1. (20 points) The population $P(t)$ of a small town is growing exponentially. Time $t$ is measured in years. Given that $P(5) = 2,000$ and $P(6) = 2,600$, find:
   
   a) $P(7)$;
   
   b) $P(0)$;
   
   c) the annual growth rate;
   
   d) the continuous growth rate.

2. (15 points) Let $f(x) = 3x^2 + 7x$. Starting with the difference quotient, use algebra to find $f'(x)$.

3. (18 points) Sketch the graph of a function which has \textit{all} of the following properties:

   a) $\lim_{x \to 0} f(x) = \infty$, $\lim_{x \to 9^-} f(x) = \infty$, and $\lim_{x \to 9^+} f(x) = -\infty$;

   b) $f'(x) > 0$ on the intervals $(-\infty, 0)$, $(5, 9)$, and $(9, \infty)$;

   c) $f'(x) < 0$ on the interval $(0, 5)$;

   d) $f''(x) > 0$ on the intervals $(0, 2)$ and $(4, 5)$;

   e) $f''(x) < 0$ on the interval $(2, 4)$.

You must label the numbers 0, 2, 4, 5 and 9 on your $x$-axis.

4. (17 points) Let $f(x) = x^3 + 2/x$. Then $f'(x) = 3x^2 - 2/x^2$.

   a) Find an equation for the line tangent to the graph of $y = f(x)$ at $x = 2$.

   b) Use tangent line approximation to estimate the value of $f(2.25)$.

*** OVER FOR PROBLEMS 5 AND 6 ***
5. (15 points) Let \( f(x) = \begin{cases} 4x^3 + 5x - 1 & : \ x \leq 1 \\ 3x^5 + 7x^4 - x^2 & : \ x > 1 \end{cases} \) .

a) What is \( \lim_{x \to 1^-} f(x) \)?

b) What is \( \lim_{x \to 1^+} f(x) \)?

c) Is \( f(x) \) continuous at \( x = 1 \)? Explain.

6. (15 points) Suppose that \( f(x) \) is defined and \( f'(x) \) exists for all real numbers \( x \). Below is a table of values of the function.

<table>
<thead>
<tr>
<th>x</th>
<th>-1</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>3</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

a) Use the table above to calculate the average rate of change of \( f(x) \) on the intervals \([-1, 1]\) and \([1, 4]\).

b) Estimate the derivative \( f'(x) \) at \( x = -1, 1, 4 \). (Use averaging to estimate \( f'(1) \).)

c) Is the statement “The graph of \( y = f(x) \) is concave up on the interval \((-2, 5)\)” consistent with the derivative estimates of part b)? Explain.