

1. [18 points] Evaluate the following limits. Answer either as a specific value, $+\infty$, $-\infty$, or “DNE.”

(a) $\lim_{x \rightarrow 4} \frac{x^2 - x - 12}{x^2 - 3x - 4}$

(b) $\lim_{x \rightarrow 3^-} \frac{x - 5}{x - 3}$

(c) $\lim_{x \rightarrow -1} \frac{x^2 - 1}{\sqrt{x + 5} - 2}$

(d) $\lim_{x \rightarrow 2} \frac{x^2 + 2x - 7}{x^2 - 9}$

(e) $\lim_{x \rightarrow 1} \frac{x^2 - 3x + 2}{|x - 1|}$

(f) $\lim_{x \rightarrow 1^+} \frac{x^2 + 4x + 3}{x^2 - 4x + 3}$

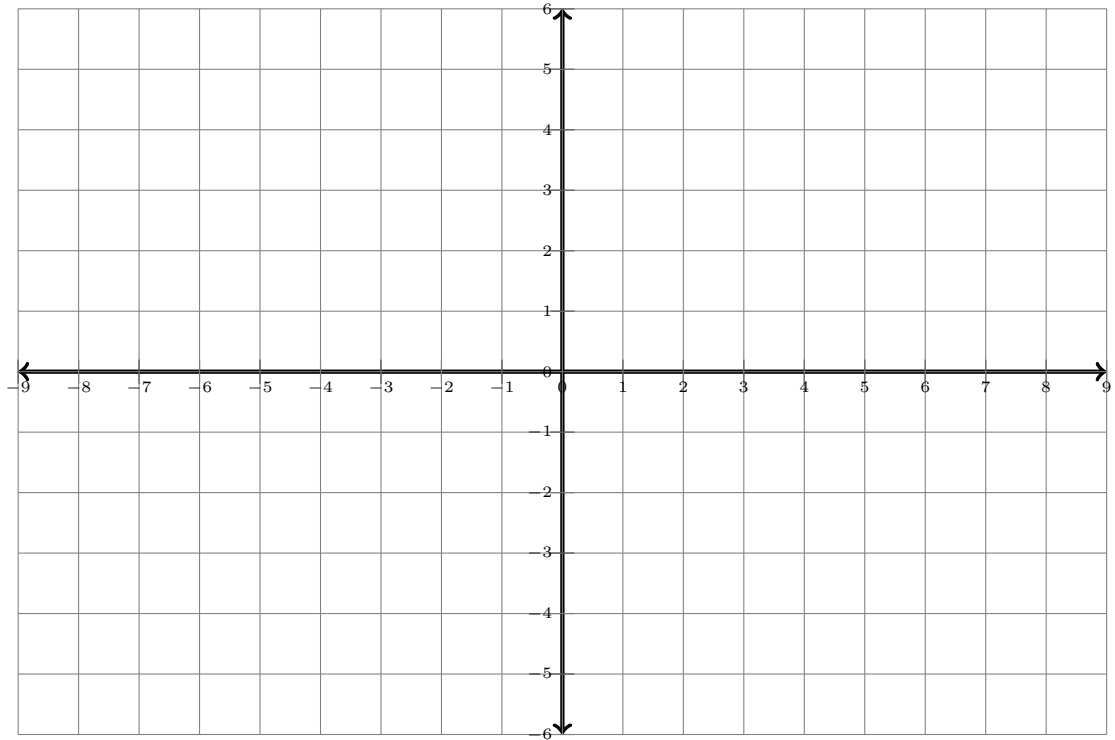
2. [16 points] Consider the following piecewise function.

$$f(x) = \begin{cases} 4 & x \leq -2 \\ 4 - x^2 & -2 < x \leq 0 \\ 1 + \frac{1}{x} & 0 < x < 1 \\ 3 - x & x \geq 1 \end{cases}$$

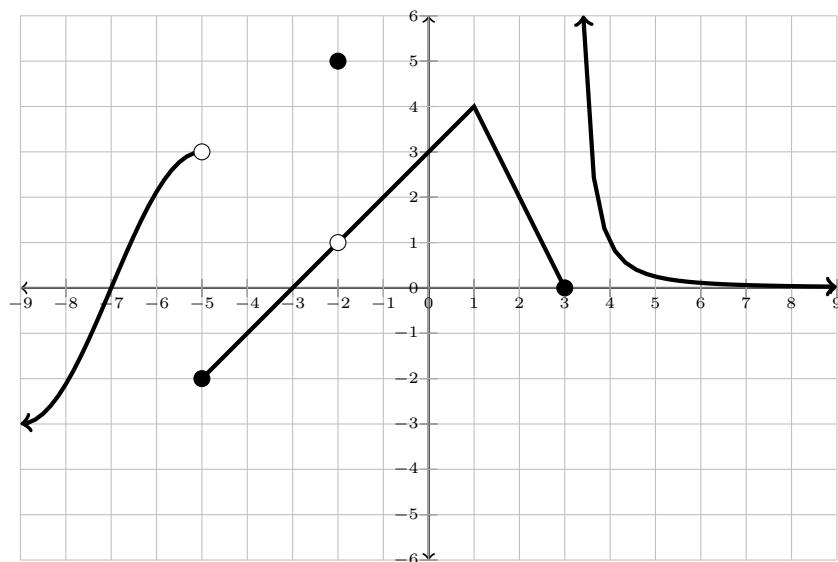
- (a) Determine all discontinuities of this function. The definition of $f(x)$ is reproduced below for convenience.

$$f(x) = \begin{cases} 4 & x \leq -2 \\ 4 - x^2 & -2 < x \leq 0 \\ 1 + \frac{1}{x} & 0 < x < 1 \\ 3 - x & x \geq 1 \end{cases}$$

- (b) Sketch the graph of this function on the axes below.



3. [5 points] Find an equation for a line that is parallel to the line $3x + 4y = 24$ and passes through the point $(1, 2)$.
4. [14 points] Shown below is the graph of a function $f(x)$. Determine the following limits of function values. If a value is $+\infty$ or $-\infty$, state this. If a value does not exist, answer “DNE.”



- (a) $\lim_{x \rightarrow (-5)^-} f(x)$ (e) $f(-2)$
(b) $\lim_{x \rightarrow (-5)^+} f(x)$ (f) $\lim_{x \rightarrow 3^-} f(x)$
(c) $f(-5)$ (g) $\lim_{x \rightarrow 3^+} f(x)$
(d) $\lim_{x \rightarrow (-2)} f(x)$ (h) Identify all values of x where $f(x)$ is discontinuous.

5. [7 points] Define $f(x)$ and $g(x)$ as follows.

$$f(x) = \frac{2+x}{1-x}$$

$$g(x) = \frac{3x+1}{x-2}$$

Compute and simplify $f(g(x))$ as much as possible.

6. [3 points (bonus)] Let $f(x) = 2 - \sqrt{3x+1}$. Compute

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

Note that the answer will be in terms of x .