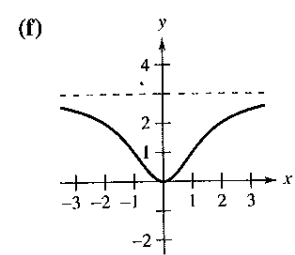
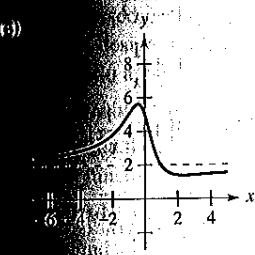
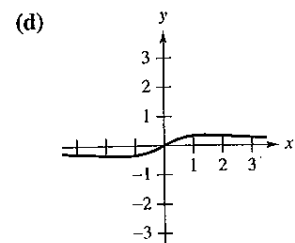
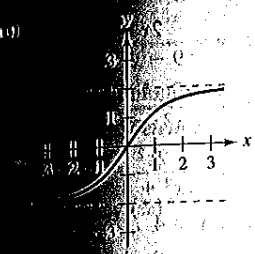
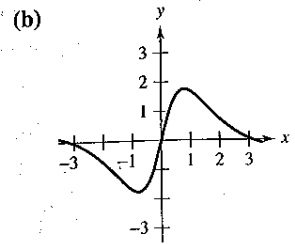
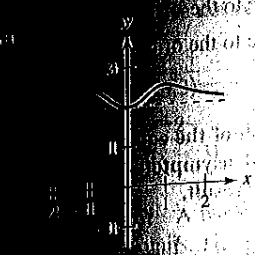


**PROBLEMS FOR SECTION 3.5**

Graph the function with one of the graphs [(a), (b), (c), (d), (e), (f)] using horizontal asymptotes as an aid.



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

- 2.  $f(x) = \frac{2x}{\sqrt{x^2 + 2}}$
- 4.  $f(x) = 2 + \frac{x^2}{x^4 + 1}$
- 6.  $f(x) = \frac{2x^2 - 3x + 5}{x^2 + 1}$

**Numerical and Graphical Analysis** In Exercises 7–12, use a graphing utility to complete the table and estimate the limit as  $x$  approaches infinity. Then use a graphing utility to graph the function and estimate the limit graphically.

$x$	$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$
$f(x)$							

- 7.  $f(x) = \frac{4x + 3}{2x - 1}$
- 8.  $f(x) = \frac{2x^2}{x + 1}$
- 9.  $f(x) = \frac{-6x}{\sqrt{4x^2 + 5}}$
- 10.  $f(x) = \frac{8x}{\sqrt{x^2 - 3}}$
- 11.  $f(x) = 5 - \frac{1}{x^2 + 1}$
- 12.  $f(x) = 4 + \frac{3}{x^2 + 2}$

In Exercises 13 and 14, find  $\lim_{x \rightarrow \infty} h(x)$ , if possible.

- 13.  $f(x) = 5x^3 - 3x^2 + 10$ 
  - (a)  $h(x) = \frac{f(x)}{x^2}$
  - (b)  $h(x) = \frac{f(x)}{x^3}$
  - (c)  $h(x) = \frac{f(x)}{x^4}$
- 14.  $f(x) = 5x^2 - 3x + 7$ 
  - (a)  $h(x) = \frac{f(x)}{x}$
  - (b)  $h(x) = \frac{f(x)}{x^2}$
  - (c)  $h(x) = \frac{f(x)}{x^3}$

In Exercises 15–18, find each of the limits, if possible.

- 15. (a)  $\lim_{x \rightarrow \infty} \frac{x^2 + 2}{x^3 - 1}$
- 16. (a)  $\lim_{x \rightarrow \infty} \frac{3 - 2x}{3x^3 - 1}$
- (b)  $\lim_{x \rightarrow \infty} \frac{x^2 + 2}{x^2 - 1}$
- (b)  $\lim_{x \rightarrow \infty} \frac{3 - 2x}{3x - 1}$
- (c)  $\lim_{x \rightarrow \infty} \frac{x^2 + 2}{x - 1}$
- (c)  $\lim_{x \rightarrow \infty} \frac{3 - 2x^2}{3x - 1}$
- 17. (a)  $\lim_{x \rightarrow \infty} \frac{5 - 2x^{3/2}}{3x^2 - 4}$
- 18. (a)  $\lim_{x \rightarrow \infty} \frac{5x^{3/2}}{4x^2 + 1}$
- (b)  $\lim_{x \rightarrow \infty} \frac{5 - 2x^{3/2}}{3x^{3/2} - 4}$
- (b)  $\lim_{x \rightarrow \infty} \frac{5x^{3/2}}{4x^{3/2} + 1}$
- (c)  $\lim_{x \rightarrow \infty} \frac{5 - 2x^{3/2}}{3x - 4}$
- (c)  $\lim_{x \rightarrow \infty} \frac{5x^{3/2}}{4\sqrt{x} + 1}$

In Exercises 19–32, find the limit.

- 19.  $\lim_{x \rightarrow \infty} \frac{2x - 1}{3x + 2}$
- 20.  $\lim_{x \rightarrow \infty} \frac{3x^3 + 2}{9x^3 - 2x^2 + 7}$
- 21.  $\lim_{x \rightarrow \infty} \frac{x}{x^2 - 1}$
- 22.  $\lim_{x \rightarrow \infty} \left(4 + \frac{3}{x}\right)$
- 23.  $\lim_{x \rightarrow -\infty} \frac{5x^2}{x + 3}$
- 24.  $\lim_{x \rightarrow -\infty} \left(\frac{1}{2}x - \frac{4}{x^2}\right)$
- 25.  $\lim_{x \rightarrow -\infty} \frac{x}{\sqrt{x^2 - x}}$
- 26.  $\lim_{x \rightarrow -\infty} \frac{x}{\sqrt{x^2 + 1}}$
- 27.  $\lim_{x \rightarrow -\infty} \frac{2x + 1}{\sqrt{x^2 - x}}$
- 28.  $\lim_{x \rightarrow -\infty} \frac{-3x + 1}{\sqrt{x^2 + x}}$
- 29.  $\lim_{x \rightarrow \infty} \frac{\sin 2x}{x} = \frac{0}{\infty}$
- 30.  $\lim_{x \rightarrow \infty} \frac{x - \cos x}{x}$
- 31.  $\lim_{x \rightarrow \infty} \frac{1}{2x + \sin x}$
- 32.  $\lim_{x \rightarrow \infty} \cos \frac{1}{x}$

**Graphical Analysis** In Exercises 33 and 34, use a graphing utility to graph the function and verify that it has two horizontal asymptotes.

- 33.  $f(x) = \frac{|x|}{x + 1}$
- 34.  $f(x) = \frac{3x}{\sqrt{x^2 + 2}}$