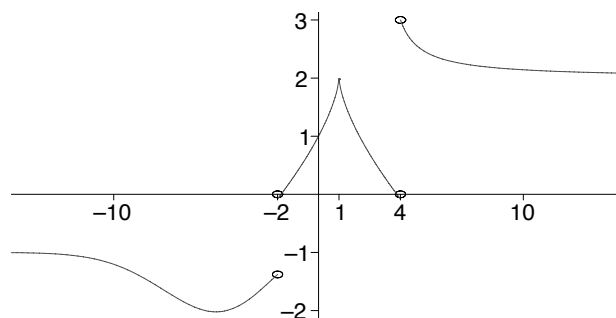


This test consists of 100 points and 4 pages, none of which is intentionally left blank. Take a few seconds right now to be sure you have all the pages. The point value of each question is to the left of the question number. Show all your work in the space provided. If you run out of room for an answer, continue working on the back of the page. Your answers must be justified by your work.

1. Using the graph shown, answer the following questions:



- (2) (a) What is the value of $\lim_{x \rightarrow -\infty} f(x)$
- (2) (b) Estimate the value of $\lim_{x \rightarrow -2^-} f(x)$
- (2) (c) What is the value of $\lim_{x \rightarrow -2^+} f(x)$
- (2) (d) What is the value of $\lim_{x \rightarrow 1} f(x)$
- (2) (e) What is the value of $\lim_{x \rightarrow 4^-} f(x)$
- (2) (f) What is the value of $\lim_{x \rightarrow 4^+} f(x)$
- (2) (g) What is the value of $\lim_{x \rightarrow \infty} f(x)$
- (3) (h) Where does f fail to be continuous? Why?
- (3) (i) Where does f fail to be differentiable? Why?

(10) 2. State the ε - δ limit of a function.

(10) 3. Using the ε - δ definition of a limit, prove

$$\lim_{x \rightarrow 2} (3 - 2x) = -1$$

4. Evaluate each of the following limits:

$$(10) \quad (a) \lim_{x \rightarrow 6} \frac{x^2 + 5x - 8}{x + 3}$$

$$(10) \quad (b) \lim_{h \rightarrow 0} \frac{(2+h)^2 + 3(2+h) - 10}{h}$$

$$(10) \quad (c) \lim_{x \rightarrow -\infty} \frac{\sqrt{x^2 - 4x + 5}}{x}$$

(10) 5. Let

$$f(x) = \begin{cases} x^2 - ax + 3 & \text{if } x < 1 \\ 3 + 4ax & \text{if } x > 1 \end{cases}$$

What is the value of a if $\lim_{x \rightarrow 1} f(x)$ exists?

- (10) 6. Let $f(x) = x \sin\left(\frac{1}{x}\right)$ for $x \neq 0$. Show that f has a removable discontinuity at $x = 0$. (I.e. use the squeeze theorem to show $\lim_{x \rightarrow 0} f(x)$ exists.)

- (10) 7. Let $f(x) = \sqrt{x-1}$. Use the definition of the derivative to find $f'(5)$.