Lesson 1.1 – Multiplication of Numbers in Exponential Form

Recall that exponents group common bases that are connected by multiplication. Fill in the missing exponents below.

$$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 7^{(\ )} \qquad 5 \cdot 5 \cdot a \cdot a \cdot a \cdot b = 5^{(\ )} a^{(\ )} b^{(\ )}$$

$$\underbrace{11 \times \cdots \times 11}_{\text{32 times}} = 11^{(\ )} \qquad \underbrace{(-3) \times \cdots \times (-3)}_{\text{17 times}} = (-3)^{(\ )}$$

Also, when an expression is in exponential notation, understanding how to use an exponent allows us to expand the expression. The bases below have large exponents. For the expressions, state the amount of times you would expect to see the base if we were to expand it.

$$4^{19} = \underbrace{4 \times \cdots \times 4}_{\text{\_\_\_ times}} \qquad 15^{48} = \underbrace{15 \times \cdots \times 15}_{\text{\_\_\_ times}}$$

$$5.7^{23} = \underbrace{5.7 \times \cdots \times 5.7}_{\text{\_\_\_ times}} \qquad \left(\frac{3}{4}\right)^{101} = \underbrace{\left(\frac{3}{4}\right) \times \cdots \times \left(\frac{3}{4}\right)}_{\text{\_\_\_ times}}$$

In general, for any number y and any positive integer n, $$y^n = \underbrace{y \times \cdots \times y}_{n \text{ times}}$$	The number $\boldsymbol{y^n}$ is called ***y* raised to the *n*-th power**, ***n*** is the **exponent** of ***y*** in $\boldsymbol{y^n}$ and ***y*** is the **base** of $\boldsymbol{y^n}$.

Multiplication of Numbers in Exponential Form

$$12^7 \times 12^2$$

An example of numbers in exponential form being multiplied.

What happens when we multiply like powers connected by multiplication in an expression?

Having a deep understanding on how to expand or condense an expression using exponents is critical to helping us answer that question. Complete the exercises on the next page.

Class Notes – Expand the expression, then condense it.

LP#1 $4^3 \cdot 4^5$	$8^2 \cdot 8^4$
LP#2 $x^2 \cdot x^3 \cdot x^5$	$y^3 \cdot y^6 \cdot y$
LP#3 $3^3 \cdot 7 \cdot 3^4 \cdot 7^2$	$6^2 \cdot 9^4 \cdot 6^3 \cdot 9^2$

Use what you observe above to complete the following. Combine the like powers below into one power.

$x^a \cdot x^b =$	$x^a \cdot y^c \cdot x^b \cdot y^d =$

When we multiply like bases the exponent for the new expression is the (sum/difference/product/quotient) ___________ of the original exponents.

Class Notes – Simplify the following expressions. Show your work by using one of the two methods below.

Examples of how to show your work.

Expanding and Condensing	Using the algorithm
$3^4 \times 3^2 = 3\cdot3\cdot3\cdot3\times3\cdot3$	$3^4 \times 3^2 = 3^{4+2}$
$= 3^6$	$= 3^6$

LP#4 $7^6 \cdot 7^8$	$3^8 \cdot 3^{10}$	$x^4 \cdot x^7$	$m^9 \cdot m^3$
LP#5 $a^2 \cdot b^2 \cdot a^4$	$6^5 \cdot y \cdot y^9 \cdot 6^4$	$11^2 \cdot 11 \cdot w^2 \cdot 11^5$	$5^3 \cdot 5^6 \cdot p^3 \cdot p$

Review – Simplify the following expressions. Show work.

R#1 $9^8 \cdot 9^{10}$	$5^4 \cdot 5^6$	$b^7 \cdot b^9$	$a \cdot a^4 \cdot a^4$
R#2 $7 \cdot 7^5$	$p^5 \cdot p^2$	$k^2 \cdot k^2 \cdot k^4$	$x^3 \cdot y \cdot y^2 \cdot x^4$
R#3 $12^{11} \cdot 12^9$	$a^8 \cdot b^4 \cdot a^5$	$k^3 \cdot m^5 \cdot m^7$	$3^3 \cdot y \cdot y^5 \cdot 3^4$