A. <u>Positive integer exponents</u>:

Meaning of exponents:

example: $3^4 = 3 \times 3 \times 3 \times 3$
$= 3 \cdot 3 \cdot 3 \cdot 3 = 81$

example: $4^3 = 4 \cdot 4 \cdot 4 = 64$

Problems 1-12: Find the value:

1. $3^2 =$

2. $2^3 =$

3. $(-3)^2 =$

4. $-(3)^2 =$

5. $-3^2 = -(3^2) =$

6. $-2^3 =$

7. $(-2)^3 =$

8. $100^2 =$

9. $(2.1)^2 =$

10. $(-.1)^3 =$

11. $\left(\frac{2}{3}\right)^3 =$

12. $\left(-\frac{2}{3}\right)^3 =$

Answers

1. 9
2. 8
3. 9
4. −9
5. −9
6. −8
7. −8
8. 10,000
9. 4.41
10. −.001
11. $\frac{8}{27}$
12. $-\frac{8}{27}$

a^b means use a as a factor b times. (b is the exponent or power of a)

example: 2^5 means $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

2^5 has a value 32

5 is the exponent or power

2 is the factor

example: $5 \cdot 5$ can be written 5^2. Its value is 25.

example: $4^1 = 4$

Problems 13-24: Write the meaning and find the value:

13. $6^3 =$

14. $(-4)^2 =$

15. $0^4 =$

16. $7^1 =$

17. $1^4 =$

18. $(-1)^3 =$

19. $(0.1)^4 =$

20. $\left(\frac{2}{3}\right)^4 =$

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

22. $2^{10} =$

23. $(.03)^2 =$

24. $3^2 \cdot 2^3 =$

Answers

13. $6 \cdot 6 \cdot 6 = 216$

14. $(-4)(-4) = 16$

15. $0 \cdot 0 \cdot 0 \cdot 0 = 0$

16. $7 = 7$

17. $1 \cdot 1 \cdot 1 \cdot 1 = 1$

18. $(-1)(-1)(-1) = -1$

19. $(.1)(.1)(.1)(.1)$
    $= .0001$

20. $\frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \frac{16}{81}$

21. $\frac{3}{2} \cdot \frac{3}{2} = \frac{9}{4} = 2\frac{1}{4}$

22. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
    $\cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
    $= 1024$

23. $(.03)(.03) = .0009$

24. $3 \cdot 3 \cdot 2 \cdot 2 \cdot 2 = 72$

example: $\frac{8}{2^4} = \frac{8}{16} = \frac{1}{2}$

example: $\frac{6^3}{6^2} = \frac{216}{36} = 6$

Problems 25-30: Simplify:

25. $\frac{6}{3^2} =$

26. $\frac{2^5}{8} =$

27. $\frac{4 \cdot 5}{10} =$

28. $\frac{10}{4^2 \cdot 5} =$

29. $\frac{2^3 \cdot 2^4}{2^5 \cdot 2} =$

30. $\frac{5 \cdot 12}{6^2 \cdot 10} =$

Problems 31-38: Find the value:

31. $3^2 + 4^2 =$

32. $5^2 =$

33. $3^2 + 4^2 + 12^2 =$

34. $13^2 =$

35. $(3.1)^2 - (.03)^2 =$

36. $(3.1)^2 + (.03)^2 =$

37. $3^3 + 4^3 + 5^3 =$

38. $6^3 =$

Answers

25. $\frac{2}{3}$

26. 4

27. 2

28. $\frac{1}{8}$

29. 2

30. $\frac{1}{6}$

31. 25

32. 25

33. 169

34. 169

35. 9.6091

36. 9.6109

37. 216

38. 216

B. <u>Integer exponent laws</u>:

Problems 39-40: Write the meaning (not the value)

39. $3^2 =$ | 40. $3^4 =$

41. Write as a power of 3: $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 =$

42. Write the meaning: $3^2 \cdot 3^4 =$

43. Write your answer to 42 as a power of 3, then find the value.

44. Now find each value and solve: $3^2 \cdot 3^4 =$

45. So $3^2 \cdot 3^4 = 3^6$. Circle each of the powers. Note how the circled numbers are related.

46. How are they related?

Problems 47-52: Write each expression as a power of the same factor:

example: $3^2 \cdot 3^4 = 3^6$

47. $4^1 \cdot 4^2 =$ | 50. $(-1)^5 \cdot (-1)^4 =$

48. $5^3 \cdot 5^3 =$ | 51. $10 \cdot 10^4 =$

49. $3^3 \cdot 3 =$ | 52. $10 \cdot 10 =$

53. Make a formula by filling in the brackets: $a^b \cdot a^c = a^{[\ \ ]}$. This is an exponent rule.

Answers

39. $3 \cdot 3$

40. $3 \cdot 3 \cdot 3 \cdot 3$

41. 3^6

42. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

43. $3^6 = 729$

44. $9 \cdot 81 = 729$

45. $3^{(2)} \cdot 3^{(4)} = 3^{(6)}$

46. $2 + 4 = 6$

47. 4^3

48. 5^6

49. 3^4

50. $(-1)^9$

51. 10^5

52. 10^2

53. $a^b \cdot a^c = a^{[b+c]}$

54. $3^6 =$ | 55. $3^4 =$ | 56. $729 \div 81 =$

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note: $3^6 \div 3^4 = \frac{3^6}{3^4} = \frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3}$

$= \frac{3}{3} \cdot \frac{3}{3} \cdot \frac{3}{3} \cdot \frac{3}{3} \cdot 3 \cdot 3 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 3 \cdot 3 = 3^2$

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57. Circle the exponents: $\frac{3^6}{3^4} = 3^2$

58. How are the circled numbers related?

Problems 59-63: Write each expression as a power

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example: $\frac{3^6}{3^4} = 3^2$

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59. $2^4 \div 2^4 =$ | 60. $\frac{2^5}{2} =$

Answers

54. 729
55. 81
56. 9
57. $\dfrac{3^{(6)}}{3^{(4)}} = 3^{(2)}$
58. $6 - 4 = 2$
59. 2^0
60. 2^4

61. $\frac{5^2}{5} =$

63. $\frac{1^5}{1^3} =$

62. $\frac{(-4)^7}{(-4)^2} =$

64. Make a formula by filling in the brackets:
$\frac{a^b}{a^c} = a^{[\quad]}$. This is another exponent rule.

Problems 65-67: Find each value:

65. $4^3 =$

67. $\left(4^3\right)^2 = \left(64\right)^2 =$

66. $4^6 =$

Problems 68-69: Write the meaning of each expression:

Answers

61. 5^1

62. $(-4)^5$

63. 1^2 (or any power of 1)

64. $\dfrac{a^b}{a^c} = a^{[b-c]}$

65. 64

66. 4096

67. 4096

example: $\left(4^3\right)^2 = 4^3 \bullet 4^3 = 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4$

$$= 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 = 4^6$$

68. $\left(3^2\right)^4 =$

69. $\left(5^1\right)^3 =$

70. Circle the three exponents: $\left(4^3\right)^2 = 4^6$

71. What is the relation of the circled numbers?

72. Make a rule: $\left(a^b\right)^c = a^{[\quad]}$

73. Write your three exponent rules below:

    I. $a^b \bullet a^c =$

    II. $\dfrac{a^b}{a^c} =$

    III. $\left(a^b\right)^c =$

Problems 74-80: Use the rules to write each expression as a power of the factor, and tell which rule you're using:

74. $3^4 \bullet 3^6 =$

75. $\dfrac{2^{10}}{2^5} =$

76. $\left(2^5\right)^2 =$

77. $\left(3^4\right)^4 =$

78. $\dfrac{3^4}{3} =$

79. $\left(5^1\right)^2 =$

80. $10^4 \bullet 10^3 =$

Answers

68. $3^2 \cdot 3^2 \cdot 3^2 \cdot 3^2$

69. $5 \cdot 5 \cdot 5$

70. $\left(4^{(3)}\right)^{(2)} = 4^{(6)}$

71. $3 \times 2 = 6$

72. $\left(a^b\right)^c = a^{[bc]}$

73. I. $a^b \cdot a^c = a^{b+c}$

    II. $\dfrac{a^b}{a^c} = a^{b-c}$

    III. $\left(a^b\right)^c = a^{bc}$

74. 3^{10} , rule I

75. 2^5 , rule II

76. 2^{10} , rule III

77. 3^{16} , rule III

78. 3^3 , rule II

79. 5^2 , rule III

80. 10^7 , rule I