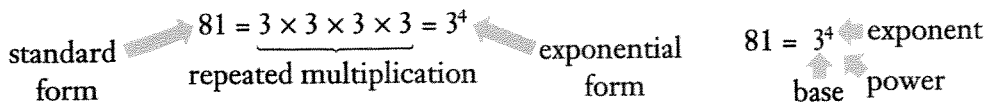


Exponents and Powers

Exponents are used as a short way to write repeated multiplication.



Activity: Do an Experiment

When you repeatedly fold a piece of paper in half, the number of layers increases with the number of folds. Fold a standard piece of paper, and copy and complete the table.

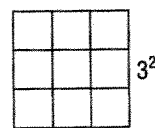
Number of Folds	Number of Layers
1	$2 = 2$ or 2^1
2	$2 \times 2 = 4$ or 2^2
3	
4	
5	
6	

Inquire

- If you were to fold the piece of paper the following numbers of times, how many layers would you have? Express each answer in exponential form.
a) 5 b) 7 c) 50
- Explain how you found your answers to question 1.
- If 10 layers of paper are about 1 mm thick, how thick is a piece of paper after 10 folds?
- What is the maximum number of times you can fold a piece of paper?

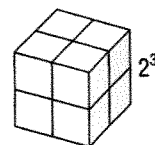
$$3 \times 3 = 3^2$$

3^2 is read as "three to the second" or more commonly "three squared" because it can be pictured as a square.



$$2 \times 2 \times 2 = 2^3$$

2^3 is read as "two to the third" or "two cubed" because it can be pictured as a cube.



Exponents are also used with variables.

$$3y^4 \text{ means } 3 \times y \times y \times y \times y$$

$$xy^2 \text{ means } x \times y \times y$$

A number that multiplies a variable is known as a **coefficient**.

In $3y^4$, the coefficient is 3.

When an exponent is outside a pair of brackets, the exponent is applied to everything inside the brackets.

$$\begin{aligned} (3y)^4 &\text{ means } (3y) \times (3y) \times (3y) \times (3y) \\ &= 3 \times 3 \times 3 \times 3 \times y \times y \times y \times y \\ &= 81y^4 \end{aligned}$$

$$\begin{aligned} (xy)^2 &\text{ means } (xy) \times (xy) \\ &= x \times x \times y \times y \\ &= x^2y^2 \end{aligned}$$

Example 1

If $x = 2$ and $y = -3$, evaluate $5x^4 + 6xy$.

Solution

Substitute the values of x and y into the expression.

$$\begin{aligned} 5x^4 + 6xy &= 5(2)^4 + 6(2)(-3) \\ &= 5(16) - 36 \\ &= 80 - 36 \\ &= 44 \end{aligned}$$

Exponents & Powers Practice

Practice

State the base and the exponent.

1. 5^3 2. 10^7 3. x^5 4. t^2

State the coefficient.

5. $2a$ 6. $-7d^2$ 7. $13x^5$ 8. $-t^3$

Write in exponential form.

9. $4 \times 4 \times 4 \times 4 \times 4 \times 4$

10. $6 \times 6 \times 6 \times 6$

11. $m \times m \times m \times m \times m$

12. $r \times r \times r$

Write as a repeated multiplication.

13. 5^2 14. 1^6 15. 2^5 16. 10^4

17. 0^3 18. y^4 19. $5x^3$ 20. $(2m)^3$

21. x^2y 22. xy^3 23. $(xy)^3$ 24. $(ab)^4$

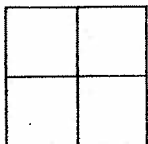
Evaluate.

25. the third power of 2 26. 3 to the fourth

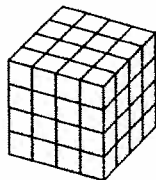
27. 5 cubed 28. 10 to the fifth

What power does each figure represent?

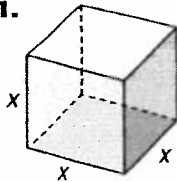
29.



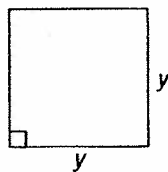
30.



31.



32.



Write each number as a power of 10.

33. 100

34. 1000

35. 100 000

36. 1 000 000

37. 100 000 000

38. 10 000 000

Write in standard form.

39. 2^5 40. 5^3 41. 4^4 42. 7^3 43. 10^7

44. 3^6 45. 0.5^2 46. 1.1^3 47. 0.1^4

Write as a power of 2 or 3 and draw the square or cube represented by it.

48. 4

49. 27

50. 16

State which is smaller.

51. 5^3 or 3^5

52. 2^5 or 5^2

53. 4^2 or 2^4

54. 2^3 or 3^2

Evaluate.

55. $7^2 + 3^2$

56. $4^3 - 2^4$

57. 3×2^3

58. $4^4 \div 2^5$

59. 100×0.1^3

60. $0.8^2 \times 0.2^3$

61. 1000×0.2^4

62. 0.1×0.1^2

Evaluate.

63. $7^2 + 3^3$

64. $4^3 - 2^2$

65. $2^2 \times 2^3$

66. $4^2 + 2^2$

67. Evaluate for $x = -4$.

a) x^3

b) $x^2 - 5$

c) $5x^2 - 7$

d) $(2x)^2$

68. Evaluate for $t = -3$ and $s = 2$.

a) $t^2 + s^2$

b) $(t + s)^3$

c) $t^3 - s^3$

d) $2t^2 - s^2$

e) $6s^3 - 2st$

f) $(3t)^2 - 4st$

Evaluate:

69. $(-3)^2$

73. 2^3

70. -3^2

74. $(-2)^3$

71. $-(3)^2$

75. -2^3

72. $-(-3)^2$

76. $-(-2)^3$

Order of Operations and Exponents

What does BEDMAS stand for?

B	E	D*	M*	A**	S**
*What order do you do D & M?			**What order do you do A & S?		

Evaluate each of the following and record the process. (Show your work)

<p>1) $(-3)^2 - 2^3 =$ Possible solution strategy: $= (-3)^2 - 2^3 \rightarrow (-3 \times -3) - 2 \times 2 \times 2$ $= 9 - 8$ $= 1$</p>	<p>2) $5^2 + 3^3 =$</p>	<p>3) $(-3)^2 + (-2)^3 =$</p>	<p>4) $(-3)^2 - (-2)^3 =$</p>
<p>5) $(-3)^2 - 2^3 =$</p>	<p>6) $-3^2 - 2^3 =$</p>	<p>7) $-3^2 - (2)^3 =$</p>	<p>8) $3^2 - 2^3 =$</p>
<p>9) $(5 - 3 \times 2)^3 =$</p>	<p>10) $(5 + 1 \times 2)^2 =$</p>	<p>11) $(3 - 2 \times 2)^2 =$</p>	<p>Spot the error. 12) $(5 - 3 \times 2)^2 =$ $= (2 \times 2)^2$ $= (4)^2$ $= 16$</p>
<p>13) $2(3 - 2^3)^3 + 5^2$ Possible solution strategy: $= 2(3 - 2^3)^3 + 5^2$ $= 2(3 - 8)^3 + 25$ $= 2(-5)^3 + 25$ $= 2(-125) + 25$ $= -250 + 25$ $= -10$ <i>Is it correct?</i></p>	<p>14) $(5^2 - 7 \times 3)^2 =$</p>	<p>15) $(18 - 5 \times 2^2)^2 =$</p>	<p>16) $(40 - 2^3 \times 5)^2 =$</p>

Insert brackets to make each statement true.

<p>17) $6 + 3^2 \div 3 = 27$</p>	<p>18) $9 - 5 - 2^3 \times 3 + 2^2 = 200$</p>	<p>19) $30 - 3 + 2^2 \times 10^2 = 500$</p>
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Where Will Campers Sleep in 20 Years ?

Do each exercise below, following the directions given for each section. Select your answer from the two choices given and circle the letter next to it. Write this letter in the box at the bottom of the page that contains the number of that exercise.

Write each expression in exponential form.

- | | | |
|---|---------------|-----------------------|
| ① $x \cdot x \cdot x \cdot x$ | Ⓐ x^3 | Ⓔ x^4 |
| ② k cubed | Ⓝ k^3 | Ⓡ k^6 |
| ③ $12 \cdot m \cdot n \cdot n$ | Ⓜ $12mn$ | Ⓢ $12mn^2$ |
| ④ $\frac{1}{3} \cdot u \cdot u \cdot u \cdot v \cdot v$ | Ⓞ uv^2 | Ⓣ $\frac{1}{3}u^3v^2$ |
| ⑤ $(a + b)(a + b)(a + b)$ | Ⓔ $(a + b)^3$ | Ⓛ $a^3 + b^3$ |
| ⑥ $(c + d)(c + d)(c - d)$ | Ⓐ $(c - d)^3$ | Ⓤ $(c + d)^2(c - d)$ |
| ⑦ $-7 \cdot x \cdot (x + 3)(x + 3)$ | Ⓐ $-21x^3$ | Ⓡ $-7x(x + 3)^2$ |
| ⑧ $(x + y)$ squared | Ⓔ $(x + y)^2$ | Ⓡ $x^2 + y^2$ |
| ⑨ the fifth power of the product of p and q | Ⓡ $(pq)^5$ | Ⓞ $(p + 5)q$ |

Evaluate each expression for the given values of the variables.

- | | | |
|--|---------|---------|
| ⑩ $x^2 - 3xy$ if $x = 5, y = 2$ | Ⓣ -5 | Ⓡ 10 |
| ⑪ $x^2 - y^2$ if $x = -7, y = -1$ | Ⓜ 48 | Ⓡ 52 |
| ⑫ $(x - y)^3$ if $x = 2, y = -4$ | Ⓐ 256 | Ⓤ 216 |
| ⑬ $xy^2 - 2x^3$ if $x = 3, y = 2$ | ⓕ -42 | Ⓟ -56 |
| ⑭ $\frac{-5a^2}{a - b}$ if $a = -4, b = 6$ | Ⓡ 12 | Ⓣ 8 |
| ⑮ $\frac{3ab^3}{(2a)^2}$ if $a = 1, b = -2$ | Ⓟ 4 | Ⓣ -6 |
| ⑯ $\frac{(a + b)^4}{9 - a^2}$ if $a = -5, b = 3$ | Ⓡ 2 | Ⓝ -1 |

9	2	4	11	1	13	6	15	12	7	5	14	8	16	10	3
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