(c) $-1 \le \dfrac{3x^2 - 1}{2x^2 + 1} \le 1.5$

$0 \le 1 + \dfrac{3x^2 - 1}{2x^2 + 1} \le 2.5$

$0 \le 2x^2 + 1 + 3x^2 - 1 \le 5x^2 + 2.5$

$0 \le 5x^2 \le 5x^2 + 2.5$

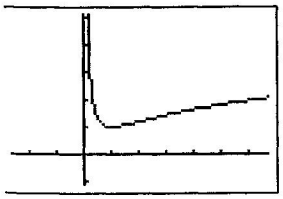
True for all x.

Section 1.3 Twelve Basic Functions

Exploration 1

1. The graphs of $f(x) = \dfrac{1}{x}$ and $f(x) = \ln x$ have vertical asymptotes at $x = 0$.

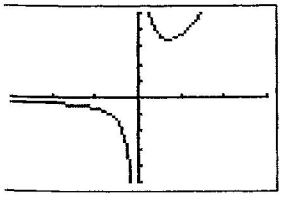
2. The graph of $g(x) = \dfrac{1}{x} + \ln x$ (shown below) does have a vertical asymptote at $x = 0$.



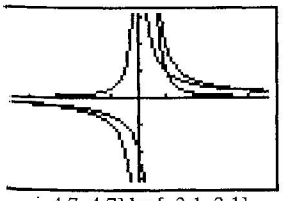
[−2.7, 6.7] by [−1.1, 5.1]

3. The graphs of $f(x) = \dfrac{1}{x}$, $f(x) = e^x$, and $f(x) = \dfrac{1}{1 + e^{-x}}$ have horizontal asymptotes at $y = 0$.

4. The graph of $g(x) = \dfrac{1}{x} + e^x$ (shown below) does have a horizontal asymptote at $y = 0$.



[−3, 3] by [−5, 5]

5. 

[−4.7, 4.7] by [−3.1, 3.1]

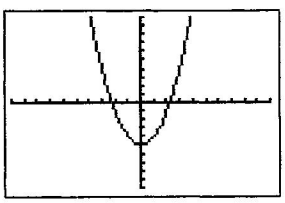
Both $f(x) = \dfrac{1}{x}$ and $g(x) = \dfrac{1}{2x^2 - x} = \dfrac{1}{x(2x - 1)}$ have vertical asymptotes at $x = 0$, but $h(x) = f(x) + g(x)$ does not; it has a removable discontinuity.

Review 1.3

1. 24
2. $1 - \pi$
3. $1 - \pi$
4. 3
5. 3
6. 3
7. 3
8. −15
9. −4
10. $|1 - \pi| - \pi = (\pi - 1) - \pi = \pi - 1 - \pi = -1$

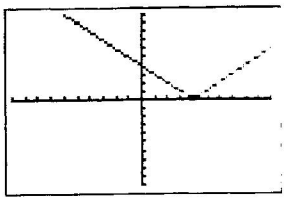
Section 1.3 Exercises

1. $y = x^3 + 1$; (e)
2. $y = |x| - 2$; (g)
3. $y = -\sqrt{x}$; (j)
4. $y = -\sin x$ or $y = \sin(-x)$; (a)
5. $y = -x$; (i)
6. $y = (x - 1)^2$; (f)
7. $y = \text{int}(x + 1)$; (k)
8. $y = -\dfrac{1}{x}$; (h)
9. $y = (x + 2)^3$; (d)
10. $y = e^x - 2$; (c)
11. $2 - \dfrac{4}{1 + e^{-x}}$; (l)
12. $y = \cos x + 1$; (b)
13. Exercise 8
14. Exercise 3
15. Exercises 7, 8
16. Exercise 7 (Remember that a continuous function is one that is continuous at every point *in its domain.*)
17. Exercises 2, 4, 6, 10, 11, 12
18. Exercises 3, 4, 11, 12
19. $y = x$, $y = x^3$, $y = \dfrac{1}{x}$, $y = \sin x$
20. $y = x$, $y = x^3$, $y = \sqrt{x}$, $y = e^x$, $y = \ln x$, $y = \dfrac{1}{1 - e^{-x}}$
21. $y = x^2$, $y = \dfrac{1}{x}$, $y = |x|$
22. $y = \sin x$, $y = \cos x$, $y = \text{int}(x)$
23. $y = \dfrac{1}{x}$, $y = e^x$, $y = \dfrac{1}{1 + e^{-x}}$
24. $y = x$, $y = x^3$, $y = \ln x$
25. $y = \dfrac{1}{x}$, $y = \sin x$, $y = \cos x$, $y = \dfrac{1}{1 + e^{-x}}$
26. $y = x$, $y = x^3$, $y = \text{int}(x)$
27. $y = x$, $y = x^3$, $y = \dfrac{1}{x}$, $y = \sin x$
28. $y = \sin x$, $y = \cos x$
29. Domain: all reals
Range: $[-5, \infty)$



[−10, 10] by [−10, 10]

30. Domain: all reals
Range: $[0, \infty)$



[−10, 10] by [−10, 10]