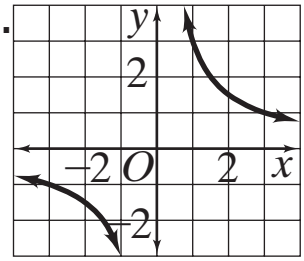
1.



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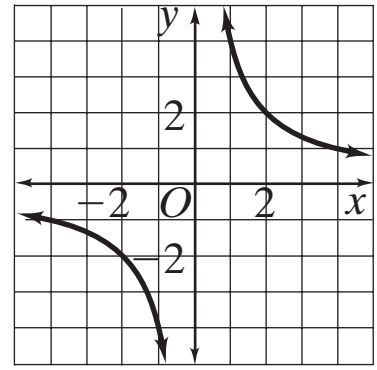

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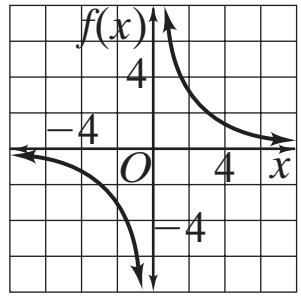

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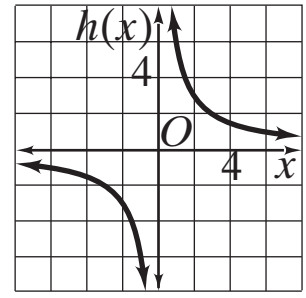
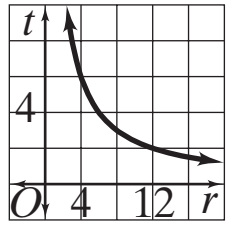


5.



6. 0

7. 2

8. −2

9. 2

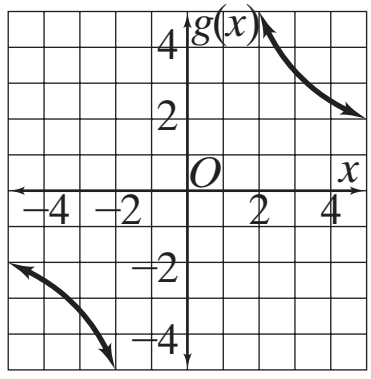
10. $x = 2, y = 0$

11. $x = -1, y = 0$

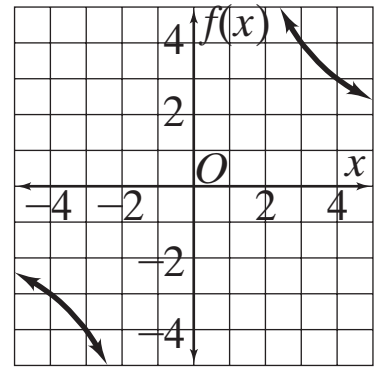
12. $x = 1, y = -1$

13. $x = 0, y = 2$

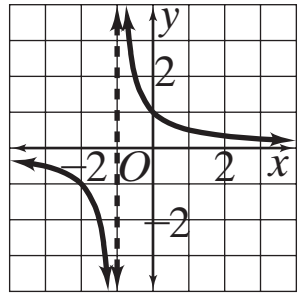
14. $x = 0$;



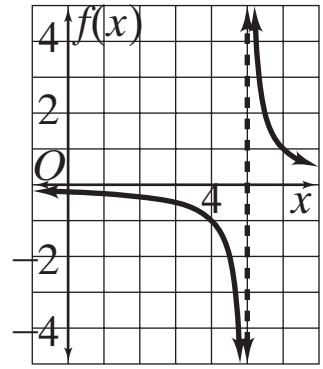
15. $x = 0$;



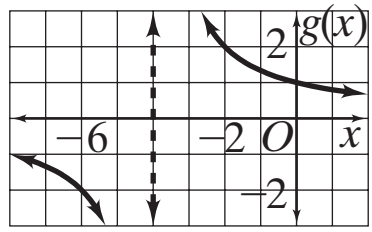
16. $x = -1$;



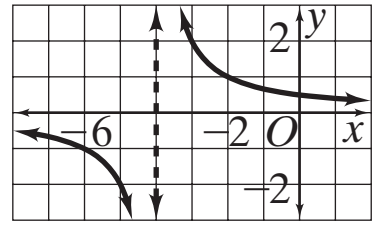
17. $x = 5$;



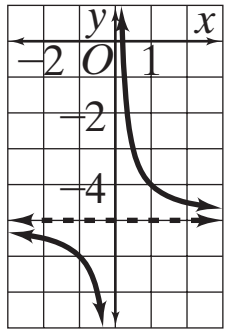
18. $x = -4$;



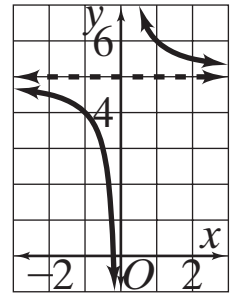
19. $x = -4$;



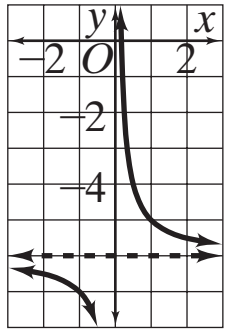
20. $x = 0, y = -5$;



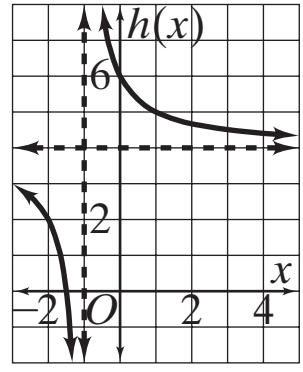
21. $x = 0, y = 5$;



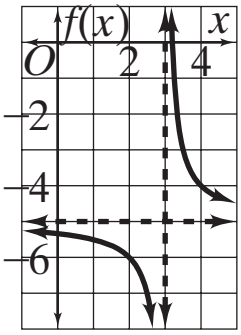
22. $x = 0, y = -6$;



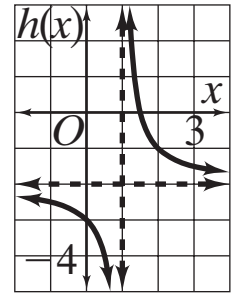
23. $x = -1, y = 4$;



24. $x = 3, y = -5$;



25. $x = 1, y = -2$;



26. line with slope 4, y-int. 1

27. absolute value function with vertex (4, 0)

28. exponential decay

29. line with slope $\frac{1}{4}$, y-int. 0

30. rational function, with asymptotes $x = 0, y = 1$

31. radical function; $y = \sqrt{x}$ shifted right 4, up 1

32. parabola with axis of symmetry $x = 0$

33. rational function with asymptotes $x = -4, y = -1$

34. parabola with axis of symmetry $x = -\frac{1}{4}$

35. moves graph 1 unit to the left

36. moves graph 3 units to the right

37. lowers graph 15 units

38. moves graph 12 units left

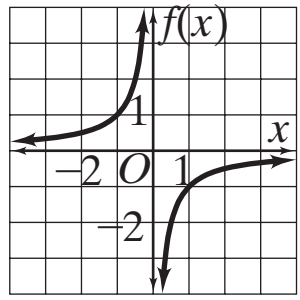
39. moves the graph up 12 units

40. moves the graph left 3 units

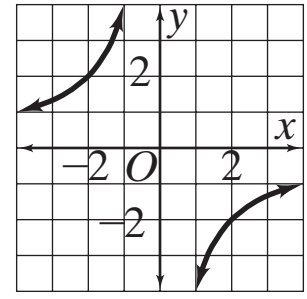
41. moves the graph down 2 units

42. moves the graph 3 units left and 2 units down

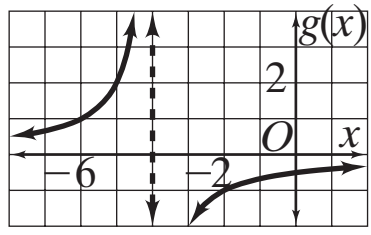
43. $x = 0, y = 0$;



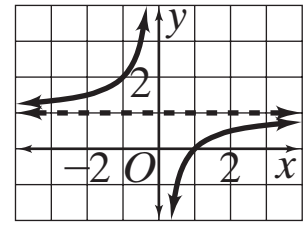
44. $x = 0, y = 0$;



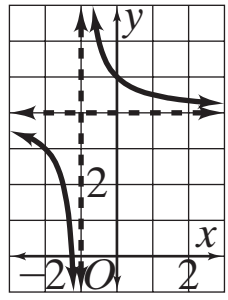
45. $x = -4, y = 0$;



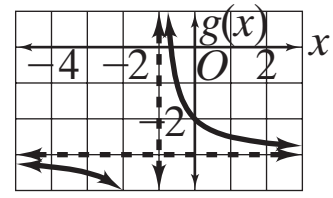
46. $x = 0, y = 1$;



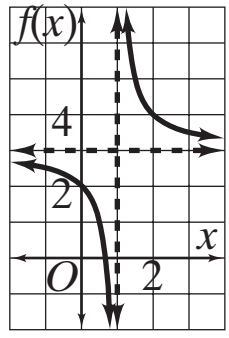
47. $x = -1, y = 4$;



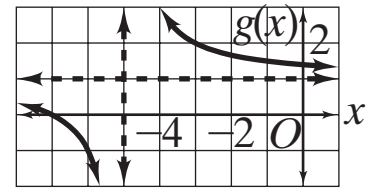
48. $x = -1, y = -3$;



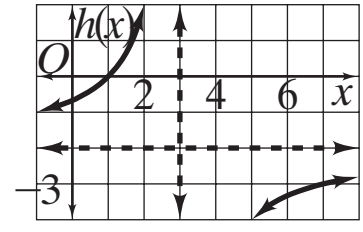
49. $x = 1, y = 3$;



50. $x = -5, y = 1$;



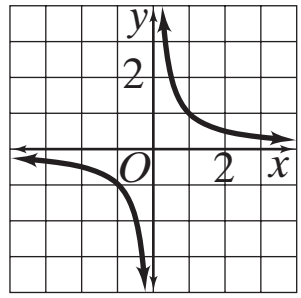
51. $x = 3, y = -2$;

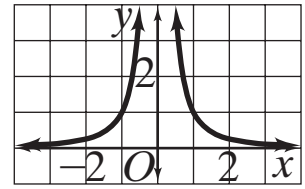


52. Answers may vary. Sample: $f(x) = \frac{1}{x} + 3$, $g(x) = \frac{1}{x}$

53. 17.8 lumens; $1.9\overline{7}$ lumens

54. a.

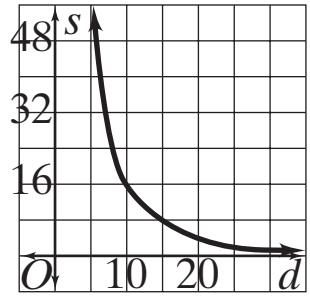




b. $x = 0, y = 0; x = 0, y = 0$

c. y is any real number except 0; $y > 0$.

55. a.



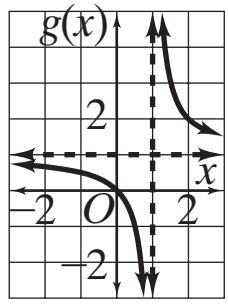
$d \geq 40$

b. 16; 1600; 160,000

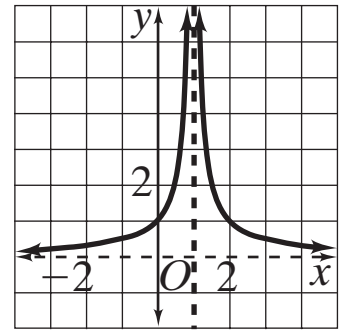
c. The signal is extremely strong when you are in the immediate vicinity of a transmitter and it will interfere with the other station.

56. The graph of $y = \frac{3}{x}$ and $y = -\frac{3}{x}$ are both composed of two curves with asymptotes $x = 0$ and $y = 0$. The graph of $y = -\frac{3}{x}$ is a reflection of the graph of $y = \frac{3}{x}$ over the y-axis.

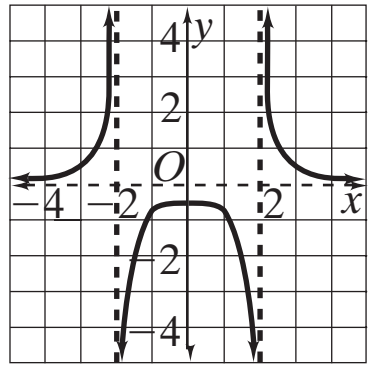
57.



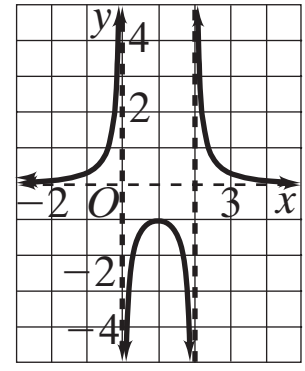
58.



59.



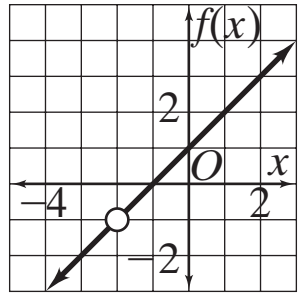
60.

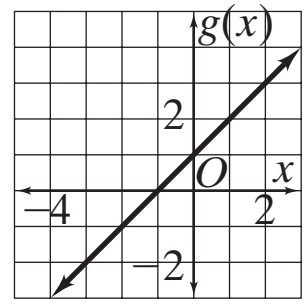


61. **a.** $x = -3, y = -2$

b. $y = \frac{1}{x + 3} - 2$

62.





No; $f(x) = \frac{(x + 2)(x + 1)}{x + 2}$ is equivalent to $g(x) = x + 1$ for all values except $x = -2$.

Answers for Lesson 12-2, pp. 674–675 Exercises

1. $\frac{2a + 3}{4}$ **2.** $\frac{1}{7x}$ **3.** $\frac{1}{3}$

4. $\frac{1}{2}$ **5.** $3x$ **6.** $\frac{x + 2}{x^2}$

7. $\frac{2}{3}$ **8.** $\frac{2}{b + 4}$ **9.** $\frac{1}{m - 7}$

10. $\frac{w}{w - 7}$ **11.** $\frac{a + 1}{5}$ **12.** $\frac{m + 3}{m + 2}$

13. $\frac{c - 4}{c + 3}$ **14.** $b + 3$ **15.** $\frac{1}{m - 2}$

16. -1 **17.** $\frac{-4}{t + 1}$ **18.** -2

19. $-\frac{1}{2}$ **20.** $-\frac{1}{v + 5}$ **21.** $-\frac{1}{w - 4}$

22. 36 min **23.** 13 min **24.** 13 min

25. $\frac{2r - 1}{r + 5}$ **26.** $\frac{7z + 2}{z - 1}$ **27.** $\frac{5t - 4}{3t - 1}$

28. $\frac{4a^2}{2a - 1}$ **29.** $\frac{3(z + 4)}{z^3}$ **30.** $\frac{2s + 1}{s^2}$

31. $-\frac{2a + 1}{a + 3}$ **32.** $\frac{4 + 3m}{m - 7}$ **33.** $\frac{-c(3c + 5)}{5c + 4}$

34. Answers may vary. Sample: $\frac{3}{(x - 2)(x + 3)}$

35. **a.** i. $\frac{2b + 4h}{bh}$ ii. $\frac{2h + 2r}{rh}$

b. $\frac{4}{9}; \frac{4}{9}$

36. The student canceled terms instead of factors.

37. -3 is not in the domain of $\frac{x^2 - 9}{x + 3}$.

38. $\frac{5w}{5w + 6}$ **39.** $\frac{1}{4}$ **40.** $\frac{3y}{4(y + 4)}$

41. $\frac{t + 3}{3(t + 2)}$ **42.** $\frac{m - n}{m + 10n}$ **43.** $\frac{a - 3b}{a + 4b}$

44. $\frac{6v - 7w}{3v - 2w}$ **45.** sometimes **46.** sometimes

47. never

Answers for Lesson 12-3, pp. 679–681 Exercises

1. $\frac{35x}{36}$ **2.** $\frac{12}{t^2}$ **3.** $\frac{40}{3a^5}$

4. $\frac{m(m-2)}{(m+2)(m-1)}$ **5.** $\frac{2x(x-1)}{3(x+1)}$ **6.** $\frac{12x^2}{5(x+1)}$

7. $\frac{2c}{c-1}$ **8.** $\frac{5x^4}{2}$ **9.** $\frac{9}{t}$

10. $\frac{1}{3}$ **11.** $\frac{1}{2}$ **12.** $\frac{3(4x+1)}{x-1}$

13. $4(t+1)(t+2)$

14. $3(2m+1)(m+2)$

15. $\frac{(x-1)(x-2)}{3}$ **16.** $\frac{x+1}{2}$ **17.** $-\frac{2d-5}{6d^2}$

18. $\frac{1}{c^2-1}$ **19.** $\frac{1}{s+4}$ **20.** $\frac{x-1}{x+3}$

21. 6 **22.** $-\frac{1}{2}$ **23.** $-\frac{1}{3}$

24. $\frac{2(x+2)}{x-1}$ **25.** $\frac{n-3}{4n+5}$ **26.** $\frac{3}{x}$

27. $\frac{11}{7k-15}$ **28.** $\frac{1}{x+1}$ **29.** $t+3$

30. $\frac{c+1}{c-1}$ **31.** $\frac{3t-5}{7t^2}$ **32.** $\frac{5(2x-5)}{x-5}$

33. $\frac{x-2}{x-3}$ **34.** $\frac{x-5}{x}$

35. The student forgot to rewrite the expression using the reciprocal before canceling.

36. Check students' work.

37. $0, 4, -4$ **38.** \$88.71 **39.** \$132.96

40. **a.** \$200,000

b. 360 payments

c. \$1199.10

d. \$431,676

41. $\frac{x - 2}{4(x + 7)}$

42. $\frac{2m^2(m + 2)}{(m - 1)(m + 4)}$

43. $\frac{2}{a + 5}$

44. $\frac{r + 3}{(r - 1)(r + 1)^2}$

45. She wrote w^5 as a fraction so she could easily see what she could cancel.

46. **a.** $\frac{x^2}{4(2x + 1)^2}$

b. $\frac{x(3x + 2)}{4(2x + 1)^2}$

47. $\frac{9m^2(m + 1)}{2}$

48. 1

49. $\frac{x}{y + 5}$

50. $\frac{-(2a + 3b)(a + 2b)}{(5a + b)(2a - 3b)}$

51. $\frac{m - 2}{2m(m - 1)}$

52. $\frac{x(x - 2)}{2(x - 1)}$

53. $\frac{1}{(w + 2)(w + 3)}$

Answers for Lesson 12-4, pp. 684–686 Exercises

1. $x^4 - x^3 + x^2$

2. $3x^4 - \frac{2}{x}$

3. $3c^2 + 2c - \frac{1}{3}$

4. $n^2 - 18n + 3$

5. $4 - \frac{16}{q}$

6. $-t^3 + 2t^2 - 4t + 5$

7. $x - 3$

8. $2t + 9 + \frac{16}{t - 3}$

9. $n - 1$

10. $y - 3 + \frac{8}{y + 2}$

11. $3x - 1$

12. $-2q - 10 + \frac{22}{2q + 1}$

13. $5t - 50$

14. $2w^2 + 2w + 5 - \frac{10}{w - 1}$

15. $b^2 - 3b - 1 + \frac{3}{3b - 1}$

16. $c^2 - \frac{1}{c - 1}$

17. $t^2 - 2t - 2$

18. $n^2 - 2n - 21 - \frac{8}{n + 2}$

19. $(r^2 + 5r + 1)$ cm

20. $(4c^2 - 8c + 16)$ ft

21. $b + 12 + \frac{1}{b + 4}$

22. $a - 1 - \frac{2}{a + 4}$

23. $10w - 681 + \frac{49{,}046}{w + 72}$

24. $t - \frac{9}{t + 4}$

25. $2x^2 + 5x + 2$

26. $3q^2 + 2q + 3 + \frac{12}{q - 2}$

27. $3x + 2 - \frac{1}{2x}$

28. $c^2 + 11c - 15 + \frac{8}{c}$

29. $2b^2 + 2b + 10 + \frac{10}{b - 1}$

30. $y^2 + 5y + 29 + \frac{138}{y - 5}$

31. $28a - 12$

32. $5t^3 - 25t^2 + 115t - 575 + \frac{2881}{t + 5}$

33. $k^2 - 0.3k - 0.4$

34. $3s - 8 + \frac{29}{2s + 3}$

35. $-2z^2 + 3z - 4 + \frac{5}{z + 1}$

36. $6m^2 - 24m + 99 - \frac{326}{m + 4}$

37. $-16c^2 - 20c - 25$

38. $2r^4 + r^2 - 7$

39. $t - 1 + \frac{2t}{2t^3 + 1}$

40. $z^3 - 3z^2 + 10z - 30 + \frac{88}{z + 3}$

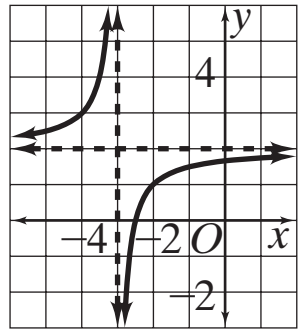
41. a. Answers may vary. Sample: $(c^3 + 3c^2 - 2c - 4); (c + 1)$

b. $(c^3 + 3c^2 - 2c - 4) \div (c + 1) = c^2 + 2c - 4$

42. a. $y = 2 - \frac{1}{x + 3}$

b. Answers may vary. Sample:

x	–2	–1	0	1	2
y	1	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{7}{4}$	$\frac{9}{5}$



c. vertical asymptote: $x = -3$
horizontal asymptote: $y = 2$

43. The binomial is a factor of the polynomial if there is no remainder from the division.

44. $m^2 + 5m + 4$

45. a. $d - 2 + \frac{3}{d + 1}$

b. $d^2 - 2d + 3 - \frac{4}{d + 1}$

c. $d^3 - 2d^2 + 3d - 4 + \frac{5}{d + 1}$

d. Answers may vary. Sample:
$d^4 - 2d^3 + 3d^2 - 4d + 5 - \frac{6}{d + 1}$

e. $d^4 - 2d^3 + 3d^2 - 4d + 5 - \frac{6}{d + 1}$

46. 12

47. a. $t = \frac{d}{r}$

b. $t^2 - 7t + 12$

48. $2a^2b^2 - 3ab^3 + 5ab^2$

49. $3x + 2y$

50. $10r^5 + 2r^4 + 5r^2$

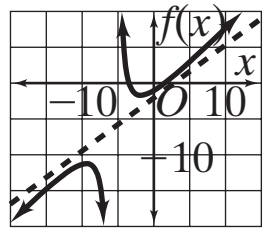
51. $2b^3 - 2b^2 + 3$

52. **a.** $x - 3 + \frac{10}{x + 5}$

b. $f(x) = x - 3 + \frac{10}{x + 5}$

c. $y = x - 3$

d.



Answers for Lesson 12-5, pp. 689–690 Exercises

1. $\frac{9}{2m}$ **2.** $\frac{7}{6t - 1}$ **3.** $\frac{n + 2}{n + 3}$

4. $\frac{14}{c - 5}$ **5.** $\frac{2s^2 + 1}{4s^2 + 2}$ **6.** $\frac{6c - 28}{2c + 7}$

7. $\frac{-3}{2 - b}$ **8.** $-\frac{1}{t^2 + 1}$ **9.** $\frac{-2t}{2t - 3}$

10. 1 **11.** 2 **12.** -1

13. $2x^2$ **14.** 18 **15.** $7z$

16. $35b^3c$ **17.** $\frac{35 + 6a}{15a}$ **18.** $\frac{12 - 2x}{3x}$

19. $\frac{18 + 20x^2}{15x^8}$ **20.** $\frac{9 + 2m}{24m^3}$ **21.** $\frac{189 - 9n}{7n^3}$

22. $\frac{45 + 36x^2}{20x^2}$ **23.** $\frac{17m - 47}{(m + 2)(m - 7)}$ **24.** $\frac{a^2 + 9a + 12}{(a + 3)(a + 5)}$

25. $\frac{a^2 + 12a + 15}{4(a + 3)}$ **26.** $\frac{c^2 + 7c + 20}{(c + 5)(c + 3)}$ **27.** $\frac{4t^2 + 5t + 5}{t^2(t + 1)}$

28. $\frac{18a + 3}{(2a + 1)(2a - 1)}$

29. **a.** $\frac{1}{r} + \frac{1}{0.7r}$

b. $\frac{17}{7r}$

c. about 0.8 h

30. $\frac{-y^2 + 2y + 2}{3y + 1}$ **31.** $\frac{h^2 + h + 1}{2t^2 - 7}$ **32.** $\frac{r - 2k - 6}{9 + p^3}$

33. $\frac{-3 - x - z}{xy^2z}$ **34.** $\frac{k + 3km}{2m^2}$ **35.** $\frac{12c - 15a}{abc}$

36. $\frac{c^3 - a^3}{abc}$ **37.** $\frac{10x + 15}{x + 2}$ **38.** $\frac{-21t + 33}{2t - 3}$

39. $\frac{6x}{(x - 3)(x + 3)^2}$ **40.** $\frac{k - 1}{k - 6}$

41. The student added the terms in the denominators.

42. **a.** $\frac{2}{r} + \frac{2}{1.25r}; \frac{18}{5r}$

b. $\frac{2}{d} + \frac{2}{0.8d}; \frac{9}{2d}$

c. Yes; they both represent the time it takes to make a round trip.

43. Answers may vary. Sample: Not always; the numerator may contain a factor of the LCD.

44. Answers may vary.

Sample: $\frac{2w}{w+3}, \frac{3w^2}{w-3}; \frac{3w^3+11w^2-6w}{(w+3)(w-3)}$

45. $\frac{8x^2-1}{x}$

46. 8

47. $\frac{-3x-5}{x(x-5)}$

48. $\frac{32x}{x-5}$

49. $\frac{x-5}{4x}$

50. $\frac{1}{2x(x-5)}$

51. $-\frac{d+3}{d+4}$

52. $\frac{-x^3+6x^2+35x-50}{x(x+5)(x^2+x-10)}$

53. $\frac{x}{x+4}$

54. $\frac{5a-8}{(a+2)(a-5)}$

Answers for Lesson 12-6, pp. 695–697 Exercises

1. -2 **2.** 3 **3.** -1

4. $6, -1$ **5.** $-\frac{1}{3}$ **6.** $-2, 4$

7. $1, 4$ **8.** 5 **9.** $1, 3$

10. $\frac{1}{3}$ **11.** $\frac{16}{3}$ **12.** -4

13. -2 **14.** -1 **15.** $-\frac{2}{3}$

16. $1\frac{5}{7}$ h **17.** $\approx$12.7 min **18.** 3

19. $10, -10$ **20.** $-\frac{3}{2}, 4$ **21.** 4

22. no solution **23.** 6 **24.** -14

25. $\frac{1}{2}, 2$ **26.** 3 **27.** $-5, 2$

28. -1 **29.** $\frac{1}{2}$ **30.** $-\frac{6}{5}, -1$

31. $0, 2$ **32.** 12 h

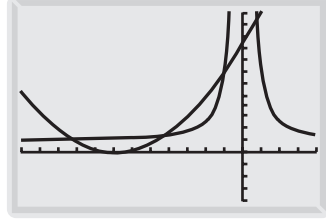
33. a. 32

b. Answers may vary. Sample: Cross-multiplying; I think it's quicker.

c. No; it only works for rational equations that are proportions.

34. $a = 4, b = \frac{7}{27}, c = 11, d = -\frac{1}{3}$

35. a. $y_1 = \frac{6}{x^2} + 1, y_2 = \frac{(x + 7)^2}{6}$



Xmin=−12 Ymin=−4
Xmax=4 Ymax=12
Xscl=1 Yscl=1

b. $(-9.53, 1.07), (-4.16, 1.35), (-1.12, 5.76), (0.81, 10.16)$

c. Yes; the x-values are solutions to the original equation since both sides are equal.

36. $66.\overline{6}\ \Omega$

37. $20\ \Omega$

38. $3.75\ \Omega$

39. $20\ \Omega$

40. Answers may vary. Sample: $\frac{2b}{b+2} = \frac{6b}{4b+3}$

41. 40 mi/h

42. 9

43. $0, \frac{1}{2}$

44. -1

45. 1

46. ≈ 23.5 min

47. **a.** $0.80s$

b. $50 - s$

c. $0.30(50 - s)$

d. $0.8s + 0.3(50 - s) = (0.62)(50)$

e. 32

f. 32 L of 80% solution and 18 L of 30% solution

48. $11\frac{1}{3}$ h

1. 10 choices

Shirt 1 → Tie 1 → S1, T1
→ Tie 2 → S1, T2
→ Tie 3 → S1, T3
→ Tie 4 → S1, T4
→ Tie 5 → S1, T5

Shirt 2 → Tie 1 → S2, T1
→ Tie 2 → S2, T2
→ Tie 3 → S2, T3
→ Tie 4 → S2, T4
→ Tie 5 → S2, T5

2. 12 menus

Salad	Soup	Main Course	Menu
S →	V →	C	SVC
		B	SVB
		S	SVS
	C →	C	SCC
		B	SCB
		S	SCS
C →	V →	C	CVC
		B	CVB
		S	CVS
	C →	C	CCC
		B	CCB
		S	CCS

3. a. 8, 10, 10, 10

b. 8,000,000 telephone numbers

4. a. 6

b. 12

5. 3,628,800 orders **6.** 120 arrangements **7.** 1680

8. 3024 **9.** 360 **10.** 120

11. 5040 **12.** 5040 **13.** 2520

14. 42 **15.** 5040 **16.** 12,144

17. ${}_8P_6$ **18.** ${}_9P_7$ **19.** ${}_8P_4$

20. a. 2; 2

b. 4

c. No; number of consonants · number of vowels = number of vowels · number of consonants.

21. a. 24

b. $\frac{1}{24}$

22. a. 24

b. $\frac{1}{14{,}950}$

c. Answers may vary. Sample: No; if someone tries to guess your password, they'll probably try your name or initials first.

23. 3 **24.** 2 **25.** 5

26. A

27. a. 260,000 license plates

b. 23,920,000 license plates

28. a. Check students' work.

b. Check students' work.

29. a. 17,576 codes

b. 17,526 codes

30. a. 35,152 call letters

b. 913,952 call letters

31. **a.** 18,278 companies

b. 12,338,352 companies

c. NASDAQ; 12,320,074 more companies

32. **a.** 2

b. 6

c. $(n - 1)!$

33. 7

34. **a.** 60 numbers

b. 6 numbers

c. $\frac{1}{10}$

35. False; if $a = 3$ and $b = 2$, then $(a - b)! = 1! = 1$, but $a! - b! = 3! - 2! = 4$.

Answers for Lesson 12-8, pp. 709–711 Exercises

1. 1 **2.** 6 **3.** 15

4. 20 **5.** 15 **6.** 6

7. 28 **8.** 28 **9.** 21

10. 21 **11.** 220 **12.** 56

13. $\frac{1}{5040}$

14. **a.** 45

b. 3

c. $\frac{1}{15}$

d. $\frac{2}{15}$

15. **a.** 56

b. 1

c. $\frac{1}{56}$

d. $\frac{5}{28}$

16. 10

17. 1

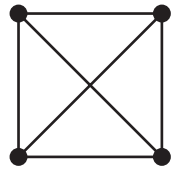
18. 35

19. 4

20. combination, since order is *not* important

21. permutation, since order *is* important

22. **a.**



b. 6

c. 6

d. 45

23. **a.** Answers may vary. Sample: It is a combination problem because order is not important.

b. 45

c. Yes; Each line segment joins two points and each handshake connects two people.

24. **a.** 59,280 sequences

b. 1482 sequences

c. $\frac{1}{40}$

d. Answers may vary. Sample: It is unlikely someone will guess the right sequence with more than 59,000 possibilities.

25. Answers may vary. Sample: Both permutations and combinations are arrangements of some or all of a group of objects. However, permutations take into account order, and combinations do not.

26. 4

27. 8

28. **a.** 24

b. $\frac{1}{4}$

29. Check students' work.

30. **a.** 792

b. 36

c. $\frac{1}{22}$

31. always

32. sometimes

33. always

34. $\frac{1}{28}$

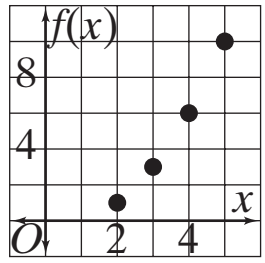
35. **a.** 15

b. 6; 3

c. 20

d. 300

36. a.



b. Answers may vary. Sample: It is the function $f(x) = \frac{x(x - 1)}{2}$, which uses the combination formula ${}_xC_2 = \frac{x!}{2!(x - 2)!}$ for x. This represents the number of combination groups of 2.

c. Groups can only be made from sets of objects, which means they must be whole numbers.