

$$(2^4)^3 = (2^4) \times (2^4) \times (2^4) = 2^{4+4+4} = 2^{12}$$

### Lesson 3: Numbers in Exponential Form Raised to a Power

★ Exponents raised together

- 1) keep the base
- 2) multiply the exponents

$$(2^4)^3 = 2^{12}$$

Classwork

ex)  $(3^2)^4 = 3^{2 \times 4} = 3^8$

For any number  $x$  and any positive integers  $m$  and  $n$ ,

$$(x^m)^n = x^{mn}$$

because

$$\begin{aligned} (x^m)^n &= \underbrace{(x \cdot x \cdots x)}_{m \text{ times}}^n \\ &= \underbrace{(x \cdot x \cdots x)}_{m \text{ times}} \times \cdots \times \underbrace{(x \cdot x \cdots x)}_{m \text{ times}} \\ &= x^{mn} \end{aligned}$$

**Exercise 1**

$$(15^3)^9 = 15^{3 \times 9} = 15^{27}$$

**Exercise 3**

$$(3.4^{17})^4 = 3.4^{68}$$

**Exercise 2**

$$((-2)^5)^8 = (-2)^{40}$$

**Exercise 4**

Let  $s$  be a number.  
 $(s^{17})^4 = s^{68}$

**Exercise 5**

Sarah wrote  $(3^5)^7 = 3^{12}$ . Correct her mistake. Write an exponential expression using a base of 3 and exponents of 5, 7, and 12 that would make her answer correct.

$$(3^5)^7 = 3^{5 \times 7} = 3^{35} \quad 3^5 \cdot 3^7 = 3^{5+7} = 3^{12}$$

**Exercise 6**

A number  $y$  satisfies  $y^{24} - 256 = 0$ . What equation does the number  $x = y^4$  satisfy?

$$2(x+3) = 2x + 6$$

For any numbers  $x$  and  $y$ , and positive integer  $n$ ,

because

$$(xy)^n = x^n y^n$$

$$(xy)^n = \underbrace{(xy) \cdots (xy)}_{n \text{ times}}$$

$$= \underbrace{(x \cdot x \cdots x)}_{n \text{ times}} \cdot \underbrace{(y \cdot y \cdots y)}_{n \text{ times}}$$

$$= x^n y^n.$$

$$(xy)^3 = x^3 y^3$$

$$(xy)^3 = (xy)(xy)(xy)$$

$$x \cdot x \cdot x \cdot y \cdot y \cdot y$$

$$x^3 y^3$$

**Exercise 7**

$$(11 \times 4)^2 = 11^2 \times 4^2$$

**Exercise 8**

$$(3^2 \times 7^4)^5 = (3^2)^5 \times (7^4)^5$$

$$= 3^{10} \times 7^{20}$$

**Exercise 9**

Let  $a$ ,  $b$ , and  $c$  be numbers.

$$(3^2 a^4)^5 =$$

**Exercise 10**

Let  $x$  be a number.

$$(5x)^2 = 5^2 x^2$$

**Exercise 11**

Let  $x$  and  $y$  be numbers.

$$(5xy^2)^7 =$$

**Exercise 12**

Let  $a$ ,  $b$ , and  $c$  be numbers.

$$(a^2 b c^3)^4 =$$

**Exercise 13**

Let  $x$  and  $y$  be numbers,  $y \neq 0$ , and let  $n$  be a positive integer. How is  $\left(\frac{x}{y}\right)^n$  related to  $x^n$  and  $y^n$ ?