



1. [24 points] Compute the following limits. If  $+\infty$  or  $-\infty$  is a correct answer, please give it.

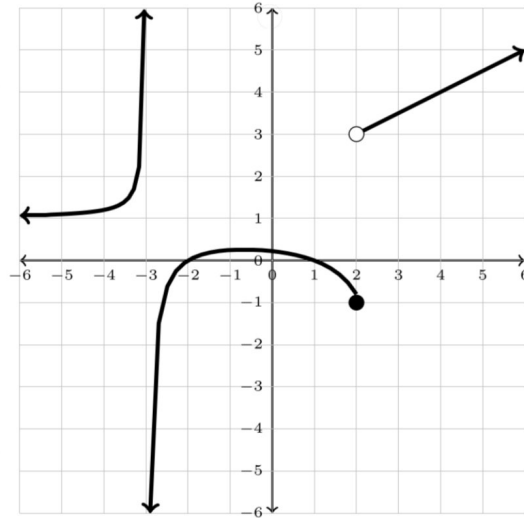
(a)  $\lim_{x \rightarrow 1} \frac{1 + x^2}{1 + x}$

(b)  $\lim_{x \rightarrow 1} \frac{x - 1}{x^2 + x - 2}$

(c)  $\lim_{x \rightarrow 4^+} \frac{x^2 - 1}{4 - x}$

(d)  $\lim_{x \rightarrow 1} \frac{\sqrt{x^2 + 1} - \sqrt{2}}{x - 1}$

2. [18 points] Consider the following graph:



- (a) What is the domain of  $f$ ? Express your answer in interval notation.
- (b) For which  $x$ 's is  $f(x) = 0$ ?
- (c) For which  $x$ 's is  $f(x) < 0$ ? Express your answer in interval notation.
- (d) Is  $f$  continuous at 2? Explain your answer using the definition of continuity.

3. [20 points] Consider the function defined by

$$g(x) = \begin{cases} 1/x & x > 0 \\ 1 & x = 0 \\ 2 - x^2 & x < 0. \end{cases}$$

(a) Draw the graph of  $g$ .

(b) Use the graph of part (a) to find  $\lim_{x \rightarrow 0^+} g(x)$ ,  $\lim_{x \rightarrow 0^-} g(x)$ ,  $\lim_{x \rightarrow 0} g(x)$  and  $g(0)$ .

4. [15 points] Let

$$f(x) = \frac{x+1}{x+2} \quad \text{and} \quad g(x) = \frac{1-x}{1+x}.$$

Simplify  $f(g(x))$  as much as possible.

5. [15 points] Suppose we know the limits

$$\lim_{x \rightarrow 2} f(x) = 4, \quad \lim_{x \rightarrow 2} g(x) = 3, \quad \lim_{x \rightarrow 2} h(x) = 0.$$

(a) What do the limit laws say about  $\lim_{x \rightarrow 2} \frac{f(x)}{g(x)}$ ?

(b) What do the limit laws say about  $\lim_{x \rightarrow 2} \frac{h(x)}{g(x)}$ ?

(c) What do the limit laws say about  ~~$\lim_{x \rightarrow 2} \frac{g(x)}{h(x)}$~~ ?

$$\lim_{x \rightarrow 2} \frac{g(x)}{h(x)}$$

6. [8 points] Find the equation of the line perpendicular to the line  $2x + 5y = 10$  that goes through the point  $(-\frac{1}{2}, 2)$ .

7. [5 points (bonus)] Let  $f(x) = 1 - x^2$ . Compute

$$\lim_{h \rightarrow 0} \frac{f\left(\frac{1}{x+h}\right) - f\left(\frac{1}{x}\right)}{h}.$$

