

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	Keep the base , add the exponents . $a^m \cdot a^n = a^{(m+n)}$	$n^2 \cdot n^5 = n^{2+5} = n^7$
Dividing	Keep the base , subtract the exponents . $\frac{a^m}{a^n} = a^{(m-n)}$	$\frac{n^6}{n^3} = n^{6-3} = n^3$

Exponential rules CANNOT be used: $a^2 \cdot b^3$, $\frac{m^4}{n^3}$

CFU

Which exponential expression can use an exponential rule? Explain.

- A $n^2 \cdot 2^3$
- B $a^2 \cdot a^3$

Which exponential expression can use an exponential rule? Explain.

- A $\frac{b^8}{b^5}$
- B $\frac{a^5}{b^2}$

- 1 Determine which property of exponents to use.
- 2 Create an equivalent expression using properties of exponents.
- 3 Interpret the expression. “ _____ simplifies to _____.”

1. $n^2 \cdot n^4$

2. $a^2 \cdot a^3$

3. $\frac{y^7}{y^4}$

4. $\frac{p^6}{p^2}$

5. $\frac{a^3 \cdot a^2}{n^5}$

6. $\frac{b^2 \cdot b^3}{y^4}$

7. $\frac{n^2 \cdot a^7}{a^5}$

8. $\frac{c^2 \cdot n^8}{n^7}$

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

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

Raising to an Exponent	Keep the base , multiply the exponents . $(a^m)^n = a^{(m \cdot n)}$	$(b^4)^3 = b^{(4 \cdot 3)} = b^{12}$
Negative Exponent	Invert the base to change the negative exponent into a positive. $a^{-n} = \frac{1}{a^n}$	$\frac{b^{-3}}{1} = \frac{1}{b^3} \quad \frac{b^3}{1} = \frac{1}{b^{-3}}$
Rational Exponent	When the exponent is a fraction , the numerator is the power and the denominator is the root . $a^{\frac{m}{n}} = \sqrt[n]{a^m}$	$c^{\frac{2}{3}} = \sqrt[3]{c^2}$

CFU

For which exponential expression can you use the raising to an exponent rule? Explain.

- A $a^4 \cdot a^2$
B $(a^4)^2$

For which exponential expression do you need to use the rational exponent rule? Explain.

- A $(a^3)^4$
B $a^{\frac{3}{4}}$

- 1 Determine which property of exponents to use.
- 2 Create an equivalent expression using properties of exponents.
- 3 Interpret the expression. “ _____ simplifies to _____.”

9. $(x^3)^4$

10. $(m^2)^3$

11. $(5n^4)^2$

12. $(4c^7)^2$

13. n^{-4}

14. t^{-5}

15. $\frac{1}{m^{-12}}$

16. $\frac{1}{c^{-9}}$

17. $b^{\frac{1}{2}}$

18. $m^{\frac{2}{3}}$

19. $t^{\frac{2}{5}}$

20. $q^{\frac{1}{7}}$

Skill Closure

- 1 Determine which property of exponents to use.
- 2 Create an equivalent expression using properties of exponents.
- 3 Interpret the expression. “ ___ simplifies to ___.”

1. $a^3 \cdot a^2$

2. $(w^3)^2$

3. p^{-4}

Concept Closure

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

$$\frac{a^8}{b^5} = a^{8-5} = a^3$$

Summary Closure

What did you learn today about simplifying expressions using exponential rules?

Word Bank

exponents
 properties
 multiply
 divide
 power
 negative

- 1 Determine which property of exponents to use.
- 2 Create an equivalent expression using properties of exponents.
- 3 Interpret the expression. “ _____ simplifies to _____.”

1. $v^2 \cdot v^2$

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

3. $\frac{n^2 \cdot n^2}{m^2}$

4. $\frac{a^2 \cdot b^9}{b^7}$

5. $(p^2)^4$

6. $(n^2)^3 \cdot n$

7. y^{-2}

8. $(r^4)^2 \cdot r^2$

9. $s^{\frac{1}{2}}$

10. $\frac{(h^3)^3}{h^6}$

11. $\frac{1}{w^{-12}}$

12. $t^{\frac{2}{5}}$

Simplify expressions with positive exponents.

1. $\frac{(f^2)^6}{f^{11}}$

2. $\frac{z^5 \cdot z^4}{z^{11}}$

3. $(u^5)^2 \cdot y^2$

4. $(n^2)^{-2}$

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

6. $(d^2)^4 \cdot d^3$

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

	Greater than n^4	Less than n^4
1. $n^2 \cdot n$		
2. $\frac{(n^5)^2}{n^9}$		
3. $\frac{n^3}{n^{-4}}$		
4. $(n^2)^1$		
5. $\frac{n^2 \cdot n^5}{n^{12}}$		
6. $\frac{1}{n^{-6}}$		

Describe the error made in simplifying exponential expressions.

1.

$$a^4 \cdot a^5 = a^{4 \cdot 5} = a^{20}$$

$$n^3 \cdot n^2 = n^{3 \cdot 2} = n^6$$

2.

$$p^2 \cdot m^3 = p^{2+3} = p^5$$

$$a^3 \cdot b^1 = a^{3+1} = a^4$$

Select Yes or No to indicate whether the expression simplifies to n^{10} .

A. $\frac{n^{15}}{n^5}$ Yes No

B. $n^2 \cdot n^5$ Yes No

C. $(n^4)^3 \cdot n^{-2}$ Yes No

D. $\frac{1}{n^{-4} \cdot n^{-6}}$ Yes No

Select Yes or No to indicate whether the expression simplifies to y^{-4} .

A. $(y^{-4})^2 \cdot y^4$ Yes No

B. $\frac{1}{y^{-3} \cdot y^{-1}}$ Yes No

C. $y^2 \cdot y^{-6}$ Yes No

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

Describe the error made in simplifying exponential expressions.

$$\begin{aligned}
 1. \quad (n^{-4})^2 \cdot n^4 &= n^{-4+2} \cdot n^4 \\
 &= n^{-2+4} \\
 &= n^2
 \end{aligned}$$

$$2. \quad \frac{p^{-3}}{p^{-2}} = p^5$$

$$\frac{q^{-2}}{q^{-3}} = q^5$$

Select Yes or No to indicate whether the expression simplifies to z^2 .

A. $z^1 \cdot z^1$ Yes No

B. $\frac{z^{-2} \cdot z^{-1}}{z^{-3} \cdot z^{-2}}$ Yes No

C. $\frac{z^{-5}}{z^3}$ Yes No

D. $(z^2)^2 \cdot z^{-2}$ Yes No

Select Yes or No to indicate whether the expression simplifies to a^{12} .

A. $a^4 \cdot a^8$ Yes No

B. $\frac{1}{a^{-11} \cdot a^{-1}}$ Yes No

C. $(a^7)^2 \cdot a^{-2}$ Yes No

D. $\frac{a^{12}}{a^{-2}}$ Yes No