Properties of exponents are rules used to create equivalent expressions.

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

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

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) $\frac{9^2}{3^2}$

We will apply the properties of exponents. | **Skill Development/Guided Practice 1**

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**.

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

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**.

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

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.

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

We will apply the properties of exponents.	Closure

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

We will apply the properties of exponents. | **Independent Practice**

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 $(5^{-4})^2 \times 5^4$ O Yes O No

B $\frac{1}{5^{-3} \times 5^{-1}}$ O Yes O No

C $5^2 \times 5^{-6}$ O Yes O No

D $\frac{5^{-9}}{5^5}$ O Yes O No

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

6.

A $10^1 \times 10^1$ O Yes O No

B $\frac{10^2 \times 10^{-1}}{10^{-3} \times 10^{-2}}$ O Yes O No

C $\frac{10^{-5}}{10^3}$ O Yes O No

D $(10^2)^2 \times 10^{-2}$ O Yes O No