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

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

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.

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

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 written in simpler form? 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. Rewrite the expression in a simpler form.

$(2x^3)(17x^7) =$

Exercise 18

Let a and b be numbers. Use the distributive law to rewrite the expression in a simpler form.

$a(a + b) =$

Exercise 19

Let a and b be numbers. Use the distributive law to rewrite the expression in a simpler form.

$b(a + b) =$

Exercise 20

Let a and b be numbers. Use the distributive law to rewrite the expression in a simpler form.

$(a + b)(a + b) =$

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

$$\frac{x^m}{x^n} = x^{m-n}.$$

Exercise 21

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

Exercise 22

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

Exercise 23

$\frac{\left(\frac{8}{5}\right)^9}{\left(\frac{8}{5}\right)^2} =$

Exercise 24

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

Exercise 25

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

$$\frac{\left(\frac{a}{b}\right)^9}{\left(\frac{a}{b}\right)^2} =$$

Exercise 26

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

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

Can the following expressions be written in simpler forms? 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 28

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

Exercise 29

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

Exercise 30

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

Exercise 31

Let x be a number. Write each expression in a simpler form.

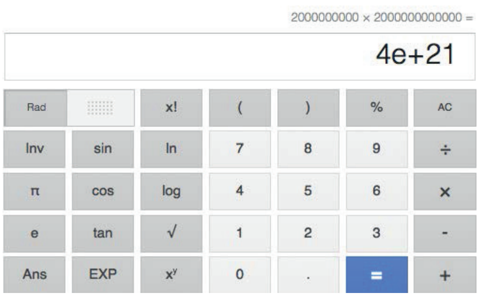
a. $\frac{5}{x^3}(3x^8) =$

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 $4\text{e} + 21$, 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 stopped 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. Write each expression using the fewest number of bases possible:

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

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. (Hint: You do not 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.