1. For the function \( f(x) = \tan x \),

(a) Draw the graph of the function. \textit{Mark all the important points, for instance, x- or y-intercepts.}

(b) Use your graph in (a) to determine the followings. \textit{No need to justify your answers.}

i. \( \lim_{x \to 0} f(x) \)

ii. \( \lim_{x \to \frac{\pi}{2}^+} f(x) \)

iii. \( \lim_{x \to \frac{\pi}{2}^-} f(x) \)

iv. \( \lim_{x \to \frac{\pi}{2}} f(x) \)

v. Vertical asymptotes in equation if exist.

vi. Horizontal asymptotes in equation if exist.
2. Use **Limit Laws** to compute the following limits. You should state **rigorous, algebraic arguments**, NOT graphs, for your reasons. Show each step clearly and state the name of the theorem if you use any. (*Do not use L’Hospital’s Rule if you know what it is*).

(a) \[ \lim_{x \to 1} \frac{2x^2 - x - 1}{x - 1} \]

(b) \[ \lim_{h \to 0} \frac{\sqrt{2 + h} - \sqrt{2}}{h} \]
(c) \( \lim_{x \to 0} x^2 \sin \frac{1}{x} \)

(d) \( \lim_{x \to \infty} \frac{x^3 + 5x}{2x^3 - x^2 + 4} \)
(e) \[ \lim_{x \to \infty} \frac{3x + 5}{\sqrt{x^2 - x + 1}} \]

(f) \[ \lim_{x \to \infty} \left( \sqrt{x^2 + x - x} \right) \]
3. Let

\[ f(x) = \begin{cases} 
2x^2 - x - 1 & \text{for } x \neq 1 \\
\frac{x - 1}{x - 1} & \text{for } x = 1 
\end{cases} \]

Determine whether \( f(x) \) is continuous at \( x = 1 \). (You may use your result at #2a.)
4. Use the **limit definition** of derivatives to find the derivative of $f(x) = 3x + 5$. *(Do NOT use differentiation formulae if you know what they are; you won’t get any credit.)*