8.1 Products and Powers

MATERIALS • paper and pencil

QUESTION How can you find a product of powers and a power of a power?

EXPLORE 1 Find products of powers

STEP 1 *Copy and complete* Copy and complete the table.

Expression	Expanded	Number of factors	Simplified
$7^4 \cdot 7^5$	$(7 \cdot 7 \cdot 7 \cdot 7) \cdot (7 \cdot 7 \cdot 7 \cdot 7 \cdot 7)$	9	$7^{4+5} = 7^9$
$(-4)^2 \cdot (-4)^3$	$[(-4) \cdot (-4)] \cdot [(-4) \cdot (-4) \cdot (-4)]$	5	$(-4)^{2+3} = (-4)^5$
$x^1 \cdot x^5$	$(x) \cdot (x \cdot x \cdot x \cdot x \cdot x)$	6	$x^{1+5} = x^6$

All exponents

$x \cdot x^5$

STEP 2 ***Analyze results*** Find a pattern that relates the exponents of the factors in the first column and the exponent of the expression in the last column.

EXPLORE 2 Find powers of powers

STEP 1 ***Copy and complete*** Copy and complete the table.

Expression	Expanded	Expression as repeated multiplication	Number of factors	Simplified
$(5^3)^2$	$5^3 \cdot 5^3 = 5^{3+3}$		6	$5^6 = 5^{3 \cdot 2}$
$[(-6)^2]^4$	$(-6)^2 \cdot (-6)^2 \cdot (-6)^2 \cdot (-6)^2 = (-6)^{2+2+2+2}$		8	$(-6)^8 = \left(\frac{-1}{6}\right)^{2 \cdot 4}$
$(a^3)^3$	$a^3 \cdot a^3 \cdot a^3 = a^{3+3+3}$		9	$a^9 = a^{3 \cdot 3}$

Multiply the exponents!

Expression	Expanded expression	Expression as repeated multiplication	Number of factors	Simplified expression
$(5^3)^2$	$(5^3) \cdot (5^3)$	$(5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5)$	6	5^6
$[(-6)^2]^4$	$[(-6)^2] \cdot [(-6)^2] \cdot [(-6)^2] \cdot [(-6)^2]$			
$(a^3)^3$				

STEP 2 ***Analyze results*** Find a pattern that relates the exponents of the expression in the first column and the exponent of the expression in the last column.

DRAW CONCLUSIONS Use your observations to complete these exercises

Simplify the expression. Write your answer using exponents.

1. $5^2 \cdot 5^3$
2. $(-6)^1 \cdot (-6)^4$
3. $m^6 \cdot m^4$
4. $(10^3)^3$
5. $[(-2)^3]^4$
6. $(c^2)^6$

In Exercises 7 and 8, copy and complete the statement.

7. If a is a real number and m and n are positive integers, then $a^m \cdot a^n =$ ___?___.
8. If a is a real number and m and n are positive integers, then $(a^m)^n =$ ___?___.

7^8

$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 =$

Products of Power

$a^m \cdot a^n = a^{m+n}$

$5^3 \cdot 5^7 = 5^{10}$

$4^5 \cdot 3^4 =$ Can not Combine

Powers of a power

$(a^m)^n = a^{m \cdot n}$

$(x^5)^4 = x^{5 \cdot 4} \quad x^{20}$

$[(m-4)^2]^8 = (m-4)^{16}$

$m-4^{16}$

Power of a Product

$(ab)^m = a^{1 \cdot m} b^{1 \cdot m}$

$(5^2 \cdot 7^1)^3 = 5^6 \cdot 7^3$