pp. 363-364 (#3-14, 16-30, and 32)

3. inverse variation
4. inverse variation
5. direct variation
6. direct variation
7. neither
8. neither
9. direct variation
10. inverse variation
11. direct variation
12. direct variation
13. inverse variation
14. neither
16. $y = \frac{9}{x}; y = 3$
17. $y = -\frac{24}{x}; y = -8$
18. $y = \frac{14}{x}; y = \frac{14}{3}$
19. $y = \frac{21}{x}; y = 7$
20. $y = \frac{5}{x}; y = \frac{5}{3}$
21. $y = \frac{2}{x}; y = \frac{2}{3}$
22. $y = -\frac{35}{3x}; y = -\frac{35}{9}$
23. The equation for direct variation was used; Because $5 = \frac{a}{8}$, $a = 40$. So, $y = \frac{40}{x}$.
24. The value of a was substituted into the direct variation equation; $y = \frac{10}{x}$

25. a.

Size	2	2.5	3	5
Number of songs	5000	4000	3333	2000

b. The number of songs decreases.

26. $P = \frac{154.8}{A}$; 2.58 lb/in.^{2}

27. $A = \frac{26{,}000}{c}$; about 321 chips per wafer

28. direct variation; The points lie on a line.

29. yes; The product of the number of hats and the price per hat is \$50, which is constant.

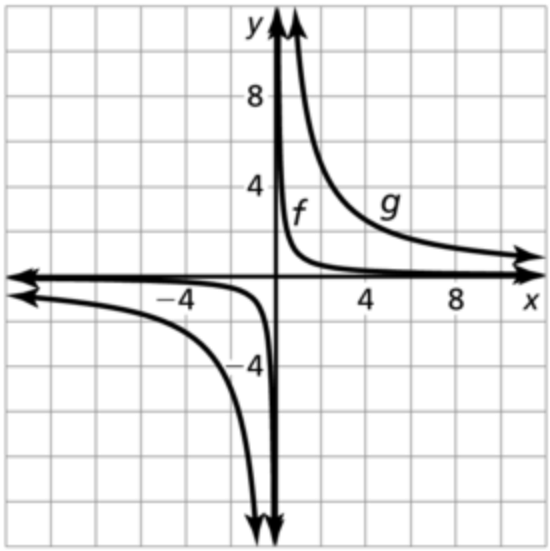
30. about 190.4 lb

32. x varies directly with z; $xy = a$, so $y = \frac{a}{x}$; $yz = b$, so $y = \frac{b}{z}$; $\frac{a}{x} = \frac{b}{z}$, $az = bx$, $x = \frac{a}{b}z$

pp. 370-371 (#2-32 evens)

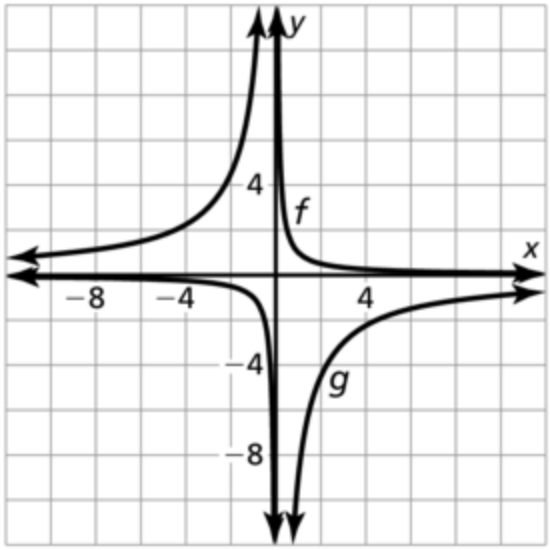
2. no; The denominator is not a polynomial.

4.



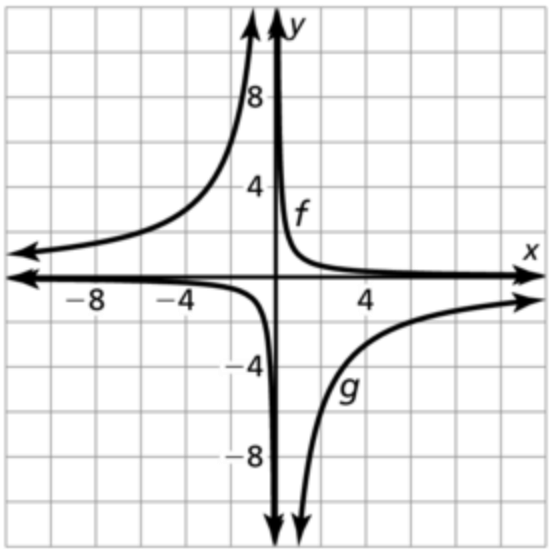
The graph of g lies farther from the axes. Both graphs lie in the first and third quadrants and have the same asymptotes, domain, and range.

6.



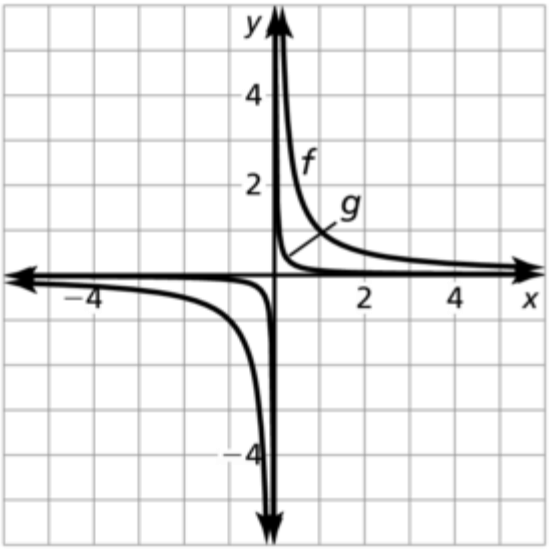
The graph of g lies farther from the axes and is reflected over the x-axis. Both graphs have the same asymptotes, domain, and range.

8.



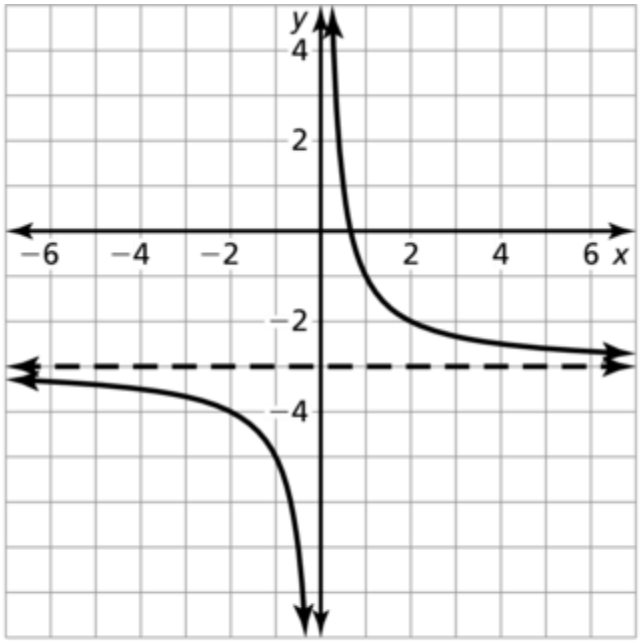
The graph of g lies farther from the axes and is reflected over the x-axis. Both graphs have the same asymptotes, domain, and range.

10.



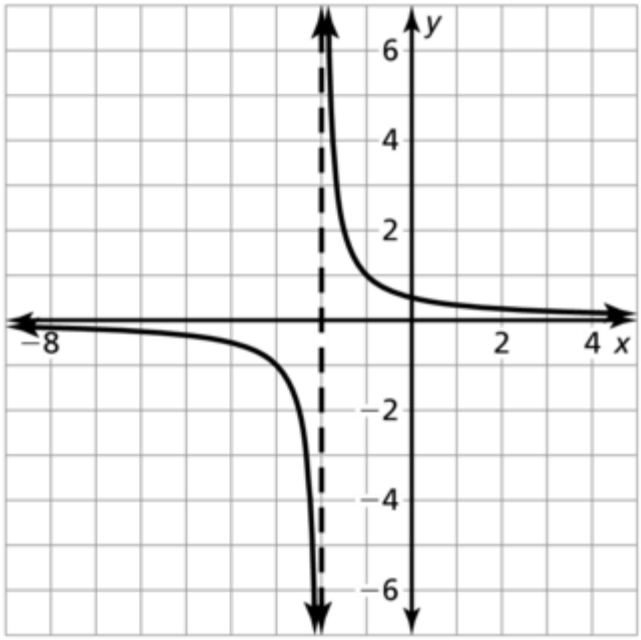
The graph of g lies closer to the axes. Both graphs lie in the first and third quadrants and have the same asymptotes, domain, and range.

12.



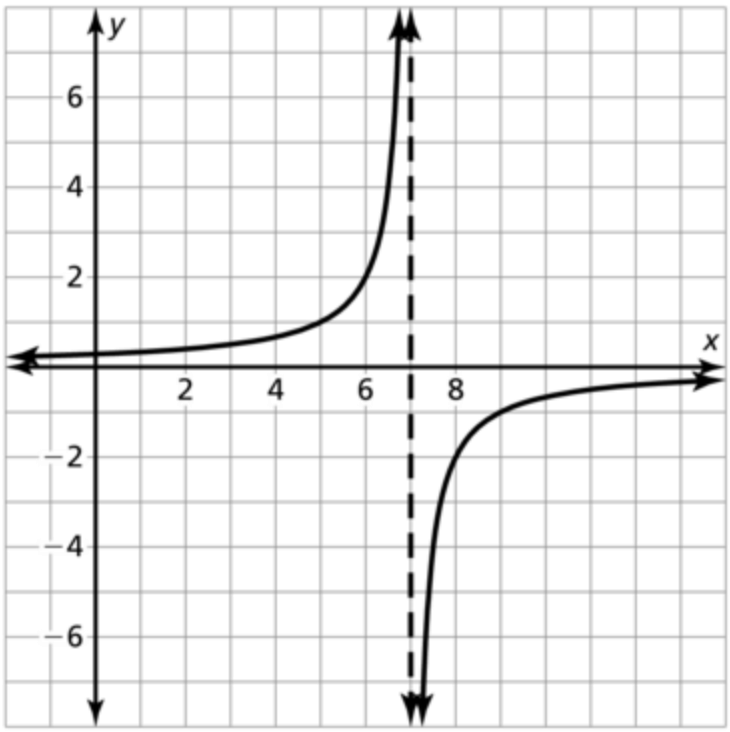
domain: all real numbers except 0; range: all real numbers except -3

14.



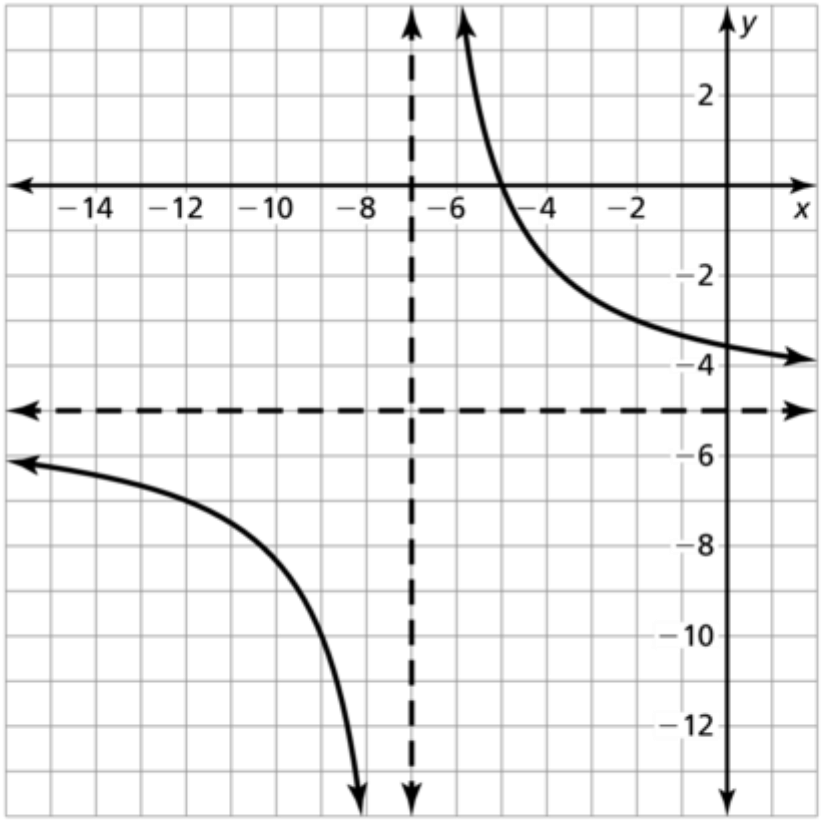
domain: all real numbers except -2; range: all real numbers except 0

16.



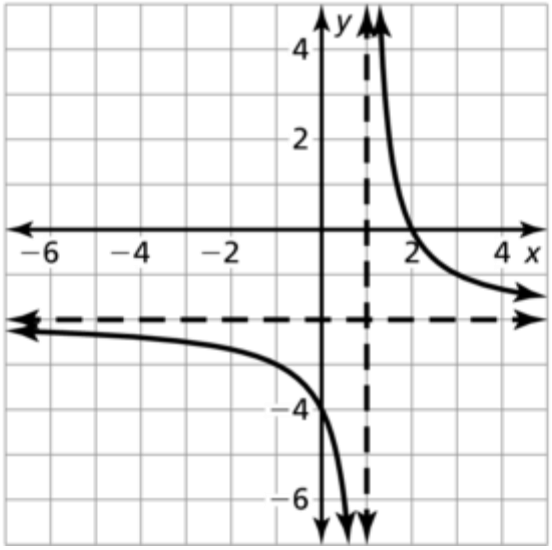
domain: all real numbers except 7; range: all real numbers except 0

18.



domain: all real numbers except -7; range: all real numbers except -5

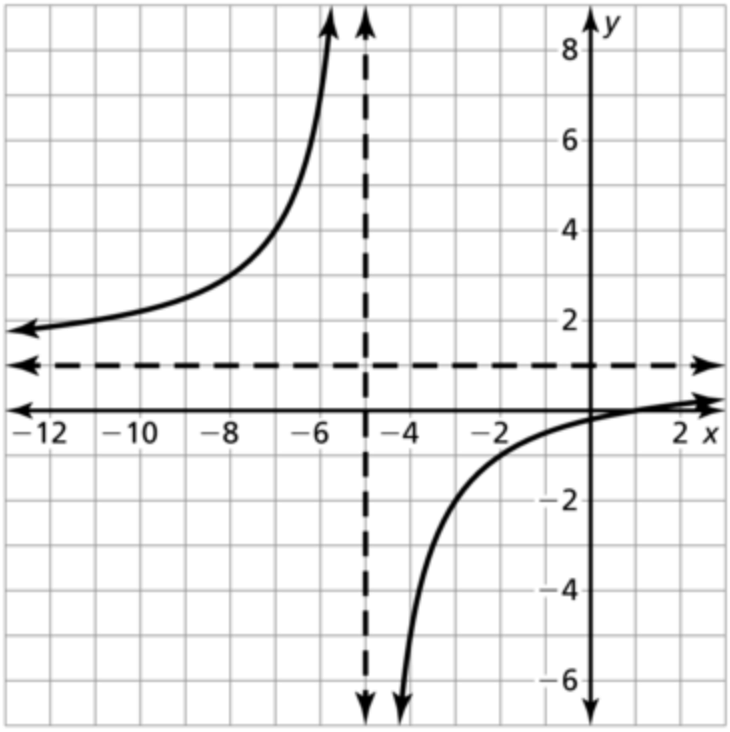
20. The vertical asymptote should be $x = 1$;



22. C; The asymptotes are $x = -3$ and $y = 1$.

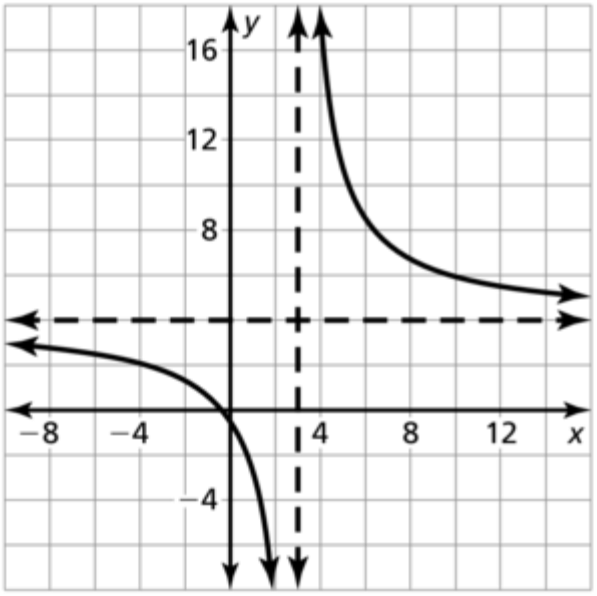
24. D; The asymptotes are $x = -3$ and $y = -1$.

26.



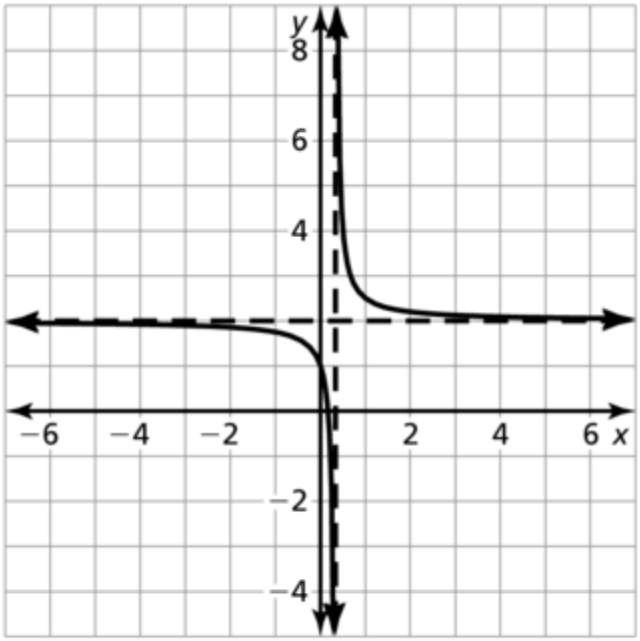
domain: all real numbers except -5; range: all real numbers except 1

28.



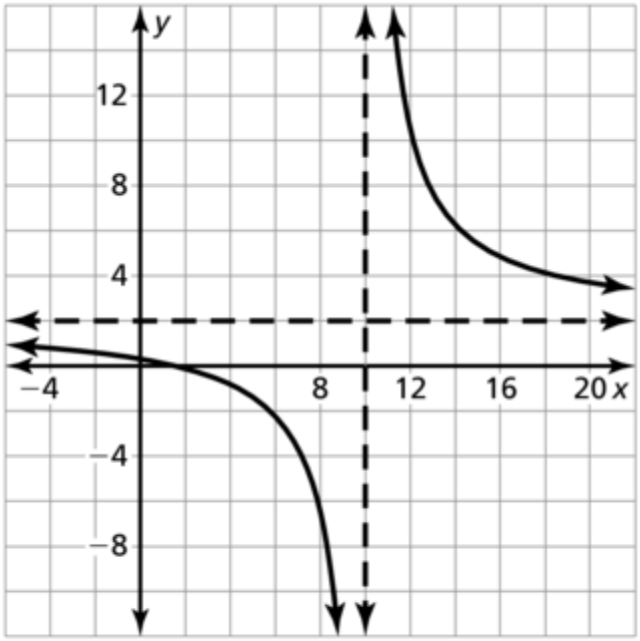
domain: all real numbers except 3; range: all real numbers except 4

30.



domain: all real numbers except $\frac{1}{3}$; range: all real numbers except 2

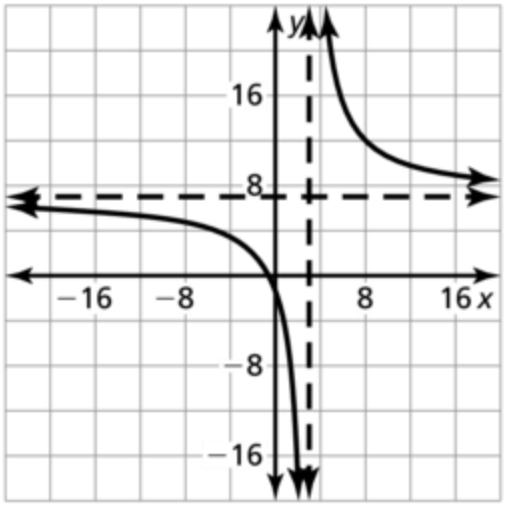
32.



domain: all real numbers except 10; range: all real numbers except 2

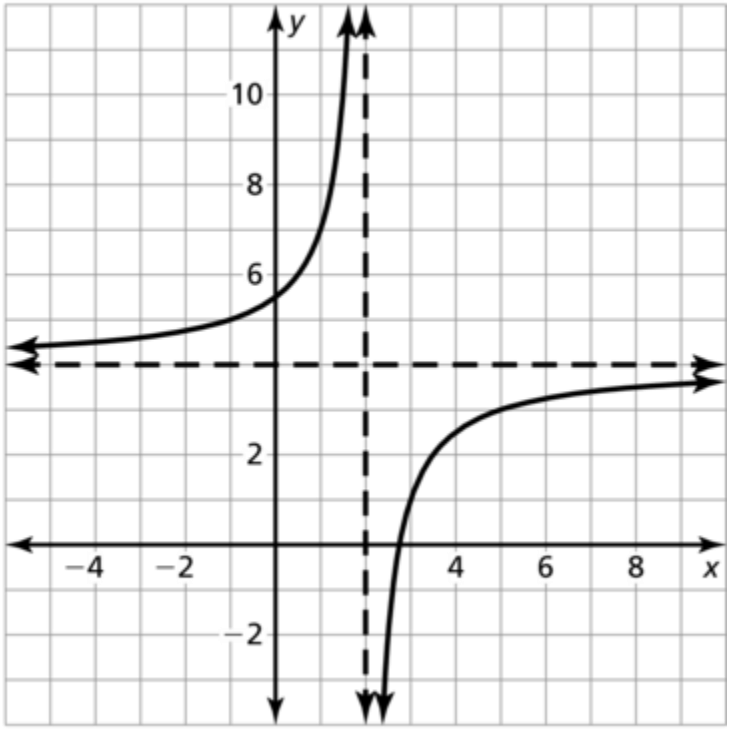
pp. 371-372 (#34-42 evens, #43-58 all)

34. $g(x) = \dfrac{25}{x - 3} + 7$



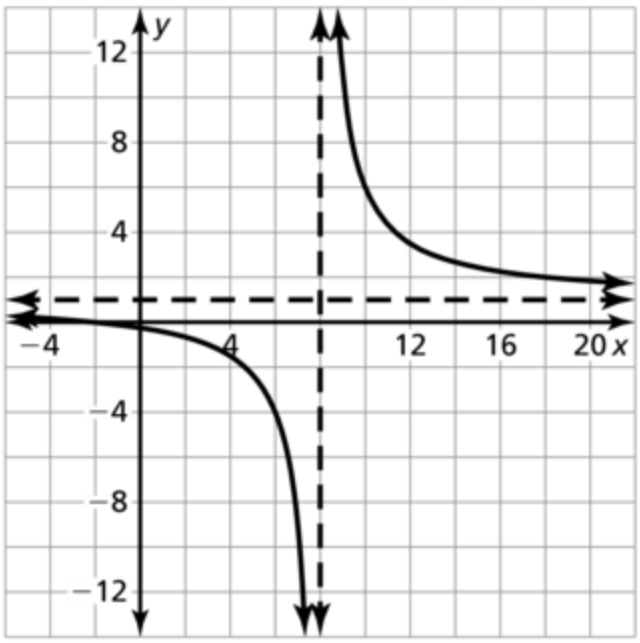
translation 3 units right and 7 units up

36. $g(x) = \dfrac{-3}{x - 2} + 4$



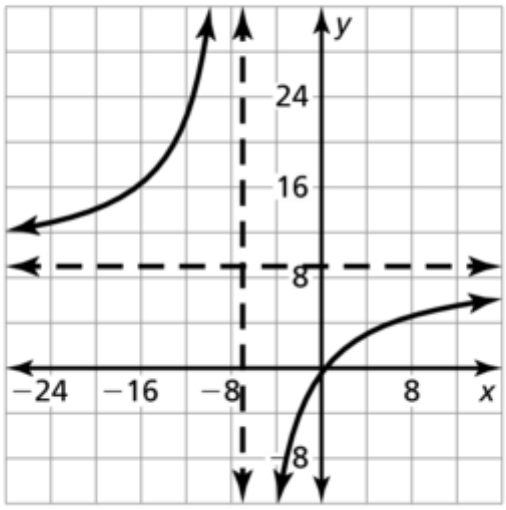
translation 2 units right and 4 units up

38. $g(x) = \dfrac{10}{x - 8} + 1$



translation 8 units right and 1 unit up

40. $g(x) = \dfrac{-66}{x + 7} + 9$



translation 7 units left and 9 units up

42. **a.** 10 months

b. The average cost approaches \$59.

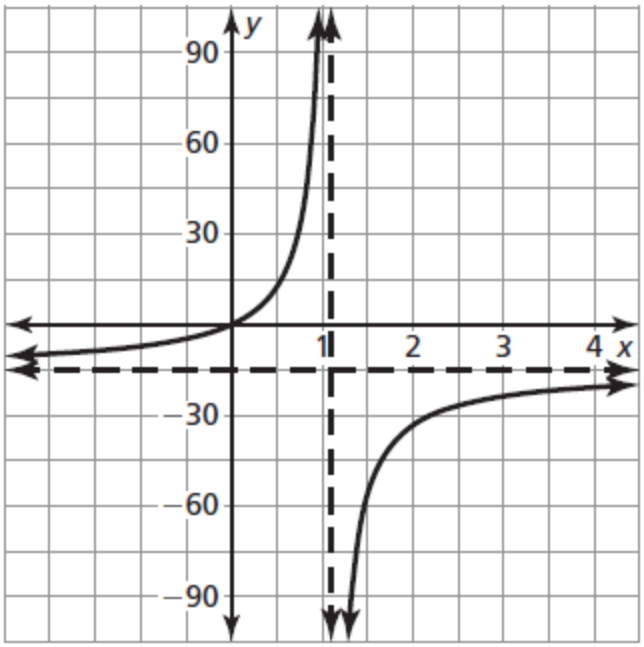
43. **B**

44. B

45. **a.** about 23°C

b. −0.005 sec/°C

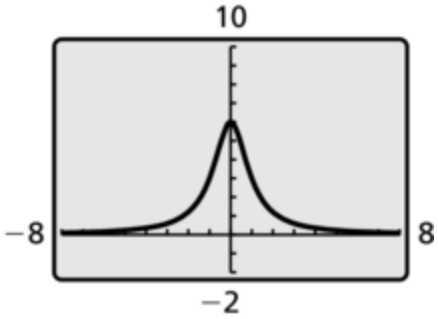
46. a.



Sample answer: domain: $0 < x < 1$; range: $0 < y < 150$

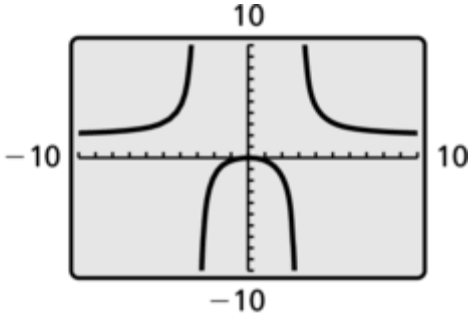
b. about \$3333; about \$8571; \$40,000; no; Doubling the percentage does not double the cost because this is not a linear function.

47.



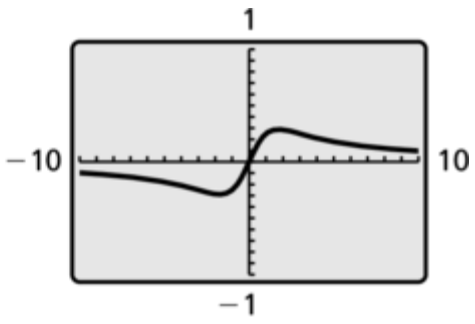
even

48.



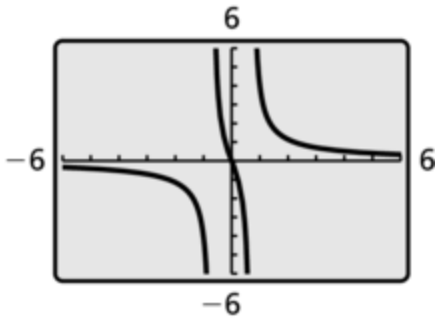
even

49.



odd

50.



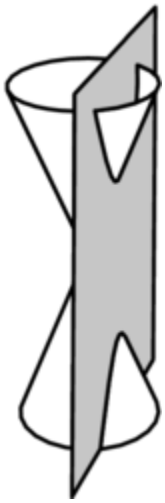
odd

51. yes; A rational function can have more than one vertical asymptote when the denominator is zero for more than one value of x, such as $y = \dfrac{3}{(x + 1)(x - 1)}$.

52. $x = -3$, $y = 2$; As x approaches -3, y approaches $\pm\infty$. As x approaches $\pm\infty$, y approaches 2.

53. $y = x$, $y = -x$; The function and its inverse are the same.

54.



55. (4, 3); The point (2, 1) is one unit left and one unit down from (3, 2), so a point on the other branch is one unit right and one unit up from (3, 2).

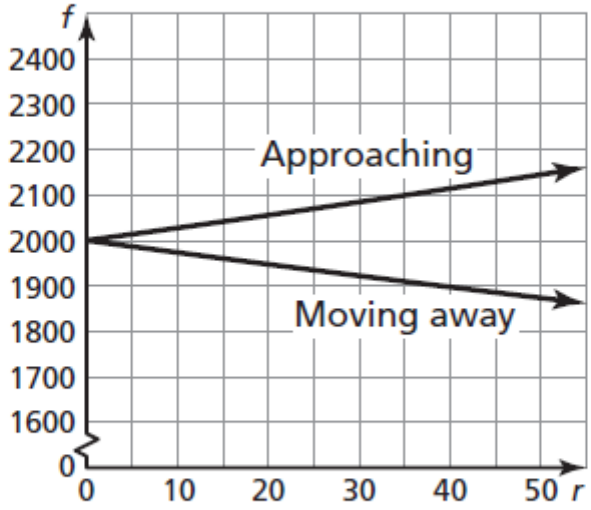
56. **a.** decreasing: $(-\infty, 0), (0, \infty)$; The graph falls from left to right.

b. increasing: $(-\infty, 0), (0, \infty)$; The graph rises from left to right.

57. The competitor is a better choice for less than 18 months of service; The cost of Internet service is modeled by $C = \frac{50 + 43x}{x}$. The competitor's cost is lesser when $x = 6$ and $x = 12$, and greater when $x = 18$ and $x = 24$.

58. **a.** $f_\ell = \frac{740(2000)}{740 - r}, f_\ell = \frac{740(2000)}{740 + r}$

b.



c. The frequency heard is greater for an approaching sound source.

pp. 380-381 (#4-26 evens)

4. $\frac{7x - 1}{2x}$

6. simplified form

8. $\frac{x - 4}{x^2 + 3x + 9}, x \neq 3$

10. $\frac{x - 1}{3(3x^2 - 7)}$

12. $\frac{8x^4}{y^2}, x \neq 0$

14. $\frac{(x + 5)(x + 8)}{3}, x \neq 0, x \neq 9$

16. $\frac{(x - 4)(x + 4)}{2}, x \neq 0, x \neq 1$

18. $\frac{(x - 3)(x + 1)}{2x^2(x + 3)}, x \neq -2$

20. $(x + 3)(x - 2), x \neq -4, x \neq 4$

22. The expression $3 - x$ should be factored into $-(x - 3)$ before dividing out the common factor; $-(x - 5)$ or $5 - x$, $x \neq 3, x \neq -5$

24. $\frac{y^5}{x^3}$; *Sample answer:* Multiplying the numerators and denominators before simplifying was faster because you only have to simplify the expression once.

26. $\frac{(x + 2)(x - 2)}{2(x + 4)}; x \neq 2, x \neq 5$

pp. 381-382 (#28-36 evens, 37-47 all)

28. $\frac{2}{3y^3}, x \neq 0, z \neq 0$

30. $3, x \neq 0, x \neq 1, x \neq 6$

32. $\frac{(x+4)}{(x+2)(x-9)}$

34. $\frac{(x-8)(x+2)}{(x-2)(x+8)}, x \neq -10, x \neq -5, x \neq -2$

36. **a.** original tin: $\frac{2s+4h}{hs}$, new tin: $\frac{s+4h}{hs}$

b. yes; The efficiency ratio of the new tin is smaller than the original tin.

37. $M = \frac{171{,}000t + 1{,}361{,}000}{(1+0.018t)(2.96t+278.649)}$; \$8443

38. $M = \frac{17{,}913t + 709{,}569}{(1-0.028t)(0.5906t+70.219)}$; \$14,665

39. **a.** The population is increasing by 2,960,000 people each year.

b. The population was 278,649,000 people in 2000.

40. $h(x)$: $x \neq 1$, $k(x)$: $x \neq -4, x \neq 1$; The value $x = 1$ is not in the domain of f. Because $y = 0$ when $x = -4$ in the graph of g, $x = -4$ is not in the domain of $\frac{1}{g}$.

41.

x	y
-3.5	-0.1333
-3.8	-0.1282
-3.9	-0.1266
-4.1	-0.1235
-4.2	-0.1220

The graph does not have a value for y when $x = -4$ and approaches $y = -0.125$.

42. You are correct; The values -9 and 5 make the denominator equal to zero in the original expression, so both values are not in the domain.

43. $\frac{4}{7x}$

44. $x - 5$

45. $9(x + 3), x \neq -\frac{3}{2}, x \neq \frac{5}{2}, x \neq 7$

46. $x - 6, x \neq -2, x \neq 2, x \neq 6$

47. Galapagos: about 0.371, King: about 0.203; King; The King penguin has a smaller surface area to volume ratio, so it is better equipped to live in a colder environment.

p. 388 (#2-26 evens, 27-30 all)

2. Both expressions require a common denominator before adding or subtracting the numerators.

4. $\frac{x-4}{16x^2}$

6. $\frac{3x(x+2)}{x-8}$

8. $2x+1, x \neq \frac{1}{2}$

10. $4x^2(x+3)$

12. $24x^2(x-2)$

14. $(3x+4)(3x-4)(x-1)$

16. $(x-9)(x+7)$

18. The LCM is $(x+2)(x-5)$, so multiply x by $x-5$ and 4 by $x+2$; $\frac{x^2-x+8}{(x+2)(x-5)}$

20. $\frac{15x+32}{12x^2}$

22. $\frac{2x^2+3x+9}{(x-3)(x+1)}$

24. $\frac{-x+1}{(x+7)(x-2)}$

26. $\frac{-x^3-3x^2-x-51}{(x+5)(x-5)(x+3)}$

27. sometimes; When the denominators have no common factors, the product of the denominators is the LCD. When the denominators have common factors, use the LCM to find the LCD.

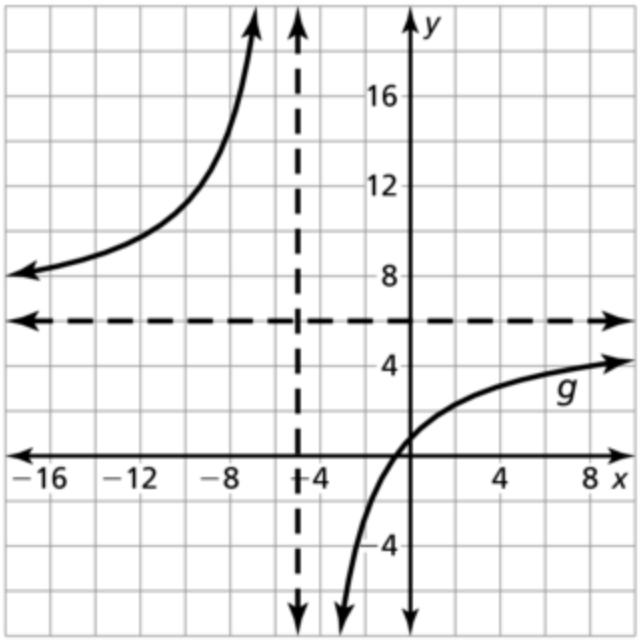
28. always; The LCD is the product of the highest power of each factor that appears in any of the denominators.

29. A

30. B

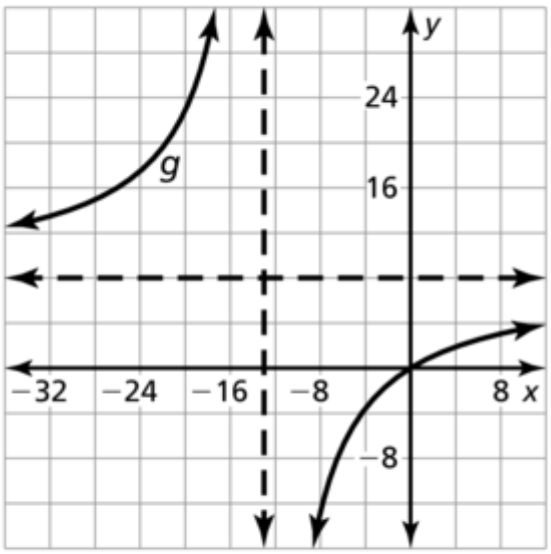
pp. 389-390 (#32-44 evens, 45-52, 55, and 57)

32. $g(x) = \dfrac{-26}{x + 5} + 6$



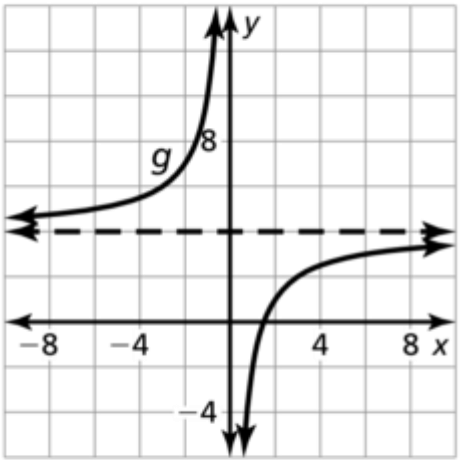
The graph of g is a translation 5 units left and 6 units up of the graph of $f(x) = \dfrac{-26}{x}$.

34. $g(x) = \dfrac{-104}{x + 13} + 8$



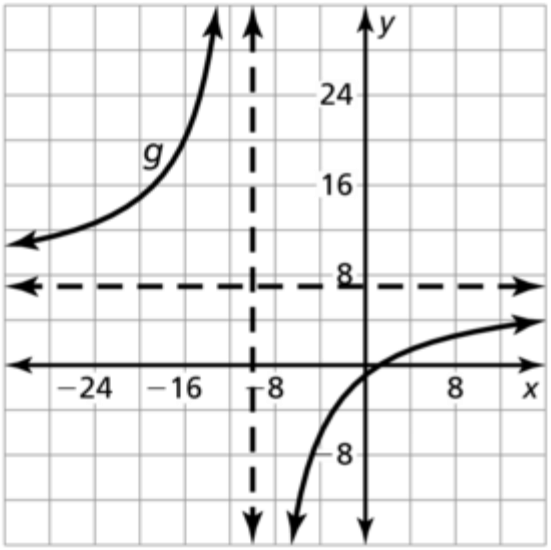
The graph of g is a translation 13 units left and 8 units up of the graph of $f(x) = \dfrac{-104}{x}$.

36. $g(x) = \dfrac{-6}{x} + 4$



The graph of g is a translation 4 units up of the graph of $f(x) = \dfrac{-6}{x}$.

38. $g(x) = \dfrac{-79}{x + 10} + 7$



The graph of g is a translation 10 units left and 7 units up of the graph of $f(x) = \dfrac{-79}{x}$.

40. $\dfrac{5(15x - 2)}{x(x + 20)}$

42. $\dfrac{8x(x + 1)}{(5x + 3)(x - 2)}, x \neq -1, x \neq 0$

44. $\dfrac{3x}{4(x - 1)}, x \neq -2, x \neq 2$

45. $T = \dfrac{2ad}{(a + j)(a - j)}$; about 10.2 h

46. $R_t = \dfrac{R_1 R_2}{R_2 + R_1}, R_1 \neq 0, R_2 \neq 0$; about 1474 ohms

47. $y = \dfrac{20(7x + 60)}{x(x + 30)}$

48. **a.** $t = \dfrac{119.5r + 147.5}{15r(r + 5)}$

b. 1 h 50 min; When $r = 2$, the value of $t \approx 1.84$.

49. no; The LCM of 2 and 4 is 4, which is greater than one number and equal to the other number.

50. $h = -1, k = -4$

51. a. $M = \dfrac{Pi}{1 - \left(\dfrac{1}{1+i}\right)^{12t}}$

$= \dfrac{Pi}{1 - \dfrac{1}{(1+i)^{12t}}} \cdot \dfrac{(1+i)^{12t}}{(1+i)^{12t}}$

$= \dfrac{Pi(1+i)^{12t}}{(1+i)^{12t} - 1}$

b. \$364.02

52. yes; *Sample answer:* $\dfrac{x^3 - 1}{x} + \dfrac{1}{x} = x^2, x \neq 0$

55. a. $R_1 = \dfrac{1}{40}, R_2 = \dfrac{1}{x}, R_3 = \dfrac{1}{x + 10}$

b. $R = \dfrac{x^2 + 90x + 400}{40x(x + 10)}$

c. about 0.0758 car/min; about 4.5 cars/h; Multiply the number of cars washed per minute by the rate 60 min/h to obtain an answer in cars per hour.

57. $1 + \dfrac{1}{2 + \dfrac{1}{2 + \dfrac{1}{2 + \dfrac{1}{2 + \frac{1}{2}}}}}, 1 + \dfrac{1}{2 + \dfrac{1}{2 + \dfrac{1}{2 + \dfrac{1}{2 + \dfrac{1}{2 + \frac{1}{2}}}}}}$;

1.4, about 1.4167, about 1.4138, about 1.4143, about 1.4142; $\sqrt{2}$

pp. 396-397 (#2-32 evens)

2. yes; When $x = 3$ is substituted into the original equation, the denominators are zero.

4. $x = 6$

6. $x = 2$

8. $x = 2, x = 5$

10. $x = -\frac{3}{2}, x = 5$

12. 15 hits

14. about 0.07 L

16. $x(x - 1)$

18. $3(x + 9)(2x - 1)$

20. $x = 4$

22. $x = 1$

24. $x = -\frac{5}{2}, x = 8$

26. no solution

28. $x = 0, x = 7$

30. $x = \frac{-1 \pm \sqrt{79}}{3}$

32. Each term of the equation should be multiplied by the LCD;

$$(2x + 5)(3x) \cdot \frac{(7x + 1)}{2x + 5} + (2x + 5)(3x) \cdot 4$$

$$= \frac{10x - 3}{3x}(2x + 5)(3x)$$

pp. 397-398 (#33-36, 38-44 evens, 45-57)

33. a.

	Work rate	Time	Work done
You	$\frac{1 \text{ room}}{8 \text{ hours}}$	5 hours	$\frac{5}{8}$ room
Friend	$\frac{1 \text{ room}}{t \text{ hours}}$	5 hours	$\frac{5}{t}$ room

b. The sum is the amount of time it would take for you and your friend to paint the room together; $\frac{5}{8} + \frac{5}{t} = 1$,

$t = 13.\overline{3}$ h $= 13$ h 20 min

34. a.

	Work rate	Time	Work done
You	$\frac{1 \text{ park}}{2 \text{ hours}}$	1.2 hours	0.6 park
Friend	$\frac{1 \text{ park}}{t \text{ hours}}$	1.2 hours	$\frac{1.2}{t}$ park

b. The sum is the amount of time it would take for you and your friend to clean the park together; $0.6 + \frac{1.2}{t} = 1$,

$t = 3$ h

35. *Sample answer:* $\frac{x+1}{x+2} = \frac{3}{x+4}$, Cross multiplication can be used when each side of the equation is a single rational expression; *Sample answer:* $\frac{x+1}{x+2} + \frac{3}{x+4} = \frac{1}{x+3}$;

Multiplying by the LCD can be used when there is more than one rational expression on one side of the equation.

36. *Sample answer:* A rational equation can be used to determine how long it would take you and your friend working together to clean a park.

38. yes; $y = \frac{7}{x} - 6$

40. yes; $y = \frac{5}{x + 6}$

42. yes; $y = \frac{8}{5x} - \frac{9}{5}$

44. no; $y = \pm\sqrt[4]{\frac{1}{x + 7}}$

45. **a.** about 21 mi/gal

b. about 21 mi/gal

46. **a.** about 190.6 ft

b. about 190.6 ft

47. $x \approx \pm 0.8165$

48. $x \approx \pm 0.7746$

49. $x \approx 1.3247$

50. $x \approx 1.2599$

51. $\frac{1 + \sqrt{5}}{2}$

52. $x = -3$; The graphs intersect at $x = -3$.

53. $g(x) = \frac{4x + 1}{x - 3}$

54. $g(x) = \frac{-3x - 7}{2x - 4}$

55. $y = \frac{b - xd}{xc - a}$

56. **a.** yes; *Sample answer:* $\frac{1}{x} = \frac{1}{x + 1}$

b. yes; *Sample answer:* See Example 2.

c. yes; *Sample answer:* See Example 3(b).

d. yes; *Sample answer:* $\frac{1}{x + 1} = \frac{3}{3x + 3}$

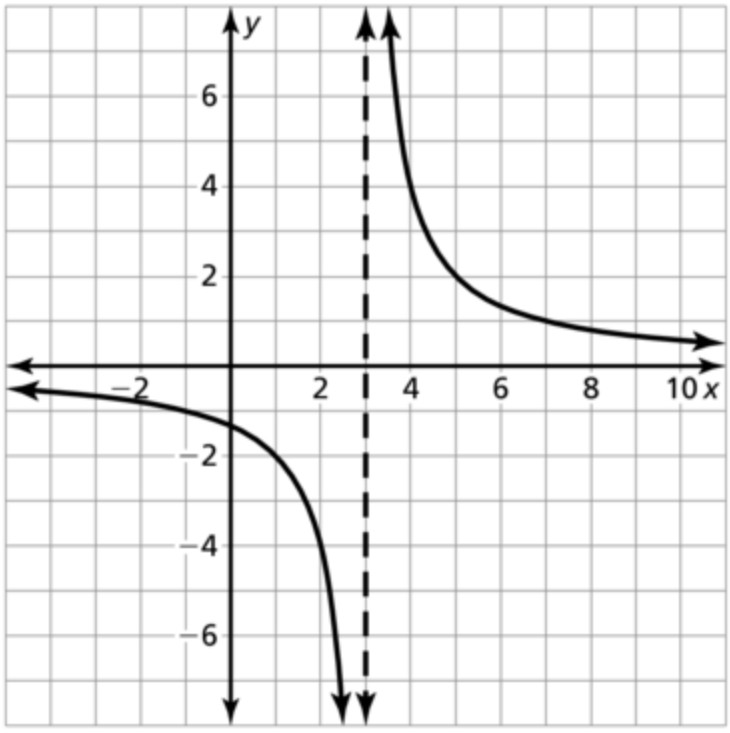
57. **a.** always true; When $x = a$, the denominators of the fractions are both zero.

b. sometimes true; The equation will have exactly one solution except when $a = 3$.

c. always true; $x = a$ is an extraneous solution, so the equation has no solution.

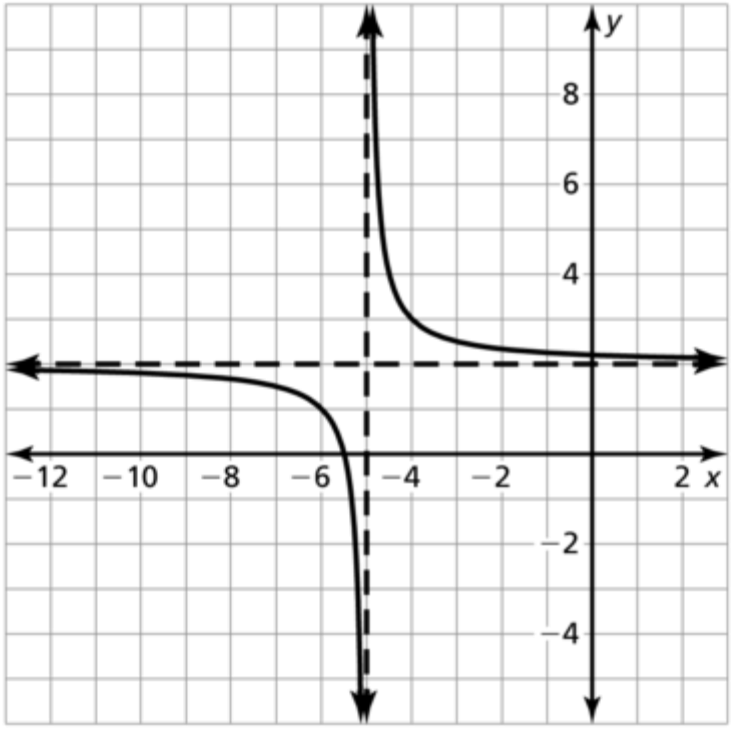
pp. 400-402 (#2-30 evens and #31)

2. direct variation
3. direct variation
4. neither
5. direct variation
6. inverse variation
7. $y = \frac{5}{x}; y = -\frac{5}{3}$
8. $y = \frac{24}{x}; y = -8$
9. $y = \frac{45}{x}; y = -15$
10. $y = \frac{-8}{x}; y = \frac{8}{3}$
11.



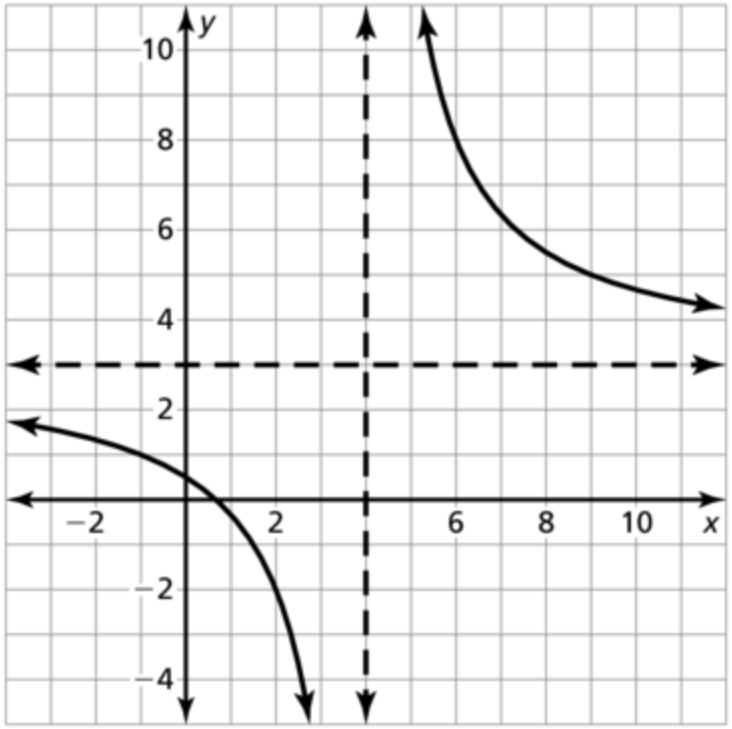
domain: all real numbers except 3; range: all real numbers except 0

12.



domain: all real numbers except -5; range: all real numbers except 2

13.



domain: all real numbers except 4; range: all real numbers except 3

14. $\frac{16x^3}{y^2}, x \neq 0$

15. $\dfrac{3(x+4)}{x+3}, x \neq 3, x \neq 4$

16. $\dfrac{3x(4x-1)}{(x-4)(x-3)}, x \neq 0, x \neq \dfrac{1}{4}$

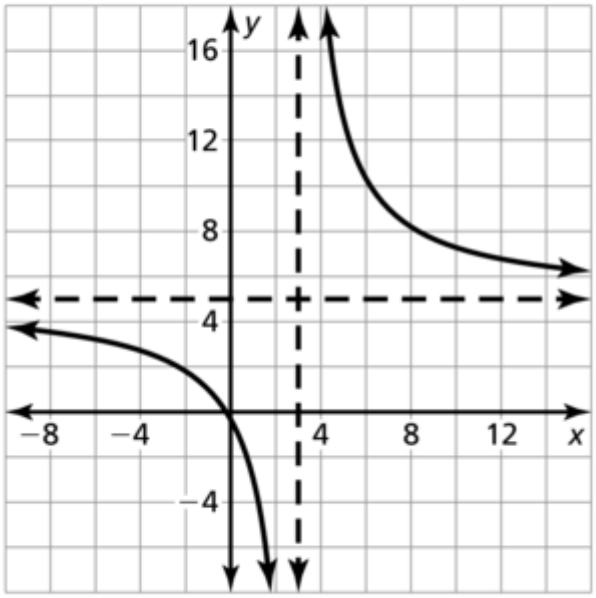
17. $\dfrac{1}{(x+3)^2}, x \neq 5, x \neq 8$

18. $\dfrac{3x^2+26x+36}{6x(x+3)}$

19. $\dfrac{5x^2-11x-9}{(x+8)(x-3)}$

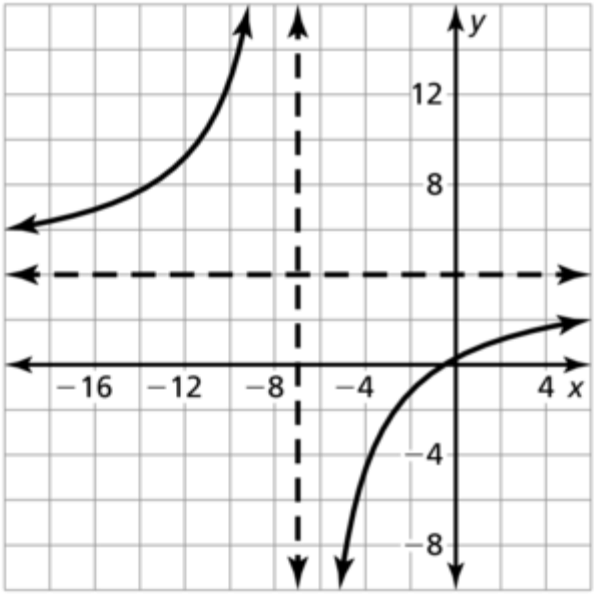
20. $\dfrac{-2(2x^2+3x+3)}{(x-3)(x+3)(x+1)}$

21. $g(x) = \dfrac{16}{x-3} + 5$



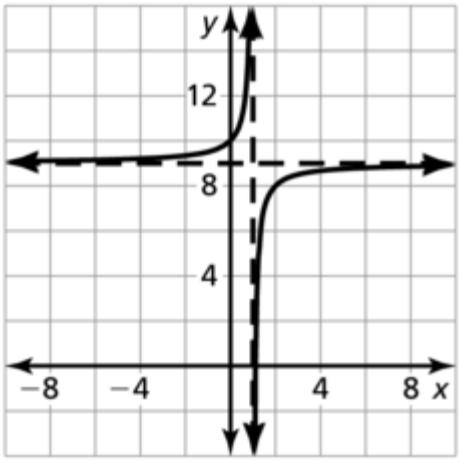
translation 3 units right and 5 units up of the graph of f

22. $g(x) = \dfrac{-26}{x + 7} + 4$



translation 7 units left and 4 units up of the graph of f

23. $g(x) = \dfrac{-1}{x - 1} + 9$



translation 1 unit right and 9 units up of the graph of f

24. $\dfrac{pq}{p + q}, p \neq 0, q \neq 0$

25. $x = 5$

26. $x = 0$

27. no solution

28. yes; $g(x) = \frac{3}{x} - 6$

29. yes; $g(x) = \frac{10}{x} + 7$

30. yes; $g(x) = \frac{1}{x - 8}$

31. **a.** 4 games

b. 4 games