1) Evaluate the following limits: (2 pts)
   a) \( \lim_{x \to \infty} \ln \left( \frac{2x}{x + 1} \right) \)

   Since \( \lim_{x \to \infty} \frac{2x}{x + 1} = 2 \) and \( \ln(x) \) is continuous, \( \lim_{x \to \infty} \ln \left( \frac{2x}{x + 1} \right) = \ln(2) \)

   b) \( \lim_{x \to -\infty} \frac{x + 1}{x^3 + 2x} \)

   Since the degree of the denominator is larger than the degree of the numerator, \( \lim_{x \to -\infty} \frac{x + 1}{x^3 + 2x} = 0 \)

2) Find the equation of the tangent line of \( f(x) = 2x^2 + x + 3 \) at \( x = 3 \). (2 pts)

   First we must find the slope of the tangent line of \( f(x) \) at \( x = 3 \). So

   \[
   \lim_{h \to 0} \frac{f(3+h) - f(3)}{h} = \lim_{h \to 0} \frac{2(3+h)^2 + (3+h) + 3 - 24}{h}
   \]

   \[
   = \lim_{h \to 0} \frac{2h^2 + 12h + 18 + h + 3 - 3 - 24}{h}
   \]

   \[
   = \lim_{h \to 0} \frac{2h^2 + 13h}{h}
   \]

   \[
   = \lim_{h \to 0} 2h + 13 = 13
   \]

   Since \( f(3) = 24 \), the tangent line has slope 13 and goes through the point \( (3, 24) \). So the equation is \( y - 24 = 13(x - 3) \) which written in point slope form is \( y = 13x - 15 \).
3) Let

\[ f(x) = \frac{1}{x - 3} + \frac{x}{3} \]

Find \( f'(x) \) and its domain. (3 pts)

We use the limit definition of the derivative to see

\[
 f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = \lim_{h \to 0} \frac{\frac{1}{x+h-3} + \frac{x+h}{3} - \frac{1}{x-3} - \frac{x}{3}}{h}
\]

\[
 = \lim_{h \to 0} \frac{\frac{1}{x+h-3} - \frac{1}{x-3} + \frac{h}{3}}{h}
\]

\[
 = \lim_{h \to 0} \frac{x-3-x+h+3}{h(x+h-3)(x-3)} + \frac{1}{3}
\]

\[
 = \lim_{h \to 0} \frac{-h}{(x + h - 3)(x - 3)} \cdot \frac{1}{h} + \frac{1}{3}
\]

\[
 = \lim_{h \to 0} \frac{-1}{(x + h - 3)(x - 3)} + \frac{1}{3}
\]

\[
 = \frac{-1}{(x - 3)^2} + \frac{1}{3} = f'(x)
\]

And from this we can see that the domain of \( f'(x) \) is \( x \neq 3 \).