Name: Solution  
Student ID #: 

Each problem of #1-#3 is worth 5 points.

1. Find the derivative function \( f'(x) \) by using the limit definition for \( f(x) = 2x + 1 \).

(No credit will be given for using any other formula or estimation over shorter intervals.)

\[
\lim_{x \to b} \frac{f(b) - f(x)}{b - x} = \lim_{x \to b} \frac{(2b+1)-(2x+1)}{b - x} = \lim_{x \to b} \frac{2b - 2x}{b - x} = \lim_{x \to b} \frac{2(b-x)}{(b-x)} = \lim_{x \to b} 2 = 2
\]

2. Determine the sign (+, -, or 0) of \( f, f' \) and \( f'' \) at each point shown in the graph of \( y = f(x) \).

(9 correct: 5 pts, 7-8 correct : 4 pts, 5-6 correct: 3 pts, 3-4 correct: 2 pts, 1-2 correct: 1 pt)

<table>
<thead>
<tr>
<th></th>
<th>( f )</th>
<th>( f' )</th>
<th>( f'' )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>C</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>

3. Estimate \( f(19) \) when the function \( y = f(x) \) satisfies \( f(21) = 3 \) and \( f'(21) = -2 \).

\[
\begin{align*}
 f(19) & \approx f'(21) \cdot (19 - 21) + f(21) \\
 & = -2 \cdot (-2) + 3 \\
 & = 4 + 3 \\
 & = 7
\end{align*}
\]

4. (Bonus problem, 1 pt) If \( y = f(x) \) is a continuous function with properties \( f'(x) > 0 \) and \( f''(x) = 0 \) for all \( x \), then what is a possible graph of \( y = f(x) \)? Determine the shape of the graph as, for example, a parabola, a line, a snake-shaped one, etc...and sketch it with considering the concavity and the increasing/decreasing property.

\[
\begin{align*}
f'(x) > 0 & \implies f \text{ is increasing} \\
f''(x) = 0 & \implies \text{no concavity.} \\
\text{So not curved at all} & \implies \text{increasing line}
\end{align*}
\]