

Chapter 7 Answers

7-1

Lesson Check

1. $\frac{1}{32}$ 2. $1, m \neq 0$ 3. $\frac{5s^2}{t}$
 4. $4x^3$ 5. -2 6. $\frac{1}{8}$
 7. division
 8. b^0 is equal to 1, not 0;
 $\frac{x^n}{a^{-n}b^0} = \frac{a^n x^n}{1} = a^n x^n$

Practice and Problem-Solving Exercises

9. $\frac{1}{9}$ 10. 1 11. $\frac{1}{25}$
 12. $-\frac{1}{25}$ 13. $\frac{1}{16}$ 14. $\frac{1}{64}$
 15. -1 16. $-\frac{1}{12}$ 17. 1
 18. $\frac{1}{58}$ 19. $0.\bar{4}$ or $\frac{4}{9}$ 20. $-\frac{1}{125}$
 21. $4a, b \neq 0$ 22. x^7 23. $\frac{5}{x^4}$
 24. c 25. $\frac{1}{9n}$ 26. $\frac{1}{k^4}, j \neq 0$
 27. $\frac{3}{x^2y}$ 28. $\frac{7a}{3b^4w}$ 29. $\frac{1}{c^3d^7}$
 30. $\frac{d^2}{c^5}$ 31. $4s^3$ 32. $\frac{7st^3}{5}$
 33. $\frac{6}{ac^3}, d \neq 0$ 34. $\frac{x^2}{8a^2}$ 35. $\frac{7}{v^{11}}$
 36. $\frac{14}{m^2t^3}$

37. $-\frac{1}{27}$ 38. $\frac{1}{125}$ 39. -225
 40. 9 41. $\frac{4}{5}$ 42. $\frac{1}{25}$
 43. $\frac{25}{81}$ 44. $-\frac{27}{400}$
 45. 100; there were 100 visitors 4 months before the number of visitors was measured.
 46. 20 represents the cactus finch population 2 decades before the population was measured; 45 represents the number of finches when the population was measured; 67.5 represents the number of finches 1 decade after the population was measured.

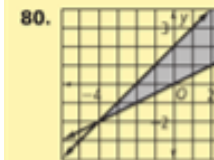
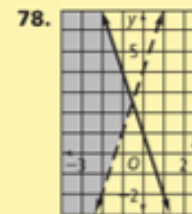
47. negative 48. positive
 49. negative 50. negative
 51. 10^{-1} 52. 10^{-2}
 53. 10^{-3} 54. 10^{-4}
 55. a. $5^{-2}, 5^{-1}, 5^0, 5^1, 5^2$
 b. 5^4 c. a^n
 56. ab^2 57. $4gh^{-3}$
 58. $\frac{5m^6n^{-1}}{3}$ 59. $\frac{8c^5d^{-4}e^2}{11}$
 60. \$125

61.

n	3	$\frac{1}{6}$	7	$\frac{5}{8}$	2
n^{-1}	$\frac{1}{3}$	6	$\frac{1}{7}$	$\frac{8}{5}$	0.5

62. a. 1
 b. They are reciprocals.

63. Answers may vary. Sample: Let $a = \frac{3}{2}$, then $a^{-1} = \frac{2}{3}$, $a^2 = \frac{4}{9}$, and $a^{-2} = \frac{9}{4}$.
 64. $1.499 < d < 1.501$
 65. No; answers may vary. Sample: $3x^{-2} = \frac{3}{x^2}$ which is not the reciprocal of $3x^2$.
 66. 1 67. 21
 68. $\frac{141}{m^2}$ 69. $8 - 48m^2$
 70. $\frac{4}{m^2x^2y^2}$ 71. $-7\frac{1}{2}$
 72. -1 and 1 73. 1
 74. -2 75. 4.5
 76. 6.8 77. 4



81. $y = -x + 4$ 82. $y = 5x - 2$
 83. $y = \frac{2}{5}x - 3$ 84. $y = -\frac{3}{11}x - 17$
 85. $y = \frac{5}{9}x + \frac{1}{3}$ 86. $y = 1.25x - 3.79$
 87. 60,000 88. 0.07
 89. 820,000 90. 0.003
 91. 340,000

Chapter 7 Answers

7-2

Lesson Check

1. 7×10^{-4}
2. 3.2×10^7
3. 3,500,000
4. 0.000127
5. 10^{-3} , 10^{-1} , 10^0 , 10^1 , 10^5
6. 5×10^{-3} , 7×10^{-1} , 3×10^0 , 2×10^4
7. 3.5×10^6 , 3.6×10^6 , 2.1×10^7 , 2.5×10^7
8. Answers may vary. Sample: When numbers are very large or very small. An example of a very large distance may be the distance from Earth to the nearest star.

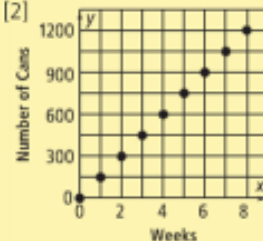
9. The student interpreted the negative exponent of -5 to represent the number of decimal places when it represents how many places to move the decimal point to the left; $1.88 \times 10^{-5} = 0.0000188$.
10. No; the difference between two numbers with different powers of 10 is more significant than the difference between two numbers with the same power of 10.

Practice and Problem-Solving Exercises

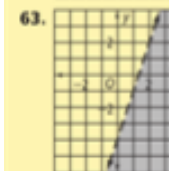
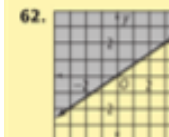
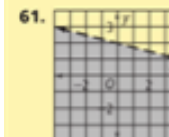
11. No; 44 is not less than 10.
12. yes
13. No; 0.9 is not greater than 1.
14. No; 1000^9 is not written as a power of 10.
15. yes
16. yes
17. No; 457 is not less than 10.
18. yes
19. 9.04×10^9
20. 2×10^{-2}
21. 9.3×10^6
22. 2.17×10^4
23. 3.25×10^{-3}
24. 8.003×10^6
25. 9.2×10^{-4}
26. 1.56×10^{-2}
27. 500
28. 745
29. 2040
30. 7,200,000
31. 0.897
32. 1.3
33. 274,000
34. 0.0048
35. 6×10^{-10} , 8×10^{-8} , 9×10^{-7} , 7×10^{-6}
36. 2.7×10^5 , 7.9×10^5 , 8.1×10^5 , 8.2×10^5
37. 0.52×10^{-3} , 4.8×10^{-3} , 50.1×10^{-3} , 56×10^{-3}
38. 5300×10^{-1} , 5.3×10^5 , 0.53×10^7 , 530×10^8
39. ^{232}U , ^{234}U , ^{236}U , ^{235}U
40. 8×10^{-3}
41. 2.4×10^{15}
42. 6×10^1
43. 3.18×10^{-3}
44. 2.46×10^{-3}
45. 3.4×10^5
46. Proxima Centauri: 2.46876×10^{13} mi;
Sirius: 5.11386×10^{13} mi;
Vega: 1.58706×10^{14} mi;
Polaris: 2.533418×10^{15} mi

47. 436 billion is 436,000,000,000 so in scientific notation it becomes 4.36×10^{11} . It must be the product of a number greater than or equal to 1 and less than 10, and a power of 10.

48. 2.8×10^{-8} cm
49. It increases by 2 because 100 is 10^2 .
Sample: $100(3.46 \times 10^5) = 346 \times 10^5 = 3.46 \times 10^7$
50. 4×10^{12}
51. $3.\bar{3} \times 10^{-3}$
52. C
53. I
54. C
55. [2]



- 8 weeks
[1] Graph correct but with error in number of weeks
56. $\frac{c}{d^6}$
 57. b^3
 58. $\frac{a}{w^3}$
 59. $4mn^5$
 60. $\frac{k^5}{9}$



65. t^7
66. $(6 - m)^3$
67. $(r + 2)^4$
68. 5^3s^3
69. 2^5x^3
70. $8^2(x - 1)^3$

Chapter 7 Answers

7-3

Lesson Check

1. 8^{12}
2. $6n$
3. 2.4×10^{10}
4. 39,900 km
5. No; x and y are not like bases and they do not share a common factor.
6. Sometimes; if the product ab is greater than 10, then the number will not be in scientific notation.
7. No; $4 \times 3 = 12$ so the correct result is $12a^7$.

Practice and Problem-Solving Exercises

8. 7^7
9. $(-6)^{19}$
10. 9^0
11. 2^9
12. 5^2
13. $(-8)^0$
14. m^7
15. $5c^{10}$
16. $\frac{8}{r^3}$
17. $56x^6$
18. $3x^4$
19. $-4.8n^3$

20. b^3
21. -7
22. $-45a^4$
23. $\frac{y^3}{x}$
24. $45x^7y^6$
25. $-12a^6c^8$
26. $x^{10}y^2$
27. a^9b
28. $\frac{-240m^3}{y}$
29. 6×10^5
30. 6×10^9
31. 4×10^3
32. 3.4×10^{-5}
33. 5.6×10^{-7}
34. 1.5×10^{22}
35. 8.84×10^7 mi
36. 2.6×10^{11} white blood cells

37. 9
38. -4
39. -3
40. 11
41. -5
42. 5
43. -4
44. 0
45. 2; -3
46. 3.42×10^{34} molecules
47. $6x^3 + 2x^2$
48. $4x^4$
49. $4y^5 + 8y^2$
50. $4c^4$
51. 2.7×10^{-8}
52. 8×10^5
53. 2.1×10^{-5}
54. 1.2×10^{-4}
55. 8×10^{-8}
56. 1.5×10^8
57. 4.0334×10^1 g
58. x^4
59. $\frac{1}{a}$
60. $4c^4$
61. $6a^4 + 2a^3$
62. $8m^7 + 16m^3$
63. $-12x^6 + 40x^4$

64. a. Answers may vary. Sample:
 $y^5 \cdot y, y^4 \cdot y^2, y^3 \cdot y^3, y^2 \cdot y^4$
- b. Answers may vary. Sample:
 $y^7 \cdot y^{-1}, y^8 \cdot y^{-2}, y^9 \cdot y^{-3}, y^6 \cdot y^0$
- c. Infinitely many; there are infinitely many ways to add to get 6.

65. 3^4
66. 2^{2n+3}
67. $2^{x+y} \cdot 3^{x+2}$
68. $\frac{1}{a+b}$
69. $(t+3)^2$
70. 5^2
71. 22.5 times
72. D
73. H
74. A
75. H
76. [4] a. $(2r)^2$
 b. $A = (2 \cdot 4)^2 = 8^2 = 64$ in.²
 c. $196 = (2r)^2$, so $(2r) = 14$,
 so $d = 14$.

77. 2.358×10^6
78. 4.65×10^{-3}
79. 7×10^{-5}
80. 5.1×10^9
81. 18, 34, 46
82. $-1, 7, 13$
83. $-6.8, -22.8, -34.8$
84. $\frac{1}{16}$
85. $5x$
86. $\frac{4n^2}{m}$
87. $\frac{-3x^3y^6}{y^2}$

Chapter 7 Answers

7-4

Lesson Check

1. n^{18} 2. $\frac{1}{b^{21}}$
 3. $81a^4$ 4. $81x^{20}$
 5. 1.6×10^{11} 6. 3.2×10^{-14}

7. Answers may vary. Sample: When you raise a power to a power, you multiply the exponents. When you multiply powers with the same base, you add the exponents.
 8. The second student; when you add like terms, you add the coefficients and keep the same variable part.
 9. Answers may vary. Sample: x^{12} , $(x^3)^4$, $(x^6)^2$, $(x^2)^6$

Practice and Problem-Solving Exercises

10. n^{32} 11. n^{32} 12. c^{10}
 13. q^{100} 14. $\frac{1}{w^7}$ 15. $\frac{1}{x^{15}}$
 16. d^{19} 17. z^5 18. $a^{15}c^4$
 19. c^{15} 20. $\frac{1}{r^{12}}$ 21. $\frac{x^{10}}{y^{11}}$

22. $1024m^5$ 23. $\frac{1}{49a^2}$ 24. $625y^4$

25. $\frac{1}{12g^4}$ 26. $\frac{n^{24}}{81}$ 27. $\frac{1}{9y^{12}}$

28. 1 29. $r^{10}s^5$ 30. $8x^5$

31. $\frac{r^{16}}{z^{15}}$ 32. 1 33. $\frac{p^{15}}{q^9}$

34. $9a^6b^8$ 35. $\frac{d^4}{c^{18}}$ 36. $\frac{j^{32}}{32k^{76}}$

37. $32j^{35}k^{11}$ 38. 9×10^{10}

39. 1.024×10^{13} 40. 8×10^{-30}

41. 8×10^{-9} 42. 5.476×10^9

43. 2.56×10^{22} 44. 4.2875×10^{-11}

45. 1.3312053×10^{25}

46. $6.499 \times 10^{-8} \text{ m}^3$

47. 4 48. -4 49. $\frac{5}{3}$

50. 0 51. -3 52. 8

53. -2 54. 0 55. -3

56. 8 57. $243x^3$ 58. 1

59. b^{17} 60. $30x^2$ 61. $-8a^9b^6$

62. $\frac{4}{25x^4}$ 63. 0 64. 43,000

65. 9

66. x^6 , x^8 ; no; $(x^2)^3 = (x^2)(x^2)(x^2) = x^6$
 while $x^{2^3} = x^{2 \cdot 2 \cdot 2} = x^8$

67. 10^9 68. 27

69. yes; $(7xyz)^2$

70. a. about $5.1 \times 10^{14} \text{ m}^2$

b. about $3.6 \times 10^{14} \text{ m}^2$

c. about $1.4 \times 10^{16} \text{ m}^3$

71. 3

72. 12

73. 6

74. 3

75. 4

76. -5

77. 10; $(2x)^4$, $(4x^2)^2$, $(16x^4)^1$, $(-2x)^4$, $(-4x^2)^2$,
 $(\frac{1}{2x})^{-4}$, $(\frac{1}{4x^2})^{-2}$, $(\frac{1}{16x^4})^{-1}$, $(\frac{1}{-2x})^{-4}$, $(\frac{1}{-4x^2})^{-2}$

78. C

79. f

80. [2] 31.68 in./min;
 $\frac{2 \times 10^{-2} \text{ m}}{1 \text{ h}} \times \frac{3280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{1 \text{ h}}{60 \text{ min}} =$
 31.68 in./min

81. $\frac{b^4}{c^{10}}$

82. a^8b^3

83. $54m^5n^4$

84. $-4t^5$

85. $-\frac{1}{4+13}$

86. 6

87. $-\frac{1}{2+13}$

88. -9

89. $\frac{1}{2+11}$

90. 31

91. $\frac{1}{2+13}$

92. $\frac{1}{2+13}$

93. $\frac{1}{2+13}$

Chapter 7 Answers

7-5

Lesson Check

1. $\frac{1}{y^2}$ 2. $\frac{x^{12}}{27}$ 3. $\frac{n^3}{m^3}$

4. $\frac{625y^{15}}{81x^4}$ 5. 27 cubes

6. In raising a quotient to a power, the exponent goes to all the factors of both the numerator and the denominator and in raising a product to a power, the exponent goes to all the factors.

7. a. Answers may vary. Sample:

a^3 can be rewritten as $\frac{1}{a^{-3}}$.

so $\frac{a^3}{a^2} = \frac{1}{a^2} \cdot \frac{1}{a^{-3}}$.

b. Check students' work.

Practice and Problem-Solving Exercises

8. 7 9. 1 10. -3

11. 0 12. 9 13. $\frac{1}{8}$

14. $\frac{1}{a^3}$ 15. n^3 16. $\frac{x^2}{y^2}$

17. y^2 18. $\frac{1}{c^3d}$ 19. $\frac{2m^4}{n^4}$

20. $\frac{m^4}{n^4}$ 21. $\frac{t^{11}}{27m^7}$ 22. $\frac{y^4}{x^4}$

23. $\frac{3b^7}{a^6c^4}$

24. 4×10^6

25. 4×10^{-5}

26. 1.3×10^{-2}

27. 4.2×10^3

28. 1.5×10^{-6}

29. 7×10^{-3}

30. 1×10^{-12} s

31. about 4.4×10^{-2} deer per acre

32. about 3511 times as great

33. $\frac{9}{64}$

34. $\frac{1}{a^3}$

35. $\frac{81x^4}{y^4}$

36. $\frac{32x^5}{243y^5}$

37. $\frac{216}{15,625}$

38. $\frac{1}{32}$

39. $\frac{262,144}{n^{30}}$

40. $\frac{80^3}{729}$

41. $\frac{5}{2}$

42. $\frac{256}{625}$

43. $\frac{25y^8}{49x^{10}}$

44. $-\frac{27y^{12}}{8x^9}$

45. $\frac{x^6}{25}$

46. $\frac{1}{80^3}$

47. b^{15}

48. 1

49. 5^3 should be 125.

50. y^{-2} contains a negative exponent.

51. Each factor should be raised to the fourth power and simplified.

52. x^0 needs to be simplified to 1.

53. The base d should appear only once.

54. about 1.6 hours per day

55. a. about 1636 h

b. about 31 h

56. definition of negative exponent

57. dividing powers with the same base, definition of negative exponent

58. multiply powers with the same base

59. raising a power to a power, dividing powers with the same base, definition of negative exponent

60. $\frac{3}{2n}$

61. $\frac{1}{16m^3}$

62. $\frac{1}{9}$

63. a^4

64. $\frac{t^3}{64}$

65. $\frac{1}{a^3}$

66. $\frac{25x^2}{4}$

67. $\frac{y^{10}}{2x^5}$

68. a.-b. Check students' work.

c. No; the factor a is divided by 2. The power will remain the same or be one less.

70. B

71. $\frac{x^6}{9y^8}$

72. $\frac{m^6p^5}{n^4}$

73. $\frac{2}{27}$

74. 1

75. $\frac{c^5}{a^{18}b^6}$

76. 186,624

77. $\frac{y^6}{256x^2}$

78. $\frac{2b^5}{3a}$

79. about $3\frac{1}{3}$ m

80. a. The student simplified the bases of 5 instead of subtracting the exponents.

b. 125

81. $x = 7$ and $y = 4$; use the two given expressions to find the system of equations, $x - y = 3$ and $x - 3y = -5$. Solve the system to find the values of x and y .

82. a. about \$19,936

b. about \$26,642

c. about 33.6%

83. $\left(\frac{m}{n}\right)^7$

84. 10^{10}

85. $\left(\frac{3x}{2y}\right)^3$

86. $\left(\frac{2}{13m}\right)^2$

87. a. a^{-n}

b. $\frac{1}{a^n}$

c. Since $\frac{a^0}{a^n}$ equals both $\frac{1}{a^n}$ and a^{-n} , $\frac{1}{a^n} = a^{-n}$.

This is the definition of a negative exponent. $0^0 = 0^0 \cdot 0^{-0} = \frac{0^0}{0^0} = \frac{0}{0}$; any expression with a zero in the denominator is undefined.

89. n^2

90. n^{4x}

91. x^6

92. $\frac{1}{m^3}$

93. about 1.6×10^6 g/m³

94. B

95. H

96. C

97. [2] The domain is $0 \leq b \leq 8$ because you can use between 0 and 8 bags.

The range is $0 \leq A(b) \leq 9600$ because $A(0) = 0$ and $A(8) = 9600$.

[1] either domain or range is incorrect, or no explanation

98. $\frac{8}{m^3t}$

99. $\frac{2c^6}{27}$

100. $\frac{1}{64c^7}$

101. $9r^{10}$

102. n^{15}

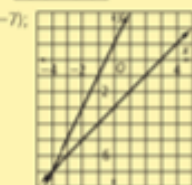
103. (0, 0);



106. no solution;



104. (-4, -7);



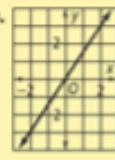
109.



105. (3, 5);



110.



107.



108.



Chapter 7 Answers

7-6

Lesson Check

1. 48

2. 5

3.



4.



5. Answers may vary. Linear functions have a constant rate of change, while an exponential function has a constant finite ratio.
6. No; the value of the base cannot be negative.
7. The student did not use the order of operations correctly. You must evaluate the exponent before you multiply:
 $f(-1) = 2 \cdot 4^{-1} = 2 \cdot \frac{1}{4} = \frac{1}{2}$

Practice and Problem-Solving Exercises

8. Exponential; the x -values have a constant difference and the y -values have a constant ratio.
9. Not exponential; the y -values do not have a constant ratio.
10. Exponential; it is of the form $y = a \cdot b^x$.
11. Not exponential; the x -value is not used as an exponent.
12. Exponential; it is of the form $y = a \cdot b^x$.
13. Not exponential; it is not of the form $y = a \cdot b^x$.
14. 36 15. 12.5
16. 2.5 17. -3.44×10^{10}
18. \$40,000 19. 4800 foxes

20.



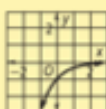
21.



22.



23.



24.



25.



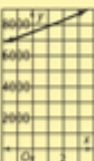
26.



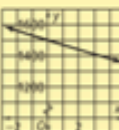
27.



28.



29.



30. [0.04, 0.2, 1, 5, 25, 125]; increase

31. [0.16, 0.4, 1, 2.5, 6.25, 15.625]; increase

32. [100, 10, 1, 0.1, 0.01, 0.001]; decrease

33. [0.3125, 1.25, 5, 20, 80, 320]; increase

34. [4, 2, 1, 0.5, 0.25, 0.125]; decrease

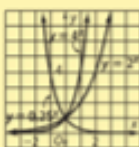
35. [0.015625, 0.125, 1, 8, 64, 512]; increase

36. [0.04, 0.4, 4, 40, 400, 4000]; increase

37. [1111.11, 333.33, 100, 30, 9, 2.7]; decrease

38. after 7 two-day periods

39. a.



b. (0, 1)

c. No, the values of y are always positive.

d. When $0 < b < 1$, the graph decreases to the right, but when $b > 1$, the graph rises to the right. The larger the value of b , the faster it rises.

40. They are the same.

41. $f(x) = 200x^2$

42. $y = 3^x$

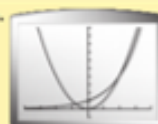
43. $f(x) = 100x^2$

44. a. $y = 1500 \cdot 0.80^x$

b. \$768

c. a little less than 5 years

45. a.



b. Answers may vary. Sample: The values are close though the exponential function is greater from 1 to 2. The two functions are equal at $x = 2$. The quadratic function is greater from 2 to 3.

c. Answers may vary. Sample: The function values increase more rapidly.

46. The range of the function consists of just 500. When b equals 1, the function is a horizontal line, $y = 500$, because 1 raised to any positive integer is 1.

47. 6

48. -3

49. 3

50. 5

51. a. 4

b. 3

c. $y = 4 \cdot 3^x$

d. $\frac{4}{3}$; 324

52. D

53. I

54. [2] $11 \leq |x - 2| + 4$

$7 \leq |x - 2|$ or $|x - 2| \geq 7$.

Therefore, $(x - 2) \geq 7$ or $(x - 2) \leq -7$

$x \geq 9$ or $x \leq -5$;



[1] appropriate methods used with a minor error in either the solving or the graph

55. a^4

56. $\frac{a^4}{a^3}$

57. $\frac{1}{a^{10}b^3}$

58. $\frac{1}{a^3}$

59. $y = 5x$

60. $y = 3x + 1$

61. $y = 0.4x - 3.8$

62. 12% decrease

63. 20% increase

64. 31% decrease

65. 36% increase