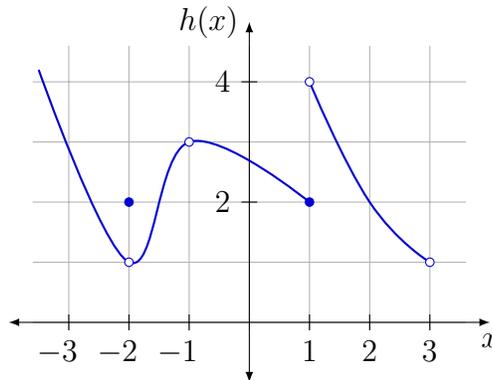


1. 3 pts. each Use the graph below to find the following limits, if they exist. If a limit does not exist, explain why.

(a)  $\lim_{x \rightarrow 1^-} h(x)$       (b)  $\lim_{x \rightarrow 1^+} h(x)$       (c)  $\lim_{x \rightarrow 1} h(x)$       (d)  $\lim_{x \rightarrow -1} h(x)$       (e)  $\lim_{x \rightarrow 2} h(x)$



2. 10 pts. each Evaluate each limit.

(a)  $\lim_{r \rightarrow 3} (r^4 - 7r + 4)^{2/3}$

(b)  $\lim_{t \rightarrow -2} \left( \frac{t^2}{t+2} + \frac{2t}{t+2} \right)$

(c)  $\lim_{x \rightarrow 0} \frac{\sqrt{2x^2 + 25} - 5}{x^2}$

3. 10 pts. Suppose the function  $g$  satisfies the inequality

$$2x^2 - 5x + \cos x \leq g(x) \leq \sin x + 1$$

for all  $x \in (0, 1)$ . Use the Squeeze Theorem to evaluate  $\lim_{x \rightarrow 0^+} g(x)$ .

4. 15 pts. Find all vertical asymptotes  $x = a$  of the function

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

For each value of  $a$  evaluate  $\lim_{x \rightarrow a^+} f(x)$ ,  $\lim_{x \rightarrow a^-} f(x)$ ,  $\lim_{x \rightarrow a} f(x)$ .

5. 15 pts. For

$$f(x) = \frac{4x^3}{2x^3 + \sqrt{9x^6 + 15x^4}}$$

evaluate  $\lim_{x \rightarrow \infty} f(x)$  and  $\lim_{x \rightarrow -\infty} f(x)$ , and identify any horizontal asymptotes of  $f$ .

6. 10 pts. Show that  $f$  is not continuous at 4.

$$f(x) = \begin{cases} x^2 - 5, & \text{if } x \neq 4 \\ 13, & \text{if } x = 4 \end{cases}$$

7. 15 pts. Let  $g$  be given by

$$g(x) = \begin{cases} x^2 + x, & \text{if } x < 1 \\ a, & \text{if } x = 1 \\ 3x + 5, & \text{if } x > 1 \end{cases}$$

Find the value of  $a$  for which  $g$  is continuous from the left at 1, and the value of  $a$  for which  $g$  is continuous from the right at 1. Is there an  $a$  value for which  $g$  is continuous at 1?

8. Let  $f(x) = \frac{1}{\sqrt{x}}$ .

(a) 10 pts. Use the *definition* of derivative to find  $f'(9)$ .

(b) 5 pts. Determine an equation for the tangent line to the graph of  $f$  at  $(9, 1/3)$ .

9. Let  $f(x) = \sqrt{3x + 1}$ .

(a) 15 pts. Use the definition of derivative to find  $f'$ .

(b) 5 pts. Determine an equation for the tangent line to the graph of  $f$  at  $(8, 5)$ .

10. **Extra Credit (15 pts.):** Prove that

$$\lim_{x \rightarrow \infty} \frac{5}{x^3} = 0$$

using the appropriate limit definition.