1. (a) Use a graph and/or table to approximate the limit, if it exists. If it does not exist, provide a reason(s).

\[
\lim_{x \to 1} \frac{\ln x^2}{x - 1} \approx \n
\]

<table>
<thead>
<tr>
<th>x</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>1</th>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>2.378</td>
<td>2.234</td>
<td>2.107</td>
<td></td>
<td>1.906</td>
<td>1.823</td>
<td>1.749</td>
</tr>
</tbody>
</table>

If the limit does not exist, reason(s) ________________________________________________

1. (b) Use a graph and/or table to approximate the limit, if it exists. If it does not exist, provide a reason(s).

\[
\lim_{x \to 0} \frac{\cos x}{x^2} \approx \n
\]

<table>
<thead>
<tr>
<th>x</th>
<th>-0.3</th>
<th>-0.2</th>
<th>-0.1</th>
<th>0</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
</table>

If the limit does not exist, reason(s) ________________________________________________
2. Find each, if it exists. **If it does not exist, provide a reason.**

\[ f(x) = \begin{cases} 
  x + 2, & x \leq 0 \\
  x^2 - 4, & x > 0
\end{cases} \]

a. \( \lim_{x \to 0^-} f(x) = \) 

b. \( \lim_{x \to 0^+} f(x) = \) 

c. \( \lim_{x \to 0} f(x) = \) 

d. \( f(0) = \) 

3. Analytically, find the limit if it exists, \( \lim_{x \to 0} \frac{x+2 - \frac{1}{2}}{x} \)
4. and 5. Determine the continuity and/or discontinuity of the function \( f(x) = \frac{x^2 + x - 2}{x^2 - 4} = \frac{(x + 2)(x - 1)}{(x + 2)(x - 2)} \) by completing the table.

<table>
<thead>
<tr>
<th>Value(s) ( x = c ) at which ( f ) is discontinuous</th>
<th>( \lim_{x \to c^-} f(x) )</th>
<th>( \lim_{x \to c^+} f(x) )</th>
<th>( \lim_{x \to c} f(x) )</th>
<th>Type of discontinuity at ( x = c )</th>
<th>Graphical characteristic at ( x = c )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Find the value(s) of \( x \) in terms of an integer \( n \) such that the function is discontinuous that is determine the value(s) of \( x \) such that the graph has vertical asymptotes.

a. \( f(x) = \csc(3x) \)  

b. \( f(x) = \sec(2x) \)
7. **Use the limit definition of the derivative** to show that for \( f(x) = x^2 - 5x + 3 \), the derivative is \( f'(x) = 2x - 5 \). No credit for basic rules, because the not the point! 😊

8. Find the derivative and simplify with positive exponents. \( f(x) = 4x^3 - 5x + \sqrt{x} - \frac{1}{x^2} + 7 \)
9. Find the derivative and the slope of the tangent line to \( f(x) = 2\sin x - 5e^x \) at the point \((0, -5)\).

10. Sketch the graphs of two distinct functions that are continuous at \( x = 1 \), but are not differentiable at \( x = 1 \). You do not need to provide the equations, just sketches of possible graphs.