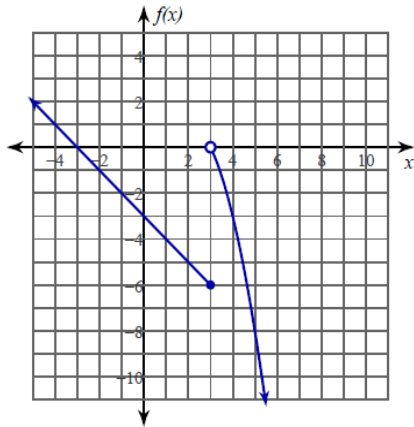
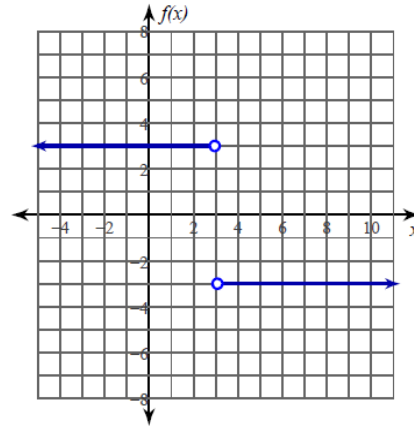


Evaluate each limit.

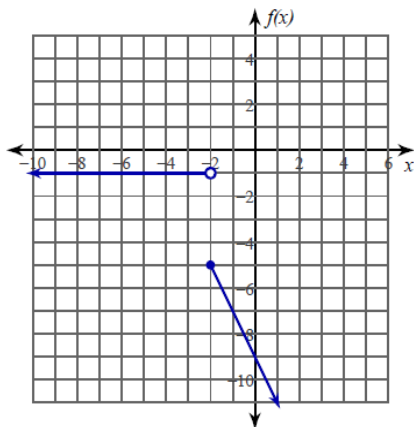
1) $\lim_{x \rightarrow 3^+} f(x), f(x) = \begin{cases} -x - 3, & x \leq 3 \\ -x^2 + 4x - 3, & x > 3 \end{cases}$



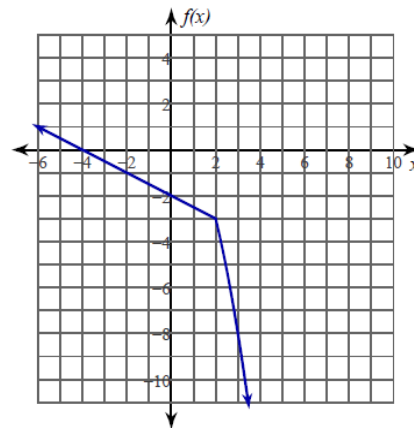
2) $\lim_{x \rightarrow 3^-} \frac{3|-x + 3|}{-x + 3}$



3) $\lim_{x \rightarrow -2} f(x), f(x) = \begin{cases} -1, & x < -2 \\ -2x - 9, & x \geq -2 \end{cases}$

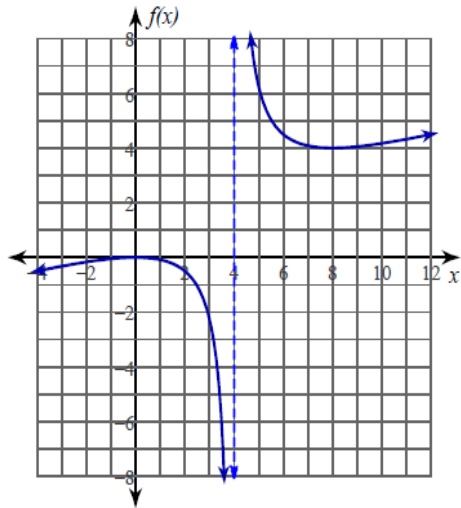


4) $\lim_{x \rightarrow 2} f(x), f(x) = \begin{cases} -\frac{x}{2} - 2, & x \leq 2 \\ -x^2 + 1, & x > 2 \end{cases}$

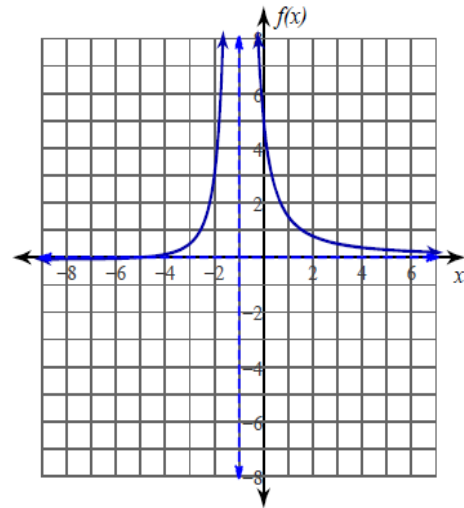


Discuss countinuity at given point

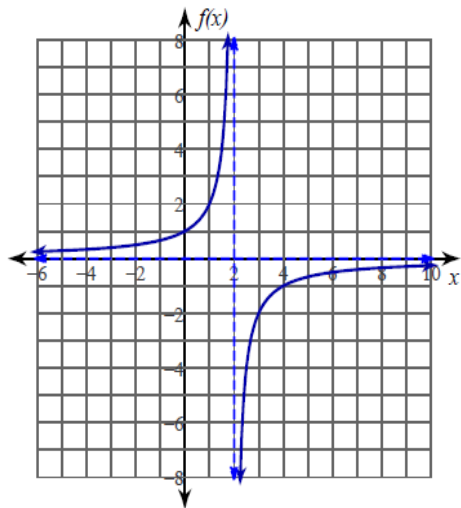
1) $\lim_{x \rightarrow 4} \frac{x^2}{4x - 16}$



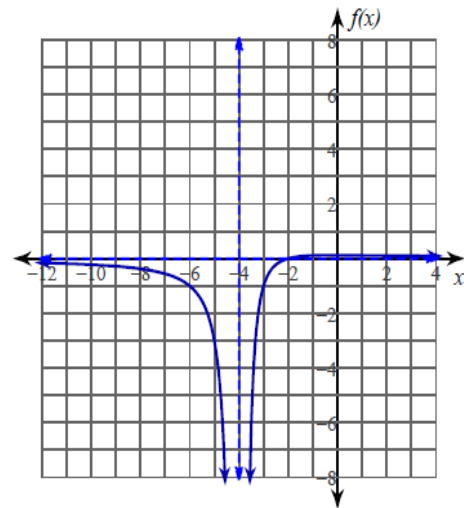
2) $\lim_{x \rightarrow -1} \frac{x + 5}{x^2 + 2x + 1}$



3) $\lim_{x \rightarrow 2^-} -\frac{2}{x - 2}$

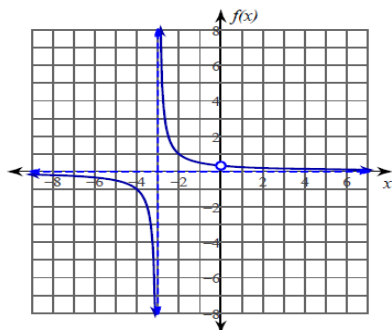


4) $\lim_{x \rightarrow -4^+} \frac{x + 2}{x^2 + 8x + 16}$

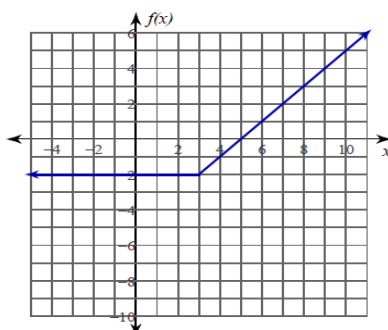


Determine if each function is continuous at the given x -values. If not continuous, classify each discontinuity.

1) $f(x) = \frac{x}{x^2 + 3x}$; at $x = -3$ and $x = 0$



2) $f(x) = \begin{cases} -2, & x \leq 3 \\ x - 5, & x > 3 \end{cases}$; at $x = 3$



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

4) $f(x) = \frac{x+2}{x^2 - 4}$; at $x = -2$ and $x = 2$

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

6) $f(x) = \begin{cases} -2x, & x < 3 \\ -x^2 + 8x - 16, & x \geq 3 \end{cases}$; at $x = 3$

Determine if each function is continuous. If the function is not continuous, find the x -axis location of and classify each discontinuity.

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

8) $f(x) = \frac{x}{x^2 + 6x + 9}$

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

10) $f(x) = \frac{x}{x^2 - 4x}$

11) $f(x) = \begin{cases} x + 4, & x \leq -2 \\ -2x - 11, & x > -2 \end{cases}$

12) $f(x) = \frac{x+7}{x^2 + 3x}$

CHAPTER 1 REVIEW EXERCISES



Graphing Utility



CAS

1. For the function f graphed in the accompanying figure, find the limit if it exists.

(a) $\lim_{x \rightarrow 1} f(x)$ (b) $\lim_{x \rightarrow 2} f(x)$ (c) $\lim_{x \rightarrow 3} f(x)$
(d) $\lim_{x \rightarrow 4} f(x)$ (e) $\lim_{x \rightarrow +\infty} f(x)$ (f) $\lim_{x \rightarrow -\infty} f(x)$
(g) $\lim_{x \rightarrow 3^+} f(x)$ (h) $\lim_{x \rightarrow 3^-} f(x)$ (i) $\lim_{x \rightarrow 0} f(x)$

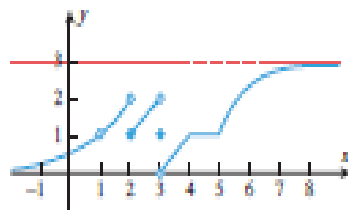


Figure Ex-1

2. In each part, complete the table and make a conjecture about the value of the limit indicated. Confirm your conjecture by finding the limit analytically.

(a) $f(x) = \frac{x-2}{x^2-4}$; $\lim_{x \rightarrow 2} f(x)$

x	2.00001	2.0001	2.001	2.01	2.1	2.5
$f(x)$						

(b) $f(x) = \frac{\tan 4x}{x}$; $\lim_{x \rightarrow 0} f(x)$

x	-0.01	-0.001	-0.0001	0.0001	0.001	0.01
$f(x)$						

3. (a) Approximate the value for the limit

$$\lim_{x \rightarrow 0} \frac{3^x - 2^x}{x}$$

to three decimal places by constructing an appropriate table of values.

- (b) Confirm your approximation using graphical evidence.

4. Approximate

$$\lim_{x \rightarrow 3} \frac{2^x - 8}{x - 3}$$

both by looking at a graph and by calculating values for some appropriate choices of x . Compare your answer with the value produced by a CAS.

- 5–10 Find the limits. ■

5. $\lim_{x \rightarrow -1} \frac{x^3 - x^2}{x - 1}$ 6. $\lim_{x \rightarrow 1} \frac{x^3 - x^2}{x - 1}$

7. $\lim_{x \rightarrow -3} \frac{3x + 9}{x^2 + 4x + 3}$ 8. $\lim_{x \rightarrow 2} \frac{x + 2}{x - 2}$

9. $\lim_{x \rightarrow +\infty} \frac{(2x - 1)^5}{(3x^2 + 2x - 7)(x^3 - 9x)}$

10. $\lim_{x \rightarrow 0} \frac{\sqrt{x^2 + 4} - 2}{x^2}$

11. In each part, find the horizontal asymptotes, if any.

(a) $y = \frac{2x - 7}{x^2 - 4x}$ (b) $y = \frac{x^3 - x^2 + 10}{3x^2 - 4x}$

(c) $y = \frac{2x^2 - 6}{x^2 + 5x}$

12. In each part, find $\lim_{x \rightarrow a} f(x)$, if it exists, where a is replaced by 0 , 5^+ , -5^- , -5 , 5 , $-\infty$, and $+\infty$.

(a) $f(x) = \sqrt{5 - x}$

(b) $f(x) = \begin{cases} (x - 5)/|x - 5|, & x \neq 5 \\ 0, & x = 5 \end{cases}$

- 13–20 Find the limits. ■

13. $\lim_{x \rightarrow 0} \frac{\sin 3x}{\tan 3x}$ 14. $\lim_{x \rightarrow 0} \frac{x \sin x}{1 - \cos x}$

15. $\lim_{x \rightarrow 0} \frac{3x - \sin(kx)}{x}$, $k \neq 0$

16. $\lim_{\theta \rightarrow 0} \tan\left(\frac{1 - \cos \theta}{\theta}\right)$

17. $\lim_{t \rightarrow \pi/2^+} e^{\tan t}$ 18. $\lim_{\theta \rightarrow 0^+} \ln(\sin 2\theta) - \ln(\tan \theta)$

EXERCISE SET 1.2

1. Given that

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

find the limits.

(a) $\lim_{x \rightarrow a} [f(x) + 2g(x)]$

(b) $\lim_{x \rightarrow a} [h(x) - 3g(x) + 1]$

(c) $\lim_{x \rightarrow a} [f(x)g(x)]$

(d) $\lim_{x \rightarrow a} [g(x)]^2$

(e) $\lim_{x \rightarrow a} \sqrt[3]{6 + f(x)}$

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

2. Use the graphs of f and g in the accompanying figure to find the limits that exist. If the limit does not exist, explain why.

(a) $\lim_{x \rightarrow 2} [f(x) + g(x)]$

(b) $\lim_{x \rightarrow 0} [f(x) + g(x)]$

(c) $\lim_{x \rightarrow 0^+} [f(x) + g(x)]$

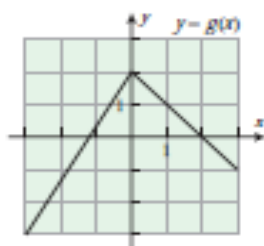
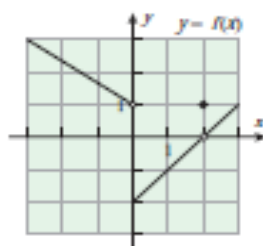
(d) $\lim_{x \rightarrow 0^-} [f(x) + g(x)]$

(e) $\lim_{x \rightarrow 2} \frac{f(x)}{1 + g(x)}$

(f) $\lim_{x \rightarrow 2} \frac{1 + g(x)}{f(x)}$

(g) $\lim_{x \rightarrow 0^+} \sqrt{f(x)}$

(h) $\lim_{x \rightarrow 0^-} \sqrt{f(x)}$



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

5. $\lim_{x \rightarrow 3} \frac{x^2 - 2x}{x + 1}$

7. $\lim_{x \rightarrow 1^+} \frac{x^4 - 1}{x - 1}$

9. $\lim_{x \rightarrow -1} \frac{x^2 + 6x + 5}{x^2 - 3x - 4}$

11. $\lim_{x \rightarrow -1} \frac{2x^2 + x - 1}{x + 1}$

13. $\lim_{t \rightarrow 2} \frac{t^3 + 3t^2 - 12t + 4}{t^3 - 4t}$

15. $\lim_{x \rightarrow 3^+} \frac{x}{x - 3}$

17. $\lim_{x \rightarrow 3} \frac{x}{x - 3}$

19. $\lim_{x \rightarrow 2} \frac{x}{x^2 - 4}$

21. $\lim_{y \rightarrow 6^+} \frac{y + 6}{y^2 - 36}$

23. $\lim_{y \rightarrow 6} \frac{y + 6}{y^2 - 36}$

25. $\lim_{x \rightarrow 4} \frac{3 - x}{x^2 - 2x - 8}$

27. $\lim_{x \rightarrow 2^+} \frac{1}{|2 - x|}$

29. $\lim_{x \rightarrow 9} \frac{x - 9}{\sqrt{x} - 3}$

31. $\lim_{x \rightarrow 0} \frac{1}{x}$

4. $\lim_{x \rightarrow 3} x^3 - 3x^2 + 9x$

6. $\lim_{x \rightarrow 0} \frac{6x - 9}{x^3 - 12x + 3}$

8. $\lim_{t \rightarrow -2} \frac{t^3 + 8}{t + 2}$

10. $\lim_{x \rightarrow 2} \frac{x^2 - 4x + 4}{x^2 + x - 6}$

12. $\lim_{x \rightarrow 1} \frac{3x^2 - x - 2}{2x^2 + x - 3}$

14. $\lim_{t \rightarrow 1} \frac{t^3 + t^2 - 5t + 3}{t^3 - 3t + 2}$

16. $\lim_{x \rightarrow 3^+} \frac{x}{x - 3}$

18. $\lim_{x \rightarrow 2^+} \frac{x}{x^2 - 4}$

20. $\lim_{x \rightarrow 2} \frac{x}{x^2 - 4}$

22. $\lim_{y \rightarrow 6^-} \frac{y + 6}{y^2 - 36}$

24. $\lim_{x \rightarrow 4^+} \frac{3 - x}{x^2 - 2x - 8}$

26. $\lim_{x \rightarrow 4} \frac{3 - x}{x^2 - 2x - 8}$

28. $\lim_{x \rightarrow 3^-} \frac{1}{|x - 3|}$

30. $\lim_{y \rightarrow 4} \frac{4 - y}{2 - \sqrt{y}}$