(1) Find the derivative of each of the following functions.
   (a) $\sec(x^2 + 3)\sin(5x - 1)$
   (b) $\cos(\sin(x))$
   (c) $\tan(\cos((x^6 - 3x + 8)^7))$

(2) Assume $f'(x) = h(x) \cdot g(x)$. Find $\frac{d}{dx} f(p(x))$ at $x = 1$, given that

<table>
<thead>
<tr>
<th>$x$</th>
<th>$g(x)$</th>
<th>$h(x)$</th>
<th>$p(x)$</th>
<th>$g'(x)$</th>
<th>$h'(x)$</th>
<th>$p'(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>-3</td>
<td>7</td>
<td>2</td>
<td>-9</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>-1</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>-5</td>
<td>2</td>
<td>3</td>
<td>-1</td>
<td>-2</td>
</tr>
</tbody>
</table>

(3) Find an equation of the tangent line to the curve $x^2y^2 = 9$ at the point $(-1, 3)$.

(4) When a circular plate of metal is heated in an oven, its radius increases at the rate of 0.01 cm/min. At what rate is the plate’s area increasing when the radius is 50 cm?

(5) Show that the linearization of $f(x) = (1 + x)^k$ at $x = 0$ is $L(x) = 1 + kx$. Use this to find the linear approximation to $(1 + 0.02)^3$.

(6) State the Extreme Value Theorem. Give examples of functions which violate the theorem’s assumptions and conclusion.

(7) For a continuous function $f$, defined on a closed interval $[a, b]$, where can the absolute extrema of the function occur?

(8) Find the absolute minimum and absolute maximum values of the following functions. Identify the intervals of increase and decrease.
   (a) $f(x) = \sqrt{4 - x^2}$, $-2 \leq x \leq 1$
   (b) $g(t) = t^3 - 3t^2$, $x \in [-5, 0]$

(9) State Rolle’s Theorem. Provide a graph to explain the theorem.

(10) State the Mean Value Theorem. Provide a graph to explain the theorem.

(11) Assume $f$ is defined on the whole real line and let $f'(x) = \frac{(x - 3)^2(x + 1)}{\sqrt{x + 2}}$, $x \neq -2$. What are the critical points of $f$? On what intervals is $f$ increasing or decreasing? At what points, if any, does $f$ assume local minimum or local maximum values?

(12) Assume $f$ is defined on the whole real line and let $f'(x) = (8x - 5x^2)(4 - x)^2$. What are the critical points of $f$? On what intervals is $f$ increasing or decreasing? At what points, if any, does $f$ assume local minimum or local maximum values? Where is the function concave up/ concave down? Sketch the graph of the function.
(13) Let \( y = \frac{2x^2 + x - 1}{x^2 - 1} \).

(a) Find any vertical and horizontal asymptotes, as well as removable singularities, if any.
(b) Find the intervals of increase/decrease.
(c) Find the local extrema, if any.
(d) Find the intervals where the function is concave up/down.
(e) Find the inflection points, if any.
(f) Find the \( y \)-intercept.
(g) Sketch a possible graph of the function.

(14) Sketch the graph of a function \( f \) which satisfies the following conditions.

(a) \( f \) is twice differentiable for all \( x \), except \( x = 3 \)
(b) \( f'(3) \) is not defined
(c) \( f'(x) > 0 \) on \((3, \infty)\)
(d) \( f'(x) < 0 \) on \((-\infty, 3)\)
(e) \( f''(x) < 0 \) for all \( x \), except \( x = 3 \)