1. Graph the following function using the techniques we have seen in class. Identify on your graph all zeros, critical points, points of inflection. Additionally, identify for which values of $x$ the function is positive, where it is negative, where it is increasing, where it is decreasing, where it is concave up, and where it is concave down.

$$f(x) = \frac{x^2 - 9}{x^2 - 4}$$

- **Zeros:**
  $$\frac{x^2 - 9}{x^2 - 4} = 0$$
  $$x^2 - 9 = 0$$
  $$x = 3, x = -3$$

- **Vertical asymptotes:**
  $$\lim_{x \to \pm \infty} \frac{x^2 - 9}{x^2 - 4} = \pm \infty$$
  $$\lim_{x \to \pm \infty} x^2 - 9 = \pm \infty$$

- **Critical points:**
  $$f'(x) = \frac{2x(x^2 - 4) - 2x(x^2 - 9)}{(x^2 - 4)^2} = 0$$
  $$2x^3 - 8x - 2x^2 + 18x = 0$$
  $$x = 0, x = 2, x = -2$$

- **Concavity:**
  $$f''(x) = \frac{12x}{(x^2 - 4)^2}$$
  $$\frac{d}{dx} f''(x) = \frac{12}{(x^2 - 4)^2}$$
  $$0 = 12x^2 - 48x - 40 = 0$$
  $$x = \frac{12 \pm \sqrt{144 + 1920}}{24}$$
  $$x = \frac{12 \pm 22}{24}$$
  $$x = -0.208, x = 1.208$$

- **Increasing/decreasing:**
  $$f'(x) > 0$$ for $$x < -2$$ and $$x > 2$$
  $$f'(x) < 0$$ for $$-2 < x < 2$$

- **Points of inflection:**
  $$f''(x) = 0$$ for $$x = -2$$ and $$x = 2$$