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) \( y = x^{2004} + 2004^x + e^{2004} + \frac{x}{2004} + \ln(2004x) + \arctan(2004x) + \ln(2004) \)

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

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

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

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

5. 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) \( \lim_{x \to 0} \frac{1}{x} \)

(f) \( \lim_{x \to 0} \frac{1}{x} \)
6. Use local linearization to estimate the value of \( \sqrt{25} \). Is your estimate too large or too small?

7. For the graph of \( g \) shown, sketch a graph of \( g' \) and a graph of an antiderivative of \( g \) (call it \( G \)) such that \( G(0) = 2 \). As an aid, fill in the table below and make sure your graphs agree with the entries in the table.

<table>
<thead>
<tr>
<th>( f )</th>
<th>positive</th>
<th>negative</th>
<th>increasing</th>
<th>decreasing</th>
<th>concave up</th>
<th>concave down</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f' )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( f'' )</td>
<td></td>
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</tr>
</tbody>
</table>
8. Suppose $f(x)$ gives your estimated score (in points out of 100) on the final exam as a function of the number of hours you study.

(a) Interpret the statement $f(12) = 80$.

(b) Interpret the statement $f'(12) = 3$.

(c) Using the information above, estimate $f(14)$ and explain its meaning.

9. The graph shown is of $f'$, NOT $f$. At which labelled point is

(a) $f$ greatest?
(b) $f$ least?
(c) $f'$ greatest?
(d) $f'$ least?
(e) $f''$ greatest?
(f) $f''$ least?
(g) $f$ increasing most rapidly?
(h) $f$ decreasing most rapidly?
(i) $f'$ increasing most rapidly?
(j) $f'$ decreasing most rapidly?

On what interval(s) is

(a) $f$ increasing?
(b) $f'$ increasing?
(c) $f$ concave up?

See old exams and quizzes at http://abacus.bates.edu/~etowne/mathresources.html