1. Use the limit laws to find limits of the following sequences:
   (a) \( \lim_{n \to \infty} \frac{2n-1}{n} \);
   (b) \( \lim_{n \to \infty} \frac{n^n}{2^n} \);
   (c) \( \lim_{n \to \infty} \frac{1}{n^2+1} \).

2. Use the formal definition of limits to show that \( \lim_{n \to \infty} a_n = 0 \).
   That is, for every \( \varepsilon > 0 \) find \( N > 0 \) so that \( |a_n - a| < \varepsilon \) for all \( n > N \):
   (a) \( \lim_{n \to \infty} \frac{1}{n^2+1} = 0; \)
   (b) \( \lim_{n \to \infty} \frac{1}{\sqrt{n+3}} = 0; \)
   (c) \( \lim_{n \to \infty} \frac{n^2}{n^2+1} = 1; \)

3. Find the following limits of functions:
   (a) \( \lim_{x \to -2} \frac{x^3+2}{x-1} \);
   (b) \( \lim_{x \to -1} \frac{x^2-1}{x-1} \);
   (c) \( \lim_{x \to 0} \frac{x-\sqrt{x^2+25}}{2x} \);
   (d) \( \lim_{x \to 0} \frac{\sqrt{x^2-x}-\sqrt{2}}{2x} \);
   (e) \( \lim_{x \to 2+} [x+1] \) and \( \lim_{x \to 2-} [x-1] \);
   (f) \( \lim_{x \to \infty} \frac{e^x}{x-x} \);
   (g) \( \lim_{x \to -\infty} \frac{2x+x^2}{x-1} \);
   (h) \( \lim_{x \to \infty} \frac{3x^3-x^2+1}{x^2+3x^2} \);
   (i) \( \lim_{x \to -\infty} \frac{x^3}{3x^2-x} \);
   (j) \( \lim_{x \to \infty} \frac{x^3+1}{3x+1} \).

4. Find the values of \( x \in \mathbb{R} \) for which the given functions are continuous:
   (a) \( f(x) = \ln \frac{x+1}{x-1} \);
   (b) \( f(x) = \ln(x^2-4) \);
   (c) \( f(x) = e^{\tan(x)} \);
   (d) \( f(x) = \tan(2x+1) \).

5. Let \( f(x) = \begin{cases} ax^2 & , \ x > 2 \\ x+6 & , \ x \leq 2 \end{cases} \). Graph the function \( f(x) \) when \( a = 1 \). Is this function continuous for \( a = 1 \)? How must you choose \( a \) so that \( f(x) \) is continuous for all \( x \in (-\infty, \infty) \)?
6. Let \( N(t) = \frac{10^4}{10+e^{-5t}} \) be the equation describing the population growth. What is the initial size of the population \( N(0) \)? What is the carrying capacity \( K \)?

7. Evaluate the following trigonometric limits:
   (a) \( \lim_{x \to 0} \frac{1 - \cos(2x)}{x} \);
   (b) \( \lim_{x \to 0} \frac{\sin(2x)}{x(1-x)} \);
   (c) \( \lim_{x \to 0} \frac{\sin(7x)}{x} \);
   (d) \( \lim_{x \to 0} \frac{x^2 \cos \left( \frac{1}{x} \right)}{x} \);
   (e) \( \lim_{x \to 0} \frac{\sin(\sin(x))}{x^2} \);
   (f) \( \lim_{x \to 0} \frac{\sin(x^3)}{\sin(\sqrt{x})} \).

8. From the point of view of the intermediate value theorem, explain why the equation \( y = x^2 - \pi \) has two roots.

9. Using the intermediate value theorem, find an interval on which the equation \( e^{2x} = x^2 \) has a solution.

10. Show that any polynomial of an odd degree (that is, degree 1, 3, 5, etc.) has at least one root. What about polynomials of even degrees (2, 4, etc.)?