Name: _____ Date: _____

Zero and Negative Exponents
Algebra 1

In our last lesson we learned how to simplify products and quotients of monomials using laws of exponents with positive integers. But, zero and negative exponents are also possible.

Exercise #1: Recall that $\frac{x^a}{x^b} = x^{a-b}$.

(a) Using this exponent law, simplify each of the following.

$\frac{x^4}{x^4} =$ $\frac{x^{10}}{x^{10}} =$ $\frac{y^7}{y^7} =$

(b) What must each of these quantities equal, assuming none of the variables equals zero?

Exercise #2: Simplify each of the following:

(a) $125^0 =$ (b) $(2y)^0 =$ (c) $5x^0 =$ (d) $(2x^0)^3 =$

We can investigate negative exponents in a very similar fashion to the zero exponent. The key is to define a negative exponent in such a way that our fundamental rules for exponents don't need to change.

Exercise #3: Consider the quotient $\frac{x^2}{x^5}$.

(a) Write this quotient using the exponent law from *Exercise* #1.

(b) Write this quotient in its simplest form without a negative exponent.

Exercise #4: Rewrite each expression in simplest terms without the use of negative exponents.

(a) $4^{-2} =$ (b) $x^{-2} =$ (c) $2^{-3} =$ (d) $y^{-10} =$

Exercise #5: Rewrite each of the following monomials without the use of negative exponents.

(a) $\dfrac{1}{x^{-2}} =$ (b) $\dfrac{1}{y^{-5}} =$ (c) $\dfrac{1}{x^{-3}}$ (d) $\dfrac{y^{-5}}{x^{-7}} =$

NEGATIVE AND ZERO EXPONENTS

If a is any *integer* and $x \neq 0$ then

(1) $x^{-a} = \dfrac{1}{x^a}$ (2) $\dfrac{1}{x^{-a}} = x^a$ (3) $x^0 = 1$

Exercise #6: Which of the following is equivalent to $\dfrac{x^{-2}y^5}{x^{-5}y^{-3}}$?

(1) $\dfrac{x^3}{y^8}$ (3) x^3y^8

(2) $\dfrac{y^8}{x^3}$ (4) $\dfrac{1}{x^3y^8}$

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Exercise #7: Rewrite the following expressions without negative or zero exponents.

(a) $4^{-2} =$ (b) $4^0 =$ (c) $-4^{-2} =$ (d) $1^{-2} =$ (e) $-1^{-2} =$ (f) $(-1)^0 =$

(g) $3x^0 =$ (h) $2x^{-3} =$ (i) $\dfrac{6}{x^{-5}} =$ (j) $2x^{-7} =$ (k) $\dfrac{a^{-3}}{d^{-2}} =$ (l) $\dfrac{r^3t^{-2}}{s^{-4}} =$

Exercise #8: Evaluate each of the following expressions using the values $a = -1$, $b = 2$ and $c = 3$. Use the **STORE** feature on your calculator to aid you.

(a) $\left(ab^{-2}\right)^{-c} =$ (b) $(abc)^{-1} =$ (c) $\left(\dfrac{a^{-2}}{b^2c^{15}}\right)^0 =$ (d) $a^{-b}b^{-c}c^{-a} =$

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Zero and Negative Exponents
Algebra 1 Homework

Skills

For problems 1 through 36, rewrite without zero or negative exponents.

1. $4^{-3} =$
2. $-5^{-2} =$
3. $5^{0} =$
4. $10^{-2} =$
5. $-4^{-3} =$
6. $2^{-4} =$
7. $\dfrac{1}{2^{-2}} =$
8. $\dfrac{1}{4^{0}} =$
9. $(-3)^{-2} =$
10. $3x^{0} =$
11. $5x^{-4} =$
12. $\dfrac{x^{5}}{y^{-3}} =$
13. $\dfrac{a^{-4}}{b^{-3}} =$
14. $-2x^{0}y^{-2} =$
15. $2^{-3} =$
16. $\left(16x^{2}y^{-5}\right)^{0} =$
17. $-3^{0} =$
18. $8x^{0}y^{-3} =$
19. $(-3)^{-3} =$
20. $\left(\dfrac{1}{2}\right)^{-1} =$
21. $\left(\dfrac{1}{2}\right)^{-2} =$
22. $\left(\dfrac{1}{3}\right)^{-1} =$
23. $1^{-6} =$
24. $(-5)^{0} =$
25. $(-1)^{-2} =$
26. $-2^{-1} =$
27. $(-2)^{-1} =$
28. $(-2)^{-2} =$
29. $\left(-2^{-2}\right)^{-1} =$
30. $\dfrac{2x^{-3}y^{2}}{4x^{-4}y^{-1}} =$
31. $a^{3}b^{-4} =$
32. $\dfrac{a^{-2}}{b^{4}} =$
33. $\dfrac{x^{2}}{2y^{-3}} =$
34. $\dfrac{-3x^{3}}{y^{-4}} =$
35. $\dfrac{x^{0}y^{-3}}{z^{2}} =$
36. $2x^{-1}y^{-4} =$

Use the STORE feature on your calculator to help evaluate the following.

37. y^{-3} for $y = 2$
38. y^{-3} for $y = \dfrac{1}{2}$
39. $2x^{-4}y^{-1}$ for $x = 2,\ y = \dfrac{1}{3}$
40. $(x+3)^{-2}$ for $x = -4$
41. x^{-y} for $x = -2,\ y = 2$
42. $\left(x^{4}y^{2}\right)^{0}$ for $x = \dfrac{4}{3},\ y = -\dfrac{2}{7}$
43. $x^{y}x^{-y}$ for $x = \dfrac{2}{5},\ y = -\dfrac{4}{3}$

Reasoning

Fill in the missing $\square$ for each of the following.

44. $\frac{1}{9} = 3^{\square}$

45. $4^{-2} = \frac{1}{\square}$

46. $\frac{1}{25} = \square^{-2}$

47. $\frac{\square}{2} = 2^{-1}$

48. $6^{-2} = \frac{1}{\square}$

49. $10^{\square} = \frac{1}{10{,}000}$

50. $\frac{1}{81} = 3^{\square}$

51. $\frac{1}{64} = 4^{\square}$

Write the answer to each of the following as a single number.

52. $[-1+(5+2)^0]^3 =$

53. $\left[\frac{1}{2}+(3-1)^{-1}\right]^2 =$

54. $\left[3^{-1}+\frac{8}{3}\right]^{-3} =$

55. Evaluate each of the following products:

(a) $2^3 \cdot 2^{-3} =$

(b) $5^2 \cdot 5^{-2} =$

(c) $10^{-4} \cdot 10^4 =$

(d) $x^a \cdot x^{-a} =$

56. Which of the following is correct?

(a) $2x^{-3} = \frac{1}{2x^3}$

(b) $2x^{-3} = \frac{2}{x^3}$

Explain why the other choice is incorrect.

True or False

57. $\left(\frac{1}{2}\right)^{-1} = 2$

58. $\left(\frac{4}{3}\right)^{-1} = -\frac{4}{3}$

59. $(-2)^{-2} = \frac{1}{4}$

60. $\frac{-2x^{-3}y^2}{a^3x^2} = \frac{-2y^2}{a^3x^5}$

61. $3^7 \cdot 3^{-4} = 27$

62. $\left(a^{-2}\right)^{-3} = \frac{1}{a^6}$

63. $(-4)^0 = 0$

64. $2^{-3} \cdot 2^3 \cdot 2^0 = 2$

65. $\frac{x^2y^{-1}}{x^{-3}y^2} = \frac{x^5}{y^3}$

Find the value of *x* that makes each statement true.

66. $2^x \cdot 2^4 = 2^{12}$

67. $5^{-2} \cdot 5^x = 5^9$

68. $\left(4^x\right)^2 = 4^{10}$

69. $3^{x-2} = 27$

70. $\left(4^2 \cdot 3^{-2} \cdot 5^4\right)^x = 1$

71. $2^{2x+6} = \frac{1}{4}$