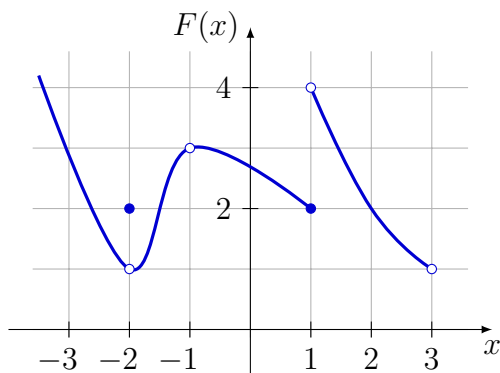


1. 3 pts. each Use the graph below to find the following limits, if they exist. If a limit does not exist, explain why.

(a)  $\lim_{x \rightarrow -1} F(x)$       (b)  $\lim_{x \rightarrow -2} F(x)$       (c)  $\lim_{x \rightarrow 1^-} F(x)$       (d)  $\lim_{x \rightarrow 1^+} F(x)$       (e)  $\lim_{x \rightarrow 3^+} F(x)$



2. 10 pts. each Evaluate each limit algebraically using limit laws, showing work.

(a)  $\lim_{x \rightarrow -b} \frac{(x+b)^7 + (x+b)^{10}}{4(x+b)}$ ,  $b$  a fixed real number.

(b)  $\lim_{h \rightarrow 0} \frac{\frac{1}{5+h} - \frac{1}{5}}{h}$

(c)  $\lim_{x \rightarrow 64} \frac{\sqrt{x} - 8}{x - 64}$

(d)  $\lim_{x \rightarrow 0} \frac{1 - \cos x}{\cos^2 x - 3 \cos x + 2}$

3. 10 pts. Suppose

$$G(x) = \begin{cases} 3x - 4k, & x < -3 \\ x + 9, & x > -3. \end{cases}$$

Determine a value for  $k$  for which the limit  $\lim_{x \rightarrow -3} G(x)$  exists, and state the value of the limit.

4. 4 pts. each Determine the following limits:

$$\lim_{x \rightarrow 3^+} \frac{-5}{(x-3)^3}, \quad \lim_{t \rightarrow -2^-} \frac{t^3 - 5t^2 + 6t}{t^4 - 4t^2}, \quad \lim_{\theta \rightarrow 0^-} \cot 6\theta.$$

5. 10 pts. Find all vertical asymptotes  $x = a$  of the function

$$f(x) = \frac{2x - 1}{2x^3 + 5x^2 - 3x}.$$

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

6. 10 pts. Evaluate the limit

$$\lim_{x \rightarrow -\infty} \frac{8 - 4x^2}{7x^2 + 5x - 12}.$$

7. 15 pts. Determine  $\lim_{x \rightarrow \infty} f(x)$  and  $\lim_{x \rightarrow -\infty} f(x)$  for

$$f(x) = \frac{4x^3 + 1}{2x^3 + \sqrt{16x^6 + 1}}.$$

Then give the horizontal asymptotes of  $f$ , if any.

8. 10 pts. Let  $h$  be given by

$$h(x) = \begin{cases} 2x^2 - x, & \text{if } x < -1 \\ s, & \text{if } x = -1 \\ 3x - 5, & \text{if } x > -1 \end{cases}$$

Find the value of  $s$  for which  $h$  is continuous from the left at  $-1$ , and the value of  $s$  for which  $h$  is continuous from the right at  $-1$ .

9. 10 pts. Use the precise definition of limit to prove that

$$\lim_{x \rightarrow -2} (4x + 9) = 1.$$

10. Let  $f(x) = \sqrt{2x - 1}$ .

(a) 10 pts. Use the limit definition of a derivative to find  $f'(1)$ .

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

11. 15 pts. Use the limit definition of a derivative to find  $f'(x)$  given that

$$f(x) = \frac{1}{3x - 4}.$$