

**Properties of exponents** are rules used to create equivalent expressions.

► **Properties of exponents** can only be used when **exponential expressions** have the **same base**.

<b>Multiplying</b> $3^2 \times 3^5$	Keep the <u>base</u> , <b>add</b> the <b>exponents</b> .	$3^2 \times 3^5 = 3^{2+5}$ $= 3^7$ $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^7$
<b>Dividing</b> $\frac{4^7}{4^2}$	Keep the <u>base</u> , <b>subtract</b> the <b>exponents</b> .	$\frac{4^7}{4^2} = 4^{7-2}$ $= 4^5$ $\frac{\cancel{4} \times \cancel{4} \times 4 \times 4 \times 4 \times 4 \times 4}{\cancel{4} \times \cancel{4}} = 4^5$

Exponent rules **CANNOT** be used when the **bases are different**:

$$5^2 \times 4^3$$

$$\frac{3^4}{4^3}$$

### CFU

Which exponential expression can use an exponential rule?

Explain.

**A**  $3^4 \times 2^4$

**B**  $4^3 \times 4^2$

Which exponential expression can use an exponential rule?

Explain.

**A**  $\frac{7^8}{7^5}$

**B**  $\frac{9^2}{3^2}$

1 Determine which property of exponents to apply.

*Hint: Be sure the bases are the same.*

2 Create an equivalent expression using properties of exponents.

3 Interpret the exponential expression. “ \_\_\_\_ is equivalent to \_\_\_\_.”

1.

$$2^2 \times 2^4$$

2.

$$3^2 \times 3^3$$

3.

$$\frac{6^7}{6^4}$$

4.

$$\frac{5^6}{5^2}$$

5.

$$\frac{4^3 \times 4^2}{3^5}$$

6.

$$\frac{2^2 \times 2^3}{5^3}$$

7.

$$\frac{3^2 \times 4^7}{4^4}$$

8.

$$\frac{2^2 \times 5^8}{5^7}$$

**Properties of exponents** are rules used to create equivalent expressions.

► **Properties of exponents** can only be used when **exponential expressions** have the **same base**.

<b>Multiplying</b> $3^2 \times 3^5$	Keep the <u>base</u> , <b>add</b> the <b>exponents</b> .	$3^2 \times 3^5 = 3^{2+5}$ $= 3^7$
<b>Dividing</b> $\frac{4^7}{4^2}$	Keep the <u>base</u> , <b>subtract</b> the <b>exponents</b> .	$\frac{4^7}{4^2} = 4^{7-2}$ $= 4^5$
<b>Raising to a power</b> $(5^4)^3$	Keep the <u>base</u> , <b>multiply</b> the <b>exponents</b> .	$(5^4)^3 = 5^{4 \times 3}$ $= 5^{12}$ $5^4 \times 5^4 \times 5^4 = 5^{12}$

Exponent rules **CANNOT** be used when the **bases are different**:

$5^2 \times 4^3$

$\frac{3^4}{4^3}$

$5(4^3)$

### CFU

Which exponential expression can use an exponential rule?  
Explain.

**A**  $4^3 \times 3^4$

**B**  $(4^3)^2$

1 Determine which property of exponents to apply.

*Hint: Be sure the bases are the same.*

2 Create an equivalent expression using properties of exponents.

3 Interpret the exponential expression. “ \_\_\_\_ is equivalent to \_\_\_\_.”

9.

$$(3^3)^4$$

10.

$$(5^2)^3$$

11.

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

12.

$$(3^2)^4 \times 3^3$$

13.

$$\frac{(5^3)^2}{5^4}$$

14.

$$\frac{(6^5)^2}{6^7}$$

**Properties of exponents** are rules used to create equivalent expressions.

► **Properties of exponents** can only be used when **exponential expressions** have the **same base**.

<p><u>Any</u> base raised to a zero power is 1.</p>	$7^0 = 1$	$15^0 = 1$	$1,359^0 = 1$
<p>Numbers with exponents can be moved between numerator and denominator by <u>reversing the sign of the exponent</u>.</p>	$\frac{6^3}{1} = \frac{1}{6^{-3}}$	$\frac{1}{6^3} = 6^{-3}$	$\frac{6^{-3}}{1} = \frac{1}{6^3}$

### CFU

Which expression is equivalent to the exponential expression  $3^0$ ?

Explain.

A 3

B 1

C 0

Which expression is equivalent to the exponential expression  $3^2$ ?

Explain.

A  $\frac{2^3}{1}$

B  $\frac{1}{3^2}$

C  $\frac{1}{3^{-2}}$

1 Determine which property of exponents to apply.

*Hint: Be sure the bases are the same.*

2 Create an equivalent expression using properties of exponents.

3 Interpret the exponential expression. " \_\_\_\_ is equivalent to \_\_\_\_."

15.

$$29^0$$

16.

$$16^0$$

17.

$$5^{-3}$$

18.

$$3^{-2}$$

19.

$$\frac{1}{7^{-2}}$$

20.

$$\frac{1}{4^{-3}}$$

## Skill Closure

1 Determine which property of exponents to apply.

*Hint: Be sure the bases are the same.*

2 Create an equivalent expression using properties of exponents.

3 Interpret the exponential expression. “ \_\_\_\_ is equivalent to \_\_\_\_.”

1.

$$4^3 \times 4^2$$

2.

$$(4^3)^2$$

3.

$$4^{-3}$$

## Concept Closure

Caroline made a mistake applying the properties of exponents. Explain the error she made.

$$\frac{4^8}{2^5} = 2^{8-5} = 2^3$$

## Summary Closure

What did you learn today about applying properties of exponents?

## Word Bank

exponents  
properties  
multiply  
divide  
power  
negative

1 Determine which property of exponents to apply.

*Hint: Be sure the bases are the same.*

2 Create an equivalent expression using properties of exponents.

3 Interpret the exponential expression. “ \_\_\_\_ is equivalent to \_\_\_\_.”

1.  $5^2 \times 5^2$

2.  $\frac{3^5}{3^2}$

3.  $\frac{2^2 \times 2^2}{5^2}$

4.  $\frac{4^2 \times 6^9}{6^7}$

5.  $(2^2)^4$

6.  $(2^2)^3 \times 2$

7.  $\frac{(7^3)^3}{7^6}$

8.  $11^0$

9.  $8^{-2}$

10.  $\frac{1}{9^{-3}}$

Create equivalent exponential expressions.

1.  $\frac{(9^4)^3}{9^{12}}$

2.  $\frac{6^5 \times 6^4}{6^{11}}$

3.  $(2^3)^2 \times 5^2$

4.  $\frac{4^5}{4^6}$

5.  $(5^2)^2 \times 6^0$

6.  $(3^2)^{-2}$

For each exponential expression, mark whether it is greater than or less than  $3^4$ .

	Greater than $3^4$	Less than $3^4$
7. $3^2 \times 3$		
8. $\frac{(3^5)^2}{3^{10}}$		
9. $\frac{3^3}{3^{-4}}$		
10. $(3^2)^1$		
11. $\frac{3^2 \times 3^5}{3^{12}}$		
12. $\frac{1}{3^{-6}}$		

Create equivalent exponential expressions.

1. 
$$\frac{1}{8^{-3}}$$

2. 
$$\frac{5^3}{7^0}$$

3. 
$$(9^3)^0 \times 2^3$$

4. 
$$\frac{4^2}{4^{-1}}$$

Describe the error made in applying the properties of exponents.

5. 
$$6^4 \times 6^5 = 6^{4 \times 5} = 6^{20}$$

$$7^3 \times 7^2 = 7^{3 \times 2} = 7^6$$

6. 
$$3^2 \times 2^3 = 6^{2+3} = 6^5$$

$$4^3 \times 3^1 = 12^{3+1} = 12^4$$

7. 
$$\frac{10^6}{5^3} = 2^{6-3} = 2^3$$

$$\frac{9^8}{3^6} = 3^{8-6} = 3^2$$

8. 
$$\frac{7^6}{7^3} = 7^{6 \div 3} = 7^2$$

$$\frac{5^{10}}{5^2} = 5^{10 \div 2} = 5^5$$

Create equivalent exponential expressions.

1.  $\frac{(7^5)^3}{7^{17}}$

2.  $\frac{10^5 \times 10^6}{10^7}$

3.  $\frac{9^8 \times 9^8}{9^{14}}$

4.  $\frac{(11^2)^9}{11^{21}}$

Select Yes or No to indicate whether the expression is equivalent to  $5^{-4}$ .

- 5.
- A  $(5^{-4})^2 \times 5^4$        Yes    No
- B  $\frac{1}{5^{-3} \times 5^{-1}}$        Yes    No
- C  $5^2 \times 5^{-6}$        Yes    No
- D  $\frac{5^{-9}}{5^5}$        Yes    No

Select Yes or No to indicate whether the expression is equivalent to  $10^2$ .

- 6.
- A  $10^1 \times 10^1$        Yes    No
- B  $\frac{10^2 \times 10^{-1}}{10^{-3} \times 10^{-2}}$        Yes    No
- C  $\frac{10^{-5}}{10^3}$        Yes    No
- D  $(10^2)^2 \times 10^{-2}$        Yes    No