



- Got It?** 4. A population of insects triples every week. The number of insects is modeled by the expression $5400 \cdot 3^w$, where w is the number of weeks after the population was measured. Evaluate the expression for $w = -2$, $w = 0$, and $w = 1$. What does each value of the expression represent in the situation?

Lesson Check

Do you know HOW?

Simplify each expression.

1. 2^{-5}

2. m^0

3. $5s^2t^{-1}$

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

Evaluate each expression for $a = 2$ and $b = -4$.

5. a^3b^{-1}

6. $2a^{-4}b^0$

Do you UNDERSTAND? MATHEMATICAL PRACTICES

7. **Vocabulary** A positive exponent shows repeated multiplication. What repeated operation does a negative exponent show?
8. **Error Analysis** A student incorrectly simplified $\frac{x^n}{a^{-n}b^0}$ as shown below. Find and correct the student's error.

$$\frac{x^n}{a^{-n}b^0} = \frac{a^n x^n}{b^0}$$

$$= \frac{a^n x^n}{0} \text{ undefined}$$

Practice and Problem-Solving Exercises



Practice

Simplify each expression.

9. 3^{-2}

10. $(-4.25)^0$

11. $(-5)^{-2}$

12. -5^{-2}

13. $(-4)^{-2}$

14. 2^{-6}

15. -3^0

16. -12^{-1}

17. $\frac{1}{2^0}$

18. 58^{-1}

19. 1.5^{-2}

20. $(-5)^{-3}$

Simplify each expression.

21. $4ab^0$

22. $\frac{1}{x^{-7}}$

23. $5x^{-4}$

24. $\frac{1}{c^{-1}}$

25. $\frac{3^{-2}}{n}$

26. $k^{-4}j^0$

27. $\frac{3x^{-2}}{y}$

28. $\frac{7ab^{-2}}{3w}$

29. $c^{-5}d^{-7}$

30. $c^{-5}d^7$

31. $\frac{8}{2s^{-3}}$

32. $\frac{7s}{5t^{-3}}$

33. $\frac{6a^{-1}c^{-3}}{d^0}$

34. $2^{-3}x^2z^{-7}$

35. $12^0t^7u^{-11}$

36. $\frac{7s^0t^{-5}}{2^{-1}m^2}$

See Problem 1.

See Problem 2.

Evaluate each expression for $r = -3$ and $s = 5$.

37. r^{-3}

38. s^{-3}

39. $\frac{3r}{s^{-2}}$

40. $\frac{s^0}{r^{-2}}$

41. $4s^{-1}$

42. r^0s^{-2}

43. $r^{-4}s^2$

44. $2^{-4}r^3s^{-2}$

← See Problem 3.

45. **Internet Traffic** The number of visitors to a certain Web site triples every month. The number of visitors is modeled by the expression $8100 \cdot 3^m$, where m is the number of months after the number of visitors was measured. Evaluate the expression $m = -4$. What does the value of the expression represent in the situation?

← See Problem 4.

STEM 46. **Population Growth** A Galápagos cactus finch population increases by half every decade. The number of finches is modeled by the expression $45 \cdot 1.5^d$, where d is the number of decades after the population was measured. Evaluate the expression for $d = -2$, $d = 0$, and $d = 1$. What does each value of the expression represent in the situation?



Galápagos cactus finch

B Apply

Mental Math Is the value of each expression *positive* or *negative*?

47. -2^2

48. $(-2)^2$

49. $(-2)^3$

50. $(-2)^{-3}$

Write each number as a power of 10 using negative exponents.

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

52. $\frac{1}{100}$

53. $\frac{1}{1000}$

54. $\frac{1}{10,000}$

Patterns Complete the pattern using powers of 5.

$\frac{1}{5^2} = \blacksquare$

$\frac{1}{5^1} = \blacksquare$

$\frac{1}{5^0} = \blacksquare$

$\frac{1}{5^{-1}} = \blacksquare$

$\frac{1}{5^{-2}} = \blacksquare$

b. Write $\frac{1}{5^{-4}}$ using a positive exponent.

c. Rewrite $\frac{1}{a^{-n}}$ as a power of a .

Rewrite each fraction with all the variables in the numerator.

56. $\frac{a}{b^{-2}}$

57. $\frac{4g}{h^3}$

58. $\frac{5m^6}{3n}$

59. $\frac{8c^5}{11d^4e^{-2}}$

Think About a Plan Suppose your drama club's budget doubles every year. This year the budget is \$500. How much was the club's budget 2 yr ago?

- What expression models what the budget of the club will be in 1 yr? In 2 yr? In y years?
- What value of y can you substitute into your expression to find the budget of the club 2 yr ago?

61. Copy and complete the table at the right.

Simplify $a^n \cdot a^{-n}$.

Reasoning What is the mathematical relationship between a^n and a^{-n} ? Explain.

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

© 63. **Open-Ended** Choose a fraction to use as a value for the variable a . Find the values of a^{-1} , a^2 , and a^{-2} .

STEM 64. **Manufacturing** A company is making metal rods with a target diameter of 1.5 mm. A rod is acceptable when its diameter is within 10^{-3} mm of the target diameter. Write an inequality for the acceptable range of diameters.

© 65. **Reasoning** Are $3x^{-2}$ and $3x^2$ reciprocals? Explain.

Challenge Simplify each expression.

66. $\left(\frac{r^{-7}b^{-8}}{t^{-4}w^1}\right)^0$

67. $(-5)^2 - (0.5)^{-2}$

68. $\frac{6}{m^2} + \frac{5m^{-2}}{3^{-3}}$

69. $2^3(5^0 - 6m^2)$

70. $\frac{2x^{-5}y^3}{n^2} \div \frac{r^2y^5}{2n}$

71. $2^{-1} - \frac{1}{3^{-2}} + 5\left(\frac{1}{2^2}\right)$

72. For what value or values of n is $n^{-3} = \left(\frac{1}{n}\right)^5$?

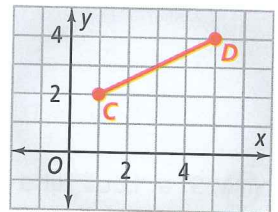
Standardized Test Prep

GRIDDED RESPONSE

SAT/ACT

73. What is the simplified form of $-6(-6)^{-1}$?

74. Segment CD represents the flight of a bird that passes through the points $(1, 2)$ and $(5, 4)$. What is the slope of a line that represents the flight of a second bird that flew perpendicular to the first bird?



75. What is the solution of the equation $1.5(x - 2.5) = 3$?

76. What is the simplified form of $|3.5 - 4.7| + 5.6$?

77. What is the y -intercept of the graph of $3x - 2y = -8$?

Mixed Review

Solve each system by graphing.

78. $y > 3x + 4$
 $y \leq -3x + 1$

79. $y \leq -2x + 1$
 $y < 2x - 1$

80. $y \geq 0.5x$
 $y \leq x + 2$

See Lesson 6-6.

Write an equation in slope-intercept form for the line with the given slope m and y -intercept b .

81. $m = -1, b = 4$

82. $m = 5, b = -2$

83. $m = \frac{2}{5}, b = -3$

84. $m = -\frac{3}{11}, b = -17$

85. $m = \frac{5}{9}, b = \frac{1}{3}$

86. $m = 1.25, b = -3.79$

See Lesson 5-3.

Get Ready! To prepare for Lesson 7-2, do Exercises 87-91.

Simplify each expression.

87. $6 \cdot 10^4$

88. $7 \cdot 10^{-2}$

89. $8.2 \cdot 10^5$

90. $3 \cdot 10^{-3}$

See Lesson 7-1.

91. $3.4 \cdot 10^5$