GRADE 7 ACCELERATED · UNIT 3 · LESSON 1

Product Laws of Exponents

MA.7.NSO.1.1

I can use the product of powers, power of a product, power of a power and identity laws to rewrite and evaluate a numerical expression.

Warm-Up

1. $\sqrt{81}$
2. Between which two whole numbers is $\sqrt{40}$?
3. Solve $3x - 7 = 11$
4. Evaluate $\left(\frac{2}{3}\right)^2$

Warm-Up

1. $\sqrt{81}$ **9**
2. Between which two whole numbers is $\sqrt{40}$? **6 and 7**
3. Solve $3x - 7 = 11$ **$x = 6$**
4. Evaluate $\left(\frac{2}{3}\right)^2$ $\frac{4}{9}$

Vocabulary

base

the number that is used as a factor: in 2^3 the base is 2

exponent

the number of times the base is used as a factor: $2^3 = 2 \cdot 2 \cdot 2$

power

a base with an exponent, such as 2^3; its value is 8

product of powers law

$a^m \cdot a^n = a^{m+n}$ — same base, add the exponents

Vocabulary

power of a product law

$(ab)^m = a^m \cdot b^m$ — the exponent goes to every factor

power of a power law

$(a^m)^n = a^{mn}$ — multiply the exponents

identity exponent law

$a^1 = a$

Notes

I. A power is a shorthand for repeated multiplication

A. **base** — the number used as a factor

B. **exponent** — how many times the base is a factor

C. **power** — the whole thing, base and exponent together

$$2^3 = 2 \cdot 2 \cdot 2 = 8 \qquad \left(\frac{2}{3}\right)^2 = \frac{2}{3} \cdot \frac{2}{3} = \frac{4}{9}$$

Notes

II. Product of powers — same base, add the exponents

$$3^2 \cdot 3^3 = (3 \cdot 3)(3 \cdot 3 \cdot 3) = 3^5$$

$3^2 \cdot 2^3 = (3 \cdot 3)(2 \cdot 2 \cdot 2)$ — different bases, no shortcut

Product of powers: $a^m \cdot a^n = a^{m+n}$

Check with values: $3^2 \cdot 3^3 = 9 \cdot 27 = 243 = 3^5$

Notes

III. Power of a product — the exponent goes to every factor

$$(2 \cdot 5)^3 = (2 \cdot 5)(2 \cdot 5)(2 \cdot 5) = (2 \cdot 2 \cdot 2)(5 \cdot 5 \cdot 5) = 2^3 \cdot 5^3$$

Power of a product: $(ab)^m = a^m \cdot b^m$

Works for a product only, never for a sum:

$(10 + (-2))^3 = 8^3 = 512$ but $10^3 + (-2)^3 = 992$

Notes

IV. Power of a power, and the exponent 1

Power of a power	Repeated multiplication	Single power
$(4^2)^3$	$4^2 \cdot 4^2 \cdot 4^2$	4^6
$(10^4)^4$	$10^4 \cdot 10^4 \cdot 10^4 \cdot 10^4$	10^{16}
$(3^1)^5$	$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$	3^5

Power of a power: $(a^m)^n = a^{mn}$ **Identity:** $a^1 = a$

Example 1

$$3^2 \cdot 3^3$$

Which law? Then find the value.

Example 1

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

$$3^5 = 243$$

$$9 \cdot 27 = 243$$

Answer: 243

Your Turn

$$2^3 \cdot 2^4$$

Which law? Then find the value.

Your Turn

$$2^3 \cdot 2^4$$

Which law? Then find the value.

$$2^3 \cdot 2^4 = 2^{3+4} = 2^7$$

$$2^7 = 128$$

Answer: $2^7 = 128$

Example 2

$$[(-2)^3]^2$$

Which law? Then find the value.

Example 2

$$[(-2)^3]^2 = (-2)^{3 \cdot 2} = (-2)^6$$

$$(-2)^6 = 64$$

$$(-8)^2 = 64$$

Answer: 64

Your Turn

$$\left[(-3)^2\right]^3$$

Which law? Then find the value.

Your Turn

$$\left[(-3)^{2}\right]^{3}$$

Which law? Then find the value.

$$((-3)^{2})^{3} = (-3)^{2 \cdot 3} = (-3)^{6}$$

$$(-3)^{6} = 729$$

Answer: $(-3)^{6} = 729$

Whiteboards · Question 1 of 9

$$5^2 \cdot 5^3$$

Answer it.

Whiteboards · Question 1 of 9

$$5^2 \cdot 5^3$$

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

Answer: 5^5

Whiteboards · Question 2 of 9

A rectangle is 2^4 centimeters long and 2^2 centimeters wide.

Its perimeter is 40 centimeters.

What is the area of the rectangle, in square centimeters?

Answer it.

Whiteboards · Question 2 of 9

A rectangle is 2^4 centimeters long and 2^2 centimeters wide.

Its perimeter is 40 centimeters.

What is the area of the rectangle, in square centimeters?

Area = length × width

$2^4 \cdot 2^2 = 2^{4+2} = 2^6$

$2^6 = 64$

Answer: $2^6 = 64$ square centimeters

Whiteboards · Question 3 of 9

$$(3 \cdot 10)^3$$

Answer it.

Whiteboards · Question 3 of 9

$$(3 \cdot 10)^3$$

$$(3 \cdot 10)^3 = 3^3 \cdot 10^3 = 27 \cdot 1{,}000 = 27{,}000$$

Answer: 27,000

Whiteboards · Question 4 of 9

$$(3^2)^4$$

Answer it.

Whiteboards · Question 4 of 9

$$(3^2)^4$$

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

Answer: 3^8

Whiteboards · Question 5 of 9

$$4^3 \cdot 4^2$$

Which expression is equivalent?

A. 16^5

B. 8^5

C. 4^6

D. 4^5

Answer it.

Whiteboards · Question 5 of 9

$$4^3 \cdot 4^2$$

Which expression is equivalent?

$$4^3 \cdot 4^2 = 4^{3+2} = 4^5$$

Answer: D — 4^5

Whiteboards · Question 6 of 9

$$(2^4)^3$$

Which expression is equivalent?

A. 2^7

B. 8^{12}

C. 2^{12}

D. 2^{64}

Answer it.

Whiteboards · Question 6 of 9

$$(2^4)^3$$

Which expression is equivalent?

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

Answer: C — 2^{12}

Whiteboards · Question 7 of 9

$$(-3)^2 \cdot (-3)^1$$

Answer it.

Whiteboards · Question 7 of 9

$$(-3)^2 \cdot (-3)^1$$

$$(-3)^2 \cdot (-3)^1 = (-3)^{2+1} = (-3)^3$$

$$(-3)^3 = -27$$

Answer: −27

Whiteboards · Question 8 of 9

$$\left(\frac{1}{2}\right)^2 \cdot \left(\frac{1}{2}\right)^3$$

Answer it.

Whiteboards · Question 8 of 9

$$\left(\frac{1}{2}\right)^2 \cdot \left(\frac{1}{2}\right)^3$$

$$\left(\frac{1}{2}\right)^2 \cdot \left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{2+3} = \left(\frac{1}{2}\right)^5$$

$$\left(\frac{1}{2}\right)^5 = \frac{1}{32}$$

Answer: $\frac{1}{32}$

Whiteboards · Question 9 of 9

Aiyanna says she can use the power of a product law to evaluate $(9 + (-3))^3$. Is she right?

Write your answer in sentences.

Whiteboards · Question 9 of 9

Aiyanna says she can use the power of a product law to evaluate $(9 + (-3))^3$. Is she right?

Inside the parentheses is a sum, not a product.

$9 + (-3) = 6$

$6^3 = 216$

Answer: No — $(9 + (-3))^3 = 6^3 = 216$

Independent Set

1. Write as one power. $3^4 \cdot 3^5$
2. Find the value. $2^3 \cdot 2^2$
3. Write as one power. $(7^3)^2$
4. Find the value. $(3 \cdot 4)^2$
5. Find the value. $(-2)^3 \cdot (-2)^2$
6. Find the value of n. $5^2 \cdot 5^n = 5^7$

IXL

1. Open IXL and start today's skills.
2. Work on paper where the question needs work. The answer box does not show it.
3. Every skill listed is required, to a SmartScore of 67. Due by the Unit 3 test.

Today's skills — all required

Evaluate powers — SZQ
Multiplication with exponents — 5SK
Power rule — 8DA
Understanding exponents — BFA