Show all your work on the exam paper, legibly and in detail, to receive full credit. The use of a calculator or any other electronic device is prohibited. You may only use techniques discussed in the text up to the end of section 3.2.

(10 points) Problem #1: Find all values of \( x \) at which the tangent line to the curve

\[
y = \frac{x^2 + x + 1}{x + 1}
\]

is horizontal.

(5 points) (a.) \( y = \log_2 x \).

(5 points) (b.) \( y = \log_\alpha 2 \)
Problem #3: Find $\frac{dy}{dx}$ in parts (a.), (b.), and (c.) below. **You DO NOT need to simplify your answers.**

(7 points) (a.) $y = (1 + x + x^{10} + 2x^{20})^{50}$

(7 points) (b.) $y = \frac{\sqrt[2]{x+1}}{\sqrt{x-1}}$

(6 points) (c.) $y = \ln (\sin(x^2))$
Problem #4: Find the slope of the tangent line to the curve $y^2 - x + 1 = 0$ at the point $(10, 3)$ in two ways as specified in parts (a.) and (b.) below (obviously, your answers should be the same!)

(5 points) (a.) Solve for $y$ explicitly in terms of $x$ and differentiate.

(5 points) (b.) Use implicit differentiation.

(5 points) Problem #5: Find $\frac{dy}{dx}$, where: $y = \frac{x^2}{(1+x^2)^4}$
(10 points) Problem #6: An airplane is flying on a horizontal path at a height of 3800 ft, as shown in the accompanying figure.

At what rate is the distance $s$ between the airplane and the fixed point $P$ changing with respect to $\theta$ when $\theta = \frac{\pi}{6}$ radians?

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Problem #7:

a)(10 points) Find: $y'(x)$, where $y$ is implicitly defined by the relation:

$$\sin(y) + y - x - 4 = 0$$

b)(5 points) Find: $y''(x)$. Your final answer should be entirely in terms of $y(x)$ and $x$. You do not have to simplify your answer.
Problem # 8: Let $y = \ln(1 + 2 \ln(x))$.

(10 points) (a.) Find the equation of the tangent line to the graph of $y(x)$ at the point $(1, 0)$.

(5 points) (b.) Sketch the tangent line to the graph of $y(x)$ at the point $(1, 0)$ on the figure below. Make your graph as accurate as possible.
Problem #9: You are given the following table of values. Compute the requested derivative at the point given, using the table values. Place your answer on the line given.

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

(3 points) \( F'(2), \text{where } F(x) = f(g(x)) \)  

(2 points) \( F'(2), \text{where } F(x) = f(x)/g(x) \)  

(2 points) \( F'(2), \text{where } F(x) = f(x)g(x) \)
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(2 points) $F'(2), \text{ where } F(x) = f(x)/g(x)$  

(2 points) $F'(2), \text{ where } F(x) = f(x)g(x)$