1. Find the limits, if they exist (remember to justify your answer).
   
   (a) \[ \lim_{x \to 1} \frac{x + 2}{x^2 - 1} \]
   
   (b) \[ \lim_{x \to -\infty} x^3 + 2x^2 \]
   
   (c) \[ \lim_{x \to \infty} \frac{x^2 + x - 7}{x^4 + 3x^3 - 4x^2 + 9} \]
   
   (d) \[ \lim_{x \to \infty} \sqrt{4x^2 - x + 3} \]
   
   (e) \[ \lim_{x \to -\infty} \frac{2x^2 - 9x}{3x^2 + 1} \]

2. For which values of \( a \) does the limit \( \lim_{x \to a} \frac{x - 2}{x^2 - 5x + 6} \) exist? For those values of \( a \), compute the limit.

3. Consider the function
   
   \[ f(x) = \begin{cases} x^2 + 1 & \text{if } x \leq 0 \\ \frac{1}{x-1} + 2 & \text{if } 0 \leq x < 1 \text{ or } 1 < x \leq 2 \\ \frac{4-x^2}{2-x} & \text{if } 2 < x \end{cases} \]
   
   Where is \( f \) continuous? Sketch a graph of \( f \).

4. Is there a number that is exactly one more than its cube?

5. For each of the following functions, state where it is continuous and justify your answer.
   
   (a) \[ \frac{1}{x+3} \]
   
   (b) \[ \frac{1}{x^2 + 3} \]
   
   (c) \[ \frac{x + 3}{|x + 3|} \]
   
   (d) \[ \frac{x^2 - 9}{x + 3} \]
   
   (e) \[ \arctan\left( \frac{1}{x+1} \right) \]
   
   (f) \[ \frac{x^2}{\sin x} \]
   
   (g) \[ \sqrt{x^2 - 4} \]
6. Find any vertical or horizontal asymptotes of the following curves.

(a) \( y = \arctan \left( \frac{1}{x + 1} \right) \)

(b) \( y = \frac{x^2 + 1}{x^2 - 1} \)

(c) \( y = \frac{e^{2x} + 5}{3 - e^{2x}} \)

7. Explain how “a fish who has jumped out of the pond is soon to make a splash” is an example of the Intermediate Value Theorem.

8. Find \( \lim_{x \to 0} x^6 e^{\cos \left( \frac{1}{x^2} \right)} \).

9. Where is the function \( \frac{e^{1/x} + \sin (3x^2 + 2)}{\tan x} \) continuous?

10. Show that \( \lim_{x \to -\infty} \frac{\cos x}{x} = \lim_{x \to \infty} \frac{\sin x}{x} \).