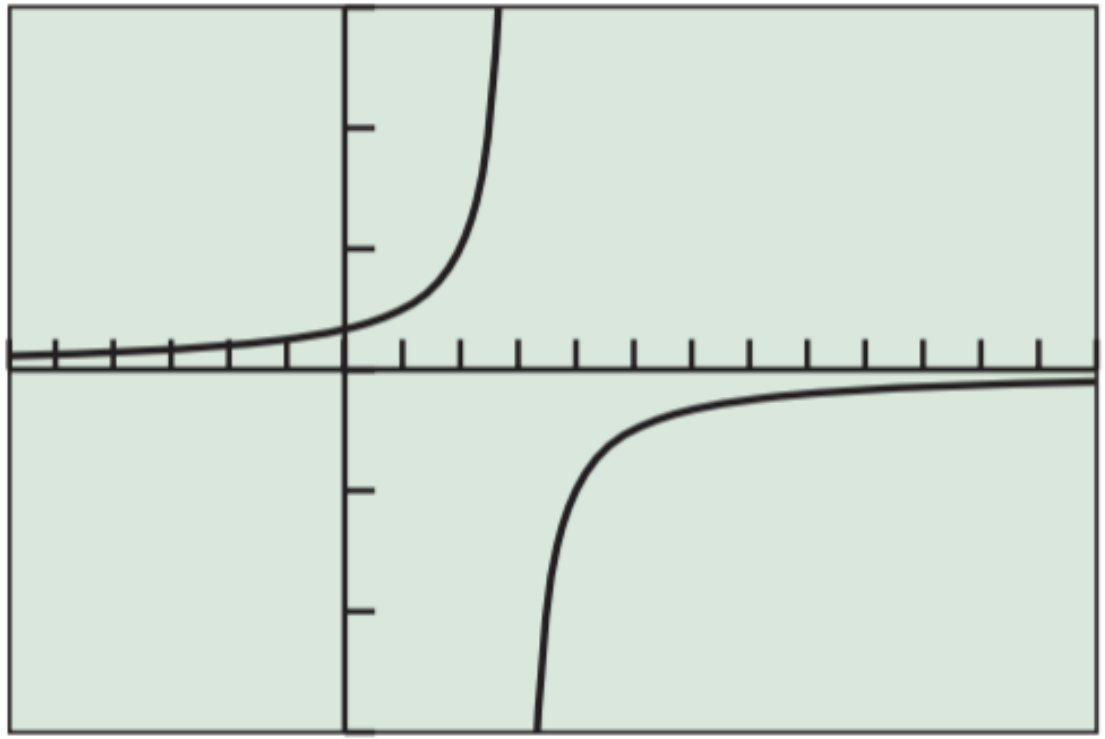
In Exercises 11–14, evaluate the limit based on the graph of f shown.



[–5.8, 13] by [–3, 3]

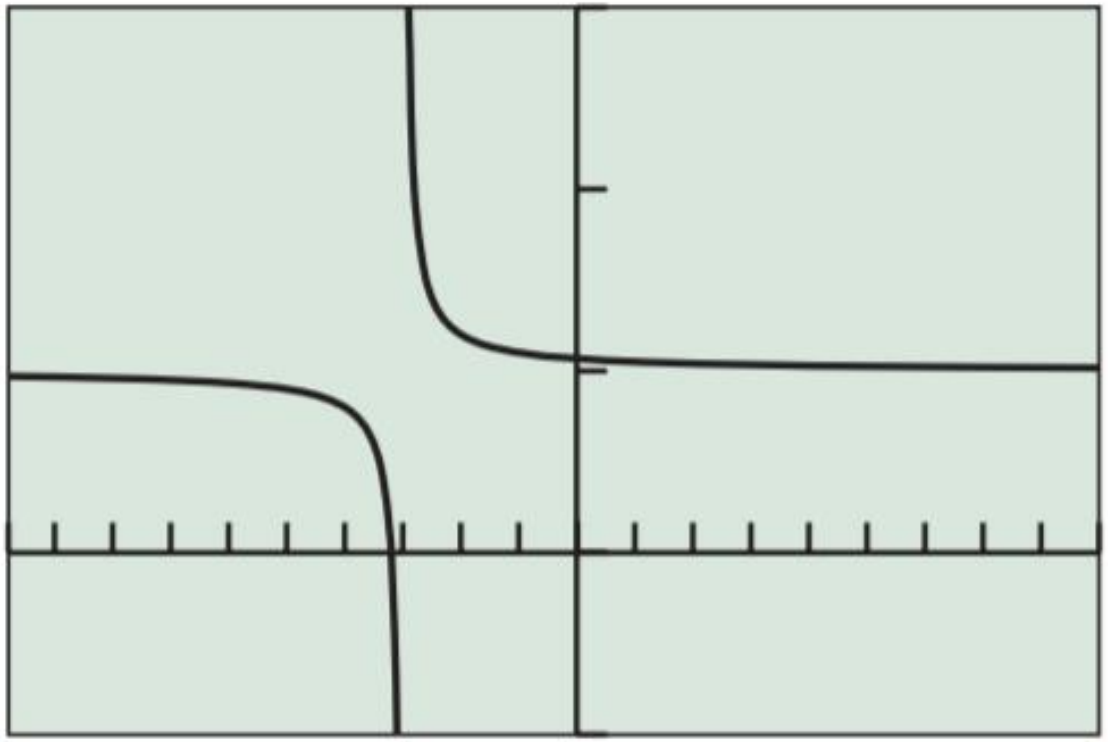
11. $\lim_{x \to 3^-} f(x)$

12. $\lim_{x \to 3^+} f(x)$

13. $\lim_{x \to \infty} f(x)$

14. $\lim_{x \to -\infty} f(x)$

In Exercises 15–18, evaluate the limit based on the graph of f shown.



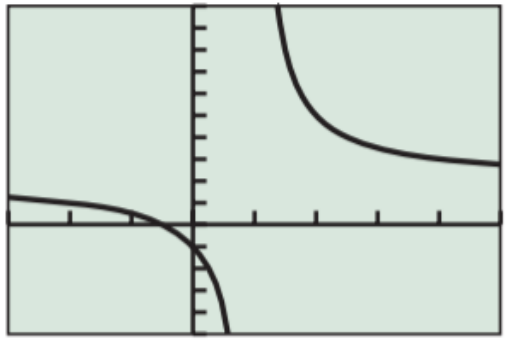
[–9.8, 9] by [–5, 15]

15. $\lim_{x \to -3^+} f(x)$

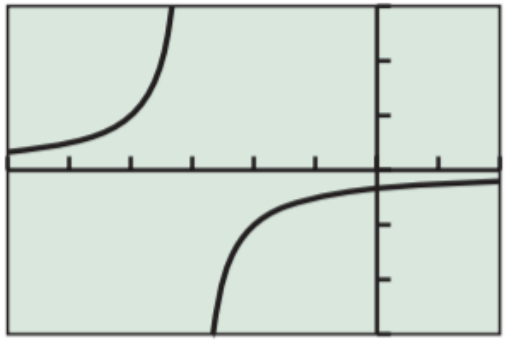
16. $\lim_{x \to -3^-} f(x)$

17. $\lim_{x \to -\infty} f(x)$

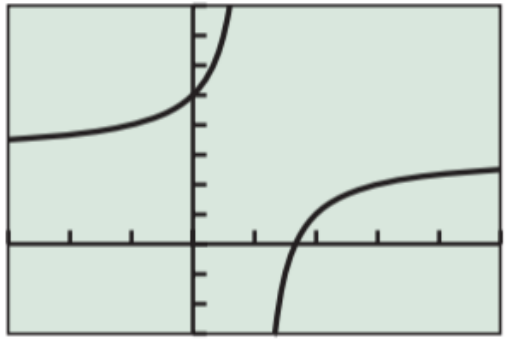
18. $\lim_{x \to \infty} f(x)$



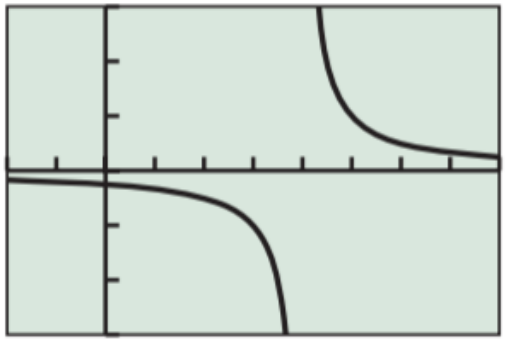
(a)



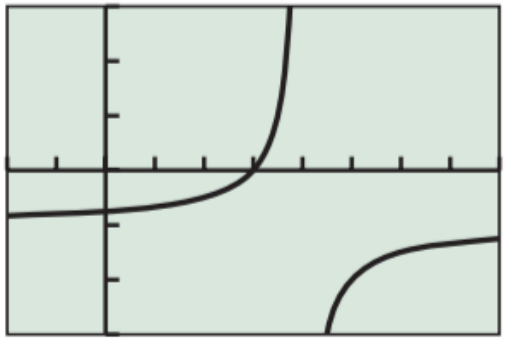
(b)



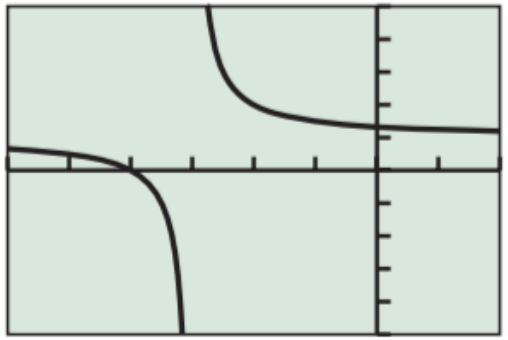
(c)



(d)



(e)



(f)

In Exercises 31–36, match the rational function with its graph. Identify the viewing window and the scale used on each axis.

31. $f(x) = \dfrac{1}{x - 4}$

32. $f(x) = -\dfrac{1}{x + 3}$

33. $f(x) = 2 + \dfrac{3}{x - 1}$

34. $f(x) = 1 + \dfrac{1}{x + 3}$

35. $f(x) = -1 + \dfrac{1}{4 - x}$

36. $f(x) = 3 - \dfrac{2}{x - 1}$

In Exercises 37–44, find the intercepts, asymptotes, use limits to describe the behavior at the vertical asymptotes, and analyze and draw the graph of the given rational function.

39. $h(x) = \dfrac{x - 1}{x^2 - x - 12}$

42. $g(x) = \dfrac{x^2 - x - 2}{x^2 - 2x - 8}$

43. $h(x) = \dfrac{x^2 + 2x - 3}{x + 2}$

In Exercises 57–62, find the intercepts, asymptotes, end-behavior asymptote, and graph the function together with its end-behavior asymptote.

58. $k(x) = \dfrac{2x^5 + x^2 - x + 1}{x^2 - 1}$