x}{2x - 10} \)

(e) \( \lim_{x \to 0^+} x^3 \ln x \)

(f) \( \lim_{x \to 0^-} \frac{1}{x} \)

(g) \( \lim_{x \to 0} \frac{1}{x} \)