Lesson 2: Multiplication of Numbers in Exponential Form

Classwork

In general, if x is any number and m, n are positive integers, then

$$x^m \cdot x^n = x^{m+n}$$

because

$$x^m \times x^n = \underbrace{x \cdots x}_{m \text{ times}} \times \underbrace{x \cdots x}_{n \text{ times}} = \underbrace{x \cdots x}_{m+n \text{ times}} = x^{m+n}.$$

Exercise 1

$\mathbf{14^{23} \times 14^{8} =}$

Exercise 2

$-72^{\ 10} \times -72^{\ 13} =$

Exercise 3

$5^{94} \times 5^{78} =$

Exercise 4

$-3^{\ 9} \times -3^{\ 5} =$

Exercise 5

Let a be a number.

$a^{23} \cdot a^{8} =$

Exercise 6

Let f be a number.

$f^{10} \cdot f^{13} =$

Exercise 7

Let b be a number.

$\boldsymbol{b^{94} \cdot b^{78} =}$

Exercise 8

Let x be a positive integer. If $-3^{\ 9} \times -3^{\ x} = -3^{\ 14}$, what is x?

What would happen if there were more terms with the same base? Write an equivalent expression for each problem.

Exercise 9

$9^4 \times 9^6 \times 9^{13} =$

Exercise 10

$2^3 \times 2^5 \times 2^7 \times 2^9 =$

Can the following expressions be simplified? If so, write an equivalent expression. If not, explain why not.

Exercise 11

$6^5 \times 4^9 \times 4^3 \times 6^{14} =$

Exercise 12

$-4^{\ 2} \cdot 17^5 \cdot\ -4^{\ 3} \cdot 17^7 =$

Exercise 13

$15^2 \cdot 7^2 \cdot 15 \cdot 7^4 =$

Exercise 14

$2^4 \times 8^2 = 2^4 \times 2^6 =$

Exercise 15

$3^7 \times 9 = 3^7 \times 3^2 =$

Exercise 16

$5^4 \times 2^{11} =$

Exercise 17

Let x be a number. Simplify the expression of the following number:

$2x^3 \quad 17x^7 \ =$

Exercise 18

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$a \ \ a + b \ =$

Exercise 19

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$b\ a+b\ =$

Exercise 20

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$a+b\quad a+b\ =$

In general, if x is nonzero and m, n are positive integers, then

$$\frac{x^m}{x^n} = x^{m-n}, \text{ if } m > n.$$

Exercise 21

$$\frac{7^9}{7^6} =$$

Exercise 22

$$\frac{-5^{\ 16}}{-5^{\ 7}} =$$

Exercise 23

$$\frac{\frac{8}{5}^{\ 9}}{\frac{8}{5}^{\ 2}} =$$

Exercise 24

$$\frac{13^5}{13^4} =$$

Exercise 25

Let a, b be nonzero numbers. What is the following number?

$$\frac{\frac{a}{b}^{9}}{\frac{a}{b}^{2}} =$$

Exercise 26

Let x be a nonzero number. What is the following number?

$$\frac{x^5}{x^4} =$$

Can the following expressions be simplified? If yes, write an equivalent expression for each problem. If not, explain why not.

Exercise 27

$$\frac{2^7}{4^2} = \frac{2^7}{2^4} =$$

Exercise 29

$$\frac{3^5 \cdot 2^8}{3^2 \cdot 2^3} =$$

Exercise 28

$$\frac{3^{23}}{27} = \frac{3^{23}}{3^3} =$$

Exercise 30

$$\frac{-2^{\ 7} \cdot 95^5}{-2^{\ 5} \cdot 95^4} =$$

Exercise 31

Let x be a number. Simplify the expression of each of the following numbers:

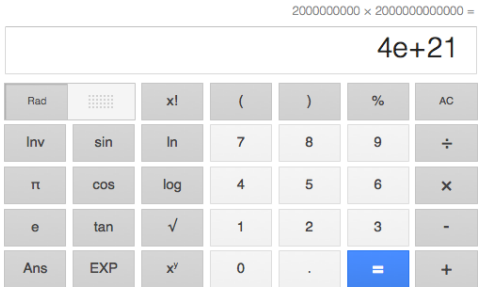
a. $\frac{5}{x^3}\ 3x^8\ =$

b. $\frac{5}{x^3}\ -4x^6\ =$

c. $\frac{5}{x^3}\ 11x^4\ =$

Exercise 32

Anne used an online calculator to multiply $2{,}000{,}000{,}000 \times 2,000,000,000,000$. The answer showed up on the calculator as $4e+21$, as shown below. Is the answer on the calculator correct? How do you know?



Problem Set

1. A certain ball is dropped from a height of x feet. It always bounces up to $\frac{2}{3}x$ feet. Suppose the ball is dropped from 10 feet and is caught exactly when it touches the ground after the 30^{th} bounce. What is the total distance traveled by the ball? Express your answer in exponential notation.

Bounce	Computation of Distance Traveled in Previous Bounce	Total Distance Traveled (in feet)
1		
2		
3		
4		
30		
n		

2. If the same ball is dropped from 10 feet and is caught exactly at the highest point after the 25^{th} bounce, what is the total distance traveled by the ball? Use what you learned from the last problem.

3. Let a and b be numbers and $b \neq 0$, and let m and n be positive integers. Simplify each of the following expressions as much as possible:

$-19^{\,5} \cdot -19^{\,11} =$	$2.7^5 \times 2.7^3 =$
$\frac{7^{10}}{7^3} =$	$\frac{1}{5}^{\,2} \cdot \frac{1}{5}^{\,15} =$
$-\frac{9}{7}^{\,m} \cdot -\frac{9}{7}^{\,n} =$	$\frac{ab^3}{b^2} =$

4. Let the dimensions of a rectangle be $(4 \times 871209^{\,5} + 3 \times 49762105)$ ft. by $7 \times 871209^{\,3} - 49762105^{\,4}$ ft. Determine the area of the rectangle. No need to expand all the powers.

5. A rectangular area of land is being sold off in smaller pieces. The total area of the land is 2^{15} square miles. The pieces being sold are 8^3 square miles in size. How many smaller pieces of land can be sold at the stated size? Compute the actual number of pieces.