

LESSON

1 Rules for Exponents

Review It!

When you work with exponents, remember these words:

equation a math sentence with an equal (=) sign

base the number that is multiplied by itself

exponent the number of times the base is used as a factor

To multiply numbers with the same base, add the exponents.

To divide numbers with the same base, subtract the exponents.

$$8^3 = 8 \times 8 \times 8$$

↑ exponent
base

$$x^3 \times x^4 = x^{3+4} = x^7$$

$$\frac{x^9}{x^3} = x^{9-3} = x^6$$

What is the value of n in the equation below? What is the value of 3^n ?

$$3^4 \times 3^2 = 3^n$$

Step 1 Simplify the left side.

$$3^4 = 3 \times 3 \times 3 \times 3 \text{ and } 3^2 = 3 \times 3$$

$$3^4 \times 3^2 = (3 \times 3 \times 3 \times 3) \times (3 \times 3) = 3^{4+2} = 3^6$$

Step 2 Find n .

$$3^6 = 3^n, \text{ so } n = 6$$

Step 3 Find the value.

$$3^6 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729$$

REMEMBER To multiply numbers with the same base, add the exponents.

REMEMBER The exponent tells how many times the base is a factor.

So, $n = 6$ and $3^n = 729$.

Try It!

Use an exponent to write each expression.

1. $4 \times 4 \times 4 = \underline{\hspace{2cm}}$ 2. $5 \times 5 \times 5 \times 5 = \underline{\hspace{2cm}}$

3. $10 \times 10 \times 10 \times 10 \times 10 \times 10 = \underline{\hspace{2cm}}$

What is the value of n in each equation?

4. $(9^5)^3 = 9^n$ 5. $\frac{7^4}{7^2} = 7^n$

6. $4^8 \times 4^8 = 4^n$ 7. $\frac{8^9}{8^6} = 8^n$

8. $(6^{16})^{10} = 6^n$ 9. $2^{24} \times 2^{12} = 2^n$

What is the value of each expression?

10. $\frac{9^6}{9^4} = \underline{\hspace{2cm}}$ 11. $(3^2)^4 = \underline{\hspace{2cm}}$

12. $5^2 \times 5^4 = \underline{\hspace{2cm}}$ 13. $\frac{6^5}{6^3} = \underline{\hspace{2cm}}$

Solve.

14. The formula $N = 10(3^t)$ gives N , the number of bacteria present in a culture after t hours. How many bacteria are present in the culture after 2 hours?

15. The formula $B = 10(2^t)$ gives B , the number of bacteria present in a culture after t hours. How many bacteria are present in the culture after 6 hours?



1.

How many factors of 4?
4, or 3?

4.

$(9^5)^3 = ?$
 $9^{5 \times 3}$, or 9^{5+3} ?

10.

$\frac{9^6}{9^4} = ?$
 9^{6-4} , or 9^2 ?

14.

$t = ?$
1, 2, or 3?

On Your Own!

Circle the best answer for each question.

- Which is the same as $8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8$?
 - 8×10
 - 10^8
 - 8^{10}
 - 80^{10}
- What is the value of n in the equation?

$$7^4 \times 7^5 = 7^n$$
 - 24
 - 13
 - 10
 - 2
- What is the value of n in the equation?

$$(8^2)^7 = 8^n$$
 - 49
 - 14
 - 9
 - 5
- What is the value of n in the equation?

$$\frac{3^{14}}{3^7} = 3^n$$
 - 196
 - 28
 - 21
 - 12
- What is the value of $4^3 \times 4^5$?
 - 65,536
 - 16,384
 - 240
 - 60
- What is the value of $(2^3)^3$?
 - 1,024
 - 512
 - 128
 - 64
- The formula $N = 10(2^t)$ gives N , the number of bacteria present in a culture after t hours. How many bacteria are present in the culture after 3 hours?
 - 80
 - 160
 - 320
 - 640
- The formula $X = 10(3^t)$ gives X , the number of bacteria present in a culture after t hours. How many bacteria are present in the culture after 5 hours?
 - 7,290
 - 2,430
 - 729
 - 243

- Scientists calculate that the distance between the asteroid Vesta and Earth is more than $5^7 \times 5^9 = 5^n$ miles. What is the value of n in the equation?
-

- The mass of the asteroid Ida is $10^5 \times 10^8 \times 10^4 = 10^n$ kilograms. What is the value of n in the equation?
-

Math Words

Fill in the blanks.

- To multiply numbers with the same base, such as $a^n \times a^m$, _____ the exponents.
- To raise a number with an exponent to a power, such as $(a^n)^m$, _____ the exponents.
- To simplify the expression $\frac{a^n}{a^m}$, _____ the exponents.