

Name: Answers

Period: _____

Algebra 1

Chapter 7: Exponents and Exponential Functions

Targets	Learning Targets	SQ Scores	Problems I have questions on:
T 7-1	I can multiply monomials using the properties of exponents and simplify expressions.		
T 7-2	I can divide monomials using the properties of exponents and simplify expressions.		
T 7-3	I can use all properties of exponents to solve exponents.		
T 7-4	I can evaluate, rewrite and solve expressions involving rational exponents		

Target Date	Lesson/Activity Homework	Homework Assignment Help o = only do odd problems	Turned In?
2/24	Multiplication Property of Exponents	Watch on www.khanacademy.org Exponent Properties 1, 3, 5 (3 videos) Take notes. Try pg394 #1-15 odd	3 videos
2/26	Multiplication Property Practice T 7-1 Multiplication Property Worksheet	Watch on www.khanacademy.org Exponent Properties 2, 4, 6 (3 videos) Take notes. Try Pg402 #1-11 odd	3 videos
3/2	Division Property Practice T 7-2 Division Property WS	Watch on www.khanacademy.org Negative Exponents Negative Exponent Intuition Take notes. Try T7-3WS Exercises #1-5	2 videos
3/4	Zero/Neg Property Practice T 7-3 Zero and Neg Property WS #1-43	Watch on www.khanacademy.org Exponents and powers of zero patterns Take notes.	1 video
3/6	Zero/Neg Property Practice Day 2 T 7-3 Zero and Neg Property WS #44-71, 1-10	Watch on www.khanacademy.org Basic Rational Exponents Solving for a Fractional Exponent Take notes. Try some practice problems: Understanding fractional exponents	2 videos
3/10	T 7-4 Rational Exponent WS	Watch on www.khanacademy.org Negative fractional exponent examples	1 video
3/12	All Exponent Properties	Stations – Participation in all stations earns a stamp.	
3/16	Chapter 7 Review	Ch.7 Review	
3/18	Chapter 7 Test		

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Retake Problems for Ch. 6

Target	Score	Target	Retake Problems
T6-1		I can solve systems of equations by graphing and determine the number of solutions.	T6-1 RETAKE WS
T6-2		I can solve systems of equations by using substitution and determine the number of solutions.	T6-2 Retake Worksheet
T6-3		I can solve systems of equations by using elimination and determine the number of solutions.	T6-3 Retake Worksheet
T6-4		I can solve and interpret systems of equations by choosing the best method and applying it to a real world situation.	T6-4 Retake Worksheet

T 7-1 Multiplication Properties of Exponents

(Multiplication Rule $a^n \cdot a^m = a^{n+m}$ and Power to Power Rule $(a^x)^y = a^{x \cdot y}$)

1. $x^5 \cdot x = x^6$	2. $y^3 \cdot y^2 = y^5$
3. $5x^3 \cdot x^4 = 5x^7$	4. $4y^2 \cdot y^5 = 4y^7$
5. $2x^3 \cdot 7x^3 = 14x^6$	6. $9y^2 \cdot 5y^2 = 45y^4$
7. $3x^5(-7x)^2 = 3x^5(-7x)(-7x) = 147x^7$	8. $5y^4(-2y)^5 = 5(-2)^5y^9 = -160y^9$
9. $(-4x)^2(-7x)^2 = 784x^4$	10. $(-3y)^3(-7y)^2 = (-3)^3y^3(-7)^2y^2 = -1323y^5$
11. $(6a^3b^3)(-4a^4b) = -24a^7b^4$	12. $(-9r^3s)(5r^5s) = -45r^8s^2$
13. $m(-m^2)(-m^3) = m^6$	14. $t^4(-t^2)(t^3) = -t^9$
15. $17a^3b^2(-2a^4)(-3b) = 102a^7b^3$	16. $-2s^3t^2(5s^4)(7t) = -70s^7t^3$
17. $4xy(-3x^3y)(2xy^4) = -24x^5y^6$	18. $3m^3(2m^2n^2)(-3n) = -18m^5n^3$
19. $3r^4(2s)(-5r^2s^2) = -30r^6s^3$	20. $5c^3(2c^3d^2)(-11d) = -110c^6d^3$
21. $10^3(10)(10^2) = 10^6$	22. $2^4(10^5)(2^2)10^{-2} = 2^6 \cdot 10^3$
23. $c^3(c^r) = c^{3+r}$	24. $d^4(d^5) = d^{4+5}$
25. $a(a^3)(a^x) = a^{4+x}$	26. $r^y(r)(r^3) = r^{4+y}$
27. $5x^a(-2x^3)(-3x) = 30x^{4+a}$	28. $12d^r(-2d)(-7d^2) = 168d^{3+r}$
Express in Scientific notation 29. $625 = 6.25 \times 10^2$ 30. $49000 = 4.9 \times 10^4$ 31. $18500000 = 1.85 \times 10^7$ 32. $37 = 3.7 \times 10$ 33. $4216 = 4.216 \times 10^3$ 34. $912 = 9.12 \times 10^2$	Express in Scientific notation 35. $0.0021 = 2.1 \times 10^{-3}$ 36. $0.263 = 2.63 \times 10^{-1}$ 37. $0.00000000000017 = 1.7 \times 10^{-13}$ 38. $0.0000000989 = 9.89 \times 10^{-8}$ 39. $0.092 = 9.2 \times 10^{-2}$ 40. $0.34 = 3.4 \times 10^{-1}$

T 7-1 Multiplication Properties of Exponents(Multiplication Rule $a^n \cdot a^m = a^{n+m}$ and Power to Power Rule $(a^x)^y = a^{x \cdot y}$ and $(ab)^x = a^x b^x$)

41. $(9.1 \times 10^2) \cdot (1.1 \times 10^3) = 10.01 \times 10^5 = 1.001 \times 10^6$	42. $(1.2 \times 10^5)(2.6 \times 10^7) = 3.12 \times 10^{12}$
43. $(a^2)^3 = a^6$	44. $(x^4)^2 = x^8$
45. $(x^3)^2 = x^6$	46. $(b^2)^5 = b^{10}$
47. $(u^7)^{10} = u^{70}$	48. $(z^8)^5 = z^{40}$
49. $(2x^2)^3 = 2^3 x^6 = 8x^6$	50. $(3y^3)^3 = 3^3 y^9 = 27y^9$
51. $(-3x^2)^2 = (-3)^2 x^4 = 9x^4$	52. $(-5y^3)^3 = (-5)^3 y^9 = -125y^9$
53. $(\frac{1}{2}x^4)^2 = (\frac{1}{2})^2 x^8 = \frac{1}{4}x^8$	54. $(\frac{1}{3}y^3)^2 = (\frac{1}{3})^2 y^6 = \frac{1}{9}y^6$
55. $2(3a^2)^3 = 2 \cdot 3^3 a^6 = 54 \cdot a^6$	56. $4(-2x^3)^3 = 4 \cdot (-2)^3 x^9 = -32x^9$
57. $\frac{1}{2}(4x^3)^2 = \frac{1}{2} 4^2 x^6 = 8x^6$	58. $\frac{1}{3}(3t^2)^3 = \frac{1}{3} \cdot 3^3 t^6 = 9t^6$
59. $(-x^2)^3 = -x^6$	60. $(-2y^3)^2 = 4y^6$
61. $(-3x^3)^2 = 9x^6$	62. $(-5y^2)^3 = -125y^6$
63. $(a^m)^n = a^{mn}$	64. $(b^x)^y = b^{xy}$
65. $(3b^5)^3 = 3^3 b^{15}$	66. $(5x^p)^2 = 5^2 x^{2p} = 25x^{2p}$
67. $(x^5)^2(2x^3)^2 = x^{10} \cdot 2^2 x^6 = 4x^{16}$	68. $(a^7)^3(a^3)^2 = a^{21} \cdot a^6 = a^{27}$
69. $(x^2)^8(x^3)^4 = x^{16} \cdot x^{12} = x^{28}$	70. $(y^3)^1(y^2)^4 = y^3 y^8 = y^{11}$
71. $(2x^m)^3(x^2)^m = 2^3 x^{3m} x^{2m} = 8x^{5m}$	72. $(3y^r)^2(y^3)^r = 3^2 y^{2r} y^{3r} = 9y^{5r}$
73. $(1.1 \times 10^2)^3 = 1.331 \times 10^6$	74. $(2.3 \times 10^5)^2 = 5.29 \times 10^{10}$

T 7-2 Division Properties of Exponents(Quotient Rule $\frac{a^n}{a^m} = a^{n-m}$ and Quotient to Power Rule $(\frac{a^n}{b^x})^y = \frac{a^{n \cdot y}}{b^{x \cdot y}}$)

1. $\frac{a^{4-2}}{a^2} = a^2$	2. $\frac{h^{17-9}}{h^8} = h^8$
3. $\frac{k^{9-5}}{k^8} = k^4$	4. $\frac{m^{13-2}}{m^2} = m^{11}$
5. $\frac{x^{100-50}}{x^{50}} = x^{50}$	6. $\frac{y^{150-27}}{y^{27}} = y^{123}$
7. $\frac{a^{10}}{a^{12-10}} = \frac{1}{a^2}$	8. $\frac{k^9}{h^{21-9}} = \frac{1}{h^{12}}$
9. $\frac{k^9}{k^{37-9}} = \frac{1}{k^{28}}$	10. $\frac{m}{m^{5-1}} = \frac{1}{m^4}$
11. $\frac{10^{3-2}}{10^2} = 10$	12. $\frac{10^{23-5}}{10^5} = 10^{18}$
13. $\frac{10^2 10^6}{10^4} = \frac{10^{8-4}}{10^4} = 10^4$	14. $\frac{x^4}{x^2 x^6} = \frac{1 \cancel{x^4}}{x^{8-4}} = \frac{1}{x^4}$
15. $\frac{5m^2(-3m^6)}{m} = \frac{5(-3)m^{8-1}}{m} = -15m^7$	16. $\frac{5 \cdot 10p^{4-1}}{3 \cdot 6p^1} = \frac{5p^3}{3}$ $\frac{10}{2} = 5$ $\frac{6}{2} = 3$
17. $\frac{8k^2}{4k^3} = \frac{2}{k}$	18. $\frac{5m^3}{10m^3} = \frac{1}{2}$
19. $\frac{4y^4}{14yx^8} = \frac{2y^3}{7x^8}$	20. $\frac{14x^4y^7}{6x^5y^4} = \frac{7y^3}{3x}$

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$$21. \frac{6 \cancel{12} \cancel{x^4}}{5 \cancel{10} \cancel{x^8-4}} = \frac{6}{5x^4}$$

$$22. \frac{16y^5x^4}{32x^8y^2} = \frac{1y^3}{2x^4}$$

$$23. \frac{4.5 \times 10^5}{2.5 \times 10^3}$$

$$24. \frac{2.5 \times 10^9}{1.5 \times 10^{15}}$$

$$25. \frac{9.2 \times 10^{15}}{3.2 \times 10^7}$$

$$26. \frac{5.46 \times 10^{35}}{1.3 \times 10^{18}}$$

$$27. \left(\frac{a}{b}\right)^3 = \frac{a^3}{b^3}$$

$$28. \left(\frac{k}{p}\right)^{15} = \frac{k^{15}}{p^{15}}$$

$$29. \left(\frac{x}{y}\right)^2 = \frac{x^2}{y^2}$$

$$30. \left(\frac{n}{m}\right)^{11} = \frac{n^{11}}{m^{11}}$$

$$31. \left(\frac{x^2}{y^3}\right)^3 = \frac{x^{2 \cdot 3}}{y^{3 \cdot 3}} = \frac{x^6}{y^9}$$

$$32. \left(\frac{n^2}{2m^5}\right)^9 = \frac{n^{2 \cdot 9}}{2^9 m^{5 \cdot 9}} = \frac{n^{18}}{512m^{45}}$$

$$33. \left(\frac{a^2}{b^3}\right)^4 = \frac{a^8}{b^{12}}$$

$$34. \left(\frac{3a^2}{2b^3}\right)^4 = \frac{81a^8}{16b^{12}}$$

$$35. \left(\frac{x^5y}{y^3-1}\right)^7 = \left(\frac{x^5}{y^2}\right)^7 = \frac{x^{5 \cdot 7}}{y^{2 \cdot 7}} = \frac{x^{35}}{y^{14}}$$

$$36. \left(\frac{xy^5}{y^3}\right)^6 = (xy^2)^6 = x^6y^{2 \cdot 6} = x^6y^{12}$$

$$37. \left(\frac{x^3y^2}{m^5x^2}\right)^2 = \frac{x^6y^4}{m^{10}x^4} = \frac{x^2y^4}{m^{10}}$$

$$38. \left(\frac{5x^3m^3y^2}{3m^2y^5}\right)^3 = \frac{5^3x^9}{3^3m^6y^9} = \frac{125x^9}{27m^6y^9}$$

$$39. \left(\frac{a^3b}{m^5}\right)^x = \frac{a^{3x}b^x}{m^{5x}}$$

$$40. \left(\frac{a^kb^4}{m^5}\right)^x = \frac{a^{kx}b^{4x}}{m^{5x}}$$

skip

23-26 skip

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Zero and Negative Exponents Algebra 1

T7-3

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.

$$\frac{x^{4-4}}{x^4} = x^0$$

$$\frac{x^{10-10}}{x^{10}} = x^0$$

$$\frac{y^{7-7}}{y^7} = y^0$$

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

Anything divided by itself is 1 so anything to zero power was divided by itself.

Exercise #2: Simplify each of the following:

(a) $125^0 = 1$

(b) $(2y)^0 = 1$

(c) $5x^0 = 5 \cdot 1 = 5$

(d) $(2x^0)^3 = (2 \cdot 1)^3 = 2^3 = 8$

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.

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

$$\text{OR } \frac{x^{2-5}}{x^0} = x^{-3}$$

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

$$\frac{x^2}{x^5} = \frac{1}{x^3}$$

When "more" powers on other side of fraction

Exercise #4: Rewrite each expression in simplest terms without the use of negative exponents. the exp is Neg. so move to "pos" side

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

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

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

(d) $y^{-10} = \frac{1}{y^{10}}$

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

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

too many on top! so neg on bottom means pos on top!

NEGATIVE AND ZERO EXPONENTS (a neg is a reciprocal)

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

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

Exercise #6: Which of the following is equivalent to $\frac{x^{-2}y^5}{x^{-5}y^{-3}}$? Circle each thing. Move it/chg it simplify more.

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

$\frac{y^5 x^{5-2} y^3}{x^2} = x^3 y^8$

$\frac{x^3 y^8}{1}$

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

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

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

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. number STO→ letter ENTER

(a) $(ab^{-2})^{-c} = (-1 \cdot \frac{1}{2^2})^{-3} = (-1 \cdot 2^{-2})^{-3} = (-\frac{1}{4})^{-3} = (-\frac{4}{1})^3 = -64$ (b) $(abc)^{-1} = -\frac{1}{6}$ (c) $(\frac{a^{-2}}{b^2 c^{15}})^0 = 1$ (d) $a^{-b} b^{-c} c^{-a} = (-1)^{-2} 2^{-3} 3^{+1} = \frac{1}{(-1)^2} \cdot \frac{1}{2^3} \cdot 3 = \frac{1}{1} \cdot \frac{1}{8} \cdot 3 = \frac{3}{8}$

$(-1 \cdot 2 \cdot 3)^{-1} = \frac{1}{(-6)^1} = -\frac{1}{6}$

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Zero and Negative Exponents Algebra 1 Homework

Skills

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

1. $4^{-3} = \frac{1}{4^3}$

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

3. $5^0 = 1$

4. $10^{-2} = \frac{1}{10^2}$

5. $-4^{-3} = \frac{-1}{4^3}$

6. $2^{-4} = \frac{1}{2^4}$

7. $\frac{1}{2^{-2}} = 2^2$

8. $\frac{1}{4^0} = 1$

9. $(-3)^{-2} = \frac{1}{(-3)^2} = \frac{1}{9}$

10. $3x^0 = 3 \cdot 1 = 3$

11. $5x^{-4} = \frac{5}{x^4}$

12. $\frac{x^5}{y^{-3}} = x^5 y^3$

13. $\frac{a^{-4}}{b^{-3}} = \frac{b^3}{a^4}$

14. $-2x^0 y^{-2} = \frac{-2}{y^2}$

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

16. $(16x^2 y^{-5})^0 = 1$

17. $-3^0 = -1$

18. $8x^0 y^{-3} = \frac{8}{y^3}$

19. $(-3)^{-3} = \frac{1}{(-3)^3} = -\frac{1}{27}$

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

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

22. $(\frac{1}{3})^{-1} = \frac{3}{1}$

23. $1^{-6} = \frac{1}{1^6}$

24. $(-5)^0 = 1$

25. $(-1)^{-2} = \frac{1}{(-1)^2} = 1$

26. $-2^{-1} = \frac{-1}{2^1} = -\frac{1}{2}$

27. $(-2)^{-1} = \frac{1}{-2}$

28. $(-2)^{-2} = \frac{1}{(-2)^2} = \frac{1}{4}$

29. $(-2^{-2})^{-1} = -2^2 = -4$

30. $\frac{2x^{-3}y^2}{4x^{-4}y^{-1}} = \frac{1y^3x}{2}$

31. $a^3 b^{-4} = \frac{a^3}{b^4}$

32. $\frac{a^{-2}}{b^4} = \frac{1}{a^2 b^4}$

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

34. $\frac{-3x^3}{y^{-4}} = -3x^3 y^4$

35. $\frac{x^0 y^{-3}}{z^2} = \frac{1}{z^2 y^3}$

36. $2x^{-1} y^{-4} = \frac{2}{xy^4}$

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

37. y^{-3} for $y=2$ $(2)^{-3} = \frac{1}{2^3}$

38. y^{-3} for $y=\frac{1}{2}$ $(\frac{1}{2})^{-3} = (\frac{2}{1})^3 = 8$

39. $2x^{-4}y^{-1}$ for $x=2, y=\frac{1}{3}$
 $2(2)^{-4}(\frac{1}{3})^{-1} = 2 \cdot \frac{1}{16} \cdot \frac{3}{1} = \frac{3}{2^3} = \frac{3}{8}$

40. $(x+3)^{-2}$ for $x=-4$
 $(-4+3)^{-2} = (-1)^{-2} = \frac{1}{(-1)^2} = 1$

41. x^{-y} for $x=-2, y=2$
 $(-2)^{-2} = \frac{1}{(-2)^2} = \frac{1}{4}$

42. $(x^4 y^2)^0$ for $x=\frac{4}{3}, y=-\frac{2}{7}$
 $= 1$

43. $x^y x^{-y}$ for $x=\frac{2}{5}, y=-\frac{4}{3}$

$(\frac{2}{5})^{-\frac{4}{3}} \cdot (\frac{2}{5})^{\frac{4}{3}} = (\frac{2}{5})^0 = 1$

$x^y \cdot x^{-y} = x^{y-y} = x^0 = 1$

Reasoning

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

44. $\frac{1}{9} = 3^{\square} 3^{-2}$

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

46. $\frac{1}{25} = \square^{-2} 5^{-2}$

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

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

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

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

51. $\frac{1}{64} = 4^{\square} 4^{-3}$

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

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

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

54. $\left[3^{-1} + \frac{8}{3}\right]^{-3} = \left(\frac{1}{27}\right)$
 $\left(\frac{1}{3} + \frac{8}{3}\right)^{-3} = \left(\frac{9}{3}\right)^{-3} = \left(\frac{3}{9}\right)^3$

55. Evaluate each of the following products:

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

(b) $5^2 \cdot 5^{-2} = 5^0 = 1$

(c) $10^{-4} \cdot 10^4 = 10^0 = 1$

(d) $x^a \cdot x^{-a} = x^0 = 1$

56. Which of the following is correct?

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

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

Explain why the other choice is incorrect.

The 2 does not go down.

True or False

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

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

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

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

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

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

63. $(-4)^0 = 0$ F $= 1$

64. $\frac{2^{-3} \cdot 2^3 \cdot 2^0}{2^0 \cdot 2^0} = 2$ F $= 1$

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

Find the value of x that makes each statement true.

66. $2^x \cdot 2^4 = 2^{12}$
 $x = 8$

67. $5^{-2} \cdot 5^x = 5^9$
 $-2 + x = 9$ $x = 11$

68. $(4^x)^2 = 4^{10}$
 $2x = 10$ $x = 5$

69. $3^{x-2} = 27$ $27 = 3^3$
 $3^{x-2} = 3^3$ $x-2 = 3$
 $x = 1$

70. $(4^2 \cdot 3^{-2} \cdot 5^4)^x = 1$
 $x = 0$

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

Simplify the following expressions. Your answers should contain only positive exponents.

1. $(x^{-2}x^{-3})^4$

$$x^{-8}x^{-12} = \frac{1}{x^{20}}$$

2. $(x^4)^{-3} \cdot 2x^4$

$$x^{-12} \cdot 2x^4 = \frac{2x^4}{x^{12-4}} = \frac{2}{x^8}$$

T7-3

3. $\frac{2y^3 \cdot \cancel{xy^3}}{\cancel{xy^3} \cdot 2y^4} = \frac{2y^6 \cdot \cancel{x}}{\cancel{y^4} \cdot x^{2-1}} = \frac{2y^2}{x}$

4. $\frac{3x^2y^2}{2x^{-1} \cdot 4yx^2} = \frac{3x^2xy^{2-1}}{8x^2y} = \frac{3xy}{8}$

5. $\frac{x}{(2x^0)^2} = \frac{x}{2^2} = \frac{x}{4}$

$$(2x^0)^2 = (2 \cdot 1)^2 = 2^2 = 4$$

6. $\frac{2m^{-4}}{(2m^{-4})^3} = \frac{2m^2}{m^4 \cdot 2^3 \cdot m^{12}} = \frac{2m^8}{2^3} = \frac{m^8}{2^2}$

7. $x^4y^3(2y^2)^0 \cdot 1$

$$x^4y^3$$

8. $ba^4(2ba^4)^{-3}$

$$\frac{ba^4}{(2ba^4)^3} = \frac{ba^4}{2^3 b^{3+12-4}} = \frac{1}{8ba^8}$$

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

$$\frac{x^{-12}x^4}{2x^{-3}} = \frac{x^3x^4}{2x^{12}} = \frac{1}{2x^5}$$

10. $\frac{(2hj^2h^4j^{-1}k^4)^0}{2h^{-3}j^{-4}k^{-2}} = \frac{1}{2h^3j^4k^2}$

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11) $\frac{(2m^2)^{-1}}{m^2}$

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

13) $(a^{-3}b^{-3})^0$

14) $x^4y^3 \cdot (2y^2)^0$

15) $ba^4 \cdot (2ba^4)^{-3}$

16) $(2x^0y^2)^{-3} \cdot 2yx^3$

17) $\frac{2k^3 \cdot k^2}{k^{-3}}$

18) $\frac{(x^{-3})^4 x^4}{2x^{-3}}$

19) $\frac{(2x)^{-4}}{x^{-1} \cdot x}$

20) $\frac{(2x^3z^2)^3}{x^3y^4z^2 \cdot x^{-4}z^3}$

21) $\frac{(2pm^{-1}q^0)^{-4} \cdot 2m^{-1}p^3}{2pq^2}$

22) $\frac{(2hj^2k^{-2} \cdot h^4j^{-1}k^4)^0}{2h^{-3}j^{-4}k^{-2}}$

Key

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T 7-4 Skills Practice

Rational Exponents

Write each expression in radical form, or write each radical in exponential form.

1. $(8x)^{\frac{3}{2}}$ $\sqrt[2]{8x}^3$

2. $6z^{\frac{1}{2}}$ $6\sqrt{z}$

3. $(\sqrt[4]{19})^3$ $19^{\frac{3}{4}}$

4. $\sqrt{11} = 11^{\frac{1}{2}}$

5. $19x^{\frac{1}{2}} = 19\sqrt{x}$

6. $\sqrt[5]{34} = 34^{\frac{1}{5}}$

7. $\sqrt{27g}$ $(27g)^{\frac{1}{2}}$

8. $33gh^{\frac{1}{2}}$ $33g\sqrt{h}$

9. $\sqrt{13abc}$ $(13abc)^{\frac{1}{2}}$

Simplify.

10. $(\frac{1}{16})^{\frac{1}{4}} = \frac{1}{2}$

11. $\sqrt[5]{3125} = 5$

12. $729^{\frac{1}{3}}$ $\sqrt[3]{729} = 9$

13. $(\frac{1}{32})^{\frac{1}{5}} = \frac{1}{\sqrt[5]{32}} = \frac{1}{2}$

14. $\sqrt[6]{4096} = 4$

15. $1024^{\frac{2}{5}}$

$\sqrt[5]{1024} = 4$

$(\sqrt[5]{1024})^2$

$(4)^2 = 16$

2 exponent
5 index

16. $\left(\frac{16}{625}\right)^{\frac{3}{4}}$

$$\frac{\sqrt[4]{16}^3}{\sqrt[4]{625}^3} = \frac{2^3}{5^3}$$

$$= \frac{8}{125}$$

$\sqrt[4]{16} = 2$

$\sqrt[4]{625} = 5$

17. $\sqrt[6]{15,625} = 5$

$$\begin{array}{c} \wedge \\ 5 \quad 3125 \\ \wedge \\ 5 \quad 625 \\ \wedge \\ 5 \quad 125 \\ \wedge \\ 5 \quad 25 \\ \wedge \\ 5 \quad 5 \end{array}$$

18. $117,649^{\frac{1}{6}} = 7$

$$\sqrt[6]{7^6} = 7$$

Solve each equation.

19. $2^x = 512$

$2^x = 2^9$

$x = 9$

20. $3^x = 6561$

$3^x = 3^8$

$x = 8$

21. $6^x = 46,656$

$6^x = 6^6$

$x = 6$

22. $5^x = 125$

$5^x = 5^3$

$x = 3$

23. $3^{x-3} = 243$

$3^{x-3} = 3^5$

$x-3 = 5$

$x = 8$

24. $4^{x-1} = 1024$

$4^{x-1} = 4^5$

$x-1 = 5$

$x = 6$

25. $6^{x-1} = 1296$

$6^{x-1} = 6^4$

$x-1 = 4$

$x = 5$

26. $2^{4x+3} = 2048$

$2^{4x+3} = 2^{11}$

$$\begin{array}{r} 4x+3 = 11 \\ -3 \quad -3 \\ \hline 4x = 8 \end{array}$$

$4x = 8$

$x = 2$

27. $3^{3x+3} = 6561$

$3^{3x+3} = 3^8$

$$\begin{array}{r} 3x+3 = 8 \\ -3 \quad -3 \\ \hline 3x = 5 \end{array}$$

$$\frac{3x}{3} = \frac{5}{3}$$

$x = \frac{5}{3}$