GRADE 7 ACCELERATED · UNIT 3 · LESSON 3

Exponential Expressions

MA.7.NSO.1.1

I can apply more than one law of exponents to evaluate an expression and to write an equivalent one.

Warm-Up

1. Find the value: $\frac{10^5}{10^3}$
2. Is $\sqrt{50}$ closer to 7 or to 8?
3. Solve $4(x - 2) = 12$
4. Evaluate $2 + 3 \cdot 4^2$

Warm-Up

1. Find the value: $\frac{10^5}{10^3}$ **100**
2. Is $\sqrt{50}$ closer to 7 or to 8? **7**
3. Solve $4(x - 2) = 12$ **x = 5**
4. Evaluate $2 + 3 \cdot 4^2$ **50**

Vocabulary

equivalent expressions

two expressions with the same value for every choice of numbers; the laws of exponents turn one into the other

evaluate

find the single value of an expression

plan

the order in which you will apply the laws; any correct order gives the same value

Notes

I. The seven laws, in one place

Law	Rule	Example
Product of powers	$a^m \cdot a^n = a^{m+n}$	$2^3 \cdot 2^1 = 2^4$
Quotient of powers	$a^m \div a^n = a^{m-n}$	$(-3)^7 \div (-3)^2 = (-3)^5$
Power of a product	$(ab)^m = a^m \cdot b^m$	$(-7 \cdot 3)^2 = (-7)^2 \cdot 3^2$
Power of a quotient	$(a \div b)^m = a^m \div b^m$	$(13 \div 5)^3 = 13^3 \div 5^3$
Power of a power	$(a^m)^n = a^{mn}$	$(6^3)^4 = 6^{12}$
Identity exponent	$a^1 = a$	$15^1 = 15$
Zero exponent	$a^0 = 1$	$127^0 = 1$

Notes

II. More than one law — make a plan, then follow it

Winston: $\left(\frac{2^6}{2^4}\right)^3 = (2^2)^3 = 2^6 = 64$

Yvette: $\left(\frac{2^6}{2^4}\right)^3 = \frac{(2^6)^3}{(2^4)^3} = \frac{2^{18}}{2^{12}} = 2^6 = 64$

Different plans, same value. Any correct sequence of laws gives the same answer.

Notes

III. Order of operations still applies

A. Parentheses first — including a fraction bar, which is a pair of parentheses in disguise.

B. Exponents next — the laws of exponents are applied here.

C. Then multiply and divide, left to right; then add and subtract.

D. **Never across a + or a –:** $2^3 + 2^2 = 8 + 4 = 12$, **not** 2^5.

Example 1

$$\frac{4^5 \cdot 4^0}{4^2}$$

Make a plan. Then find the value.

Example 1

$$\frac{4^5 \cdot 4^0}{4^2} = \frac{4^{5+0}}{4^2} = \frac{4^5}{4^2}$$

$$\frac{4^5 \cdot 4^0}{4^2} = \frac{4^5 \cdot 1}{4^2} = \frac{4^5}{4^2}$$

$$\frac{4^5}{4^2} = 4^3 = 64$$

Answer: 64

Your Turn

$$\frac{5^4 \cdot 5^0}{5^2}$$

Make a plan. Then find the value.

Your Turn

$$\frac{5^4 \cdot 5^0}{5^2}$$

Make a plan. Then find the value.

$5^0 = 1$, so the top is $5^4 \cdot 1 = 5^4$

$$\frac{5^4}{5^2} = 5^{4-2} = 5^2 = 25$$

Answer: $5^2 = 25$

Example 2

$$11.6^0 \cdot \frac{(-15)^4}{1.5^4}$$

Make a plan. Then find the value.

Example 2

$$11.6^{0} \cdot \frac{(-15)^{4}}{1.5^{4}} = 1 \cdot \left(\frac{-15}{1.5}\right)^{4}$$

$$\left(\frac{-15}{1.5}\right)^{4} = (-10)^{4}$$

$$(-10)^{4} = 10000$$

Answer: 10,000

Your Turn

$$7^0 \cdot \frac{(-12)^3}{4^3}$$

Make a plan. Then find the value.

Your Turn

$$7^0 \cdot \frac{(-12)^3}{4^3}$$

Make a plan. Then find the value.

$7^0 = 1$

$$\frac{(-12)^3}{4^3} = \left(\frac{-12}{4}\right)^3 = (-3)^3 = -27$$

Answer: −27

Whiteboards · Question 1 of 9

A warehouse holds 6^4 boxes in 6^2 equal rows.

Each box weighs 3 kilograms.

How many boxes are in each row?

Answer it.

Whiteboards · Question 1 of 9

A warehouse holds 6^4 boxes in 6^2 equal rows.

Each box weighs 3 kilograms.

How many boxes are in each row?

$$6^4 \div 6^2 = 6^{4-2} = 6^2$$

$$6^2 = 36$$

Answer: 36

Whiteboards · Question 2 of 9

$$(3^0 \cdot 3^2)^3$$

Answer it.

Whiteboards · Question 2 of 9

$$(3^0 \cdot 3^2)^3$$

Inside first: $3^0 \cdot 3^2 = 3^{0+2} = 3^2$

$(3^2)^3 = 3^{2 \cdot 3} = 3^6 = 729$

Answer: 729

Whiteboards · Question 3 of 9

$$\frac{(0.5^3)^2}{(0.5)^2}$$

Answer it.

Whiteboards · Question 3 of 9

$$\frac{(0.5^3)^2}{(0.5)^2}$$

Top: $(0.5^3)^2 = 0.5^{3 \cdot 2} = 0.5^6$

$\frac{0.5^6}{0.5^2} = 0.5^{6-2} = 0.5^4 = 0.0625$

Answer: 0.0625

Whiteboards · Question 4 of 9

$$\left(\frac{2.5^5}{2.5^3}\right)^1$$

Answer it.

Whiteboards · Question 4 of 9

$$\left(\frac{2.5^{5}}{2.5^{3}}\right)^{1}$$

$$\frac{2.5^{5}}{2.5^{3}} = 2.5^{5-3} = 2.5^{2}$$

$$(2.5^{2})^{1} = 2.5^{2} = 6.25$$

Answer: 6.25

Whiteboards · Question 5 of 9

$$\frac{(2^2 \cdot 3.2^0)^6}{2^{10}}$$

Which is the value?

A. 1/4

B. 2^{22}

C. 0

D. 4

Answer it.

Whiteboards · Question 5 of 9

$$\frac{(2^2 \cdot 3.2^0)^6}{2^{10}}$$

Which is the value?

$3.2^0 = 1$, so the top is $(2^2)^6 = 2^{2 \cdot 6} = 2^{12}$

$$\frac{2^{12}}{2^{10}} = 2^{12-10} = 2^2 = 4$$

Answer: D — 4

Whiteboards · Question 6 of 9

$$\frac{0.2^3}{2^3} \cdot 0.1^2$$

Which expression is equivalent?

A. $0.2^0 \cdot 0.1^2$

B. $0.2^3 \cdot 0.1^2$

C. 0.1^5

D. 0.1^6

Answer it.

Whiteboards · Question 6 of 9

$$\frac{0.2^3}{2^3} \cdot 0.1^2$$

Which expression is equivalent?

$$\frac{0.2^3}{2^3} = \left(\frac{0.2}{2}\right)^3 = 0.1^3$$

$$0.1^3 \cdot 0.1^2 = 0.1^{3+2} = 0.1^5$$

Answer: C — 0.1^5

Whiteboards · Question 7 of 9

$$0.1^2 \cdot (0.1^1)^2$$

Answer it.

Whiteboards · Question 7 of 9

$$0.1^2 \cdot (0.1^1)^2$$

$$(0.1^1)^2 = 0.1^{1 \cdot 2} = 0.1^2$$

$$0.1^2 \cdot 0.1^2 = 0.1^{2+2} = 0.1^4 = 0.0001$$

Answer: 0.0001

Whiteboards · Question 8 of 9

$$\frac{(-4)^2 \cdot (-4)^1}{(-4)^0}$$

Answer it.

Whiteboards · Question 8 of 9

$$\frac{(-4)^2 \cdot (-4)^1}{(-4)^0}$$

Top: $(-4)^2 \cdot (-4)^1 = (-4)^{2+1} = (-4)^3$

Bottom: $(-4)^0 = 1$

$(-4)^3 = -64$

Answer: −64

Whiteboards · Question 9 of 9

Winston writes $\left(\frac{4^7}{4^4}\right)^2 = (4^3)^2$. Yvette writes $\left(\frac{4^7}{4^4}\right)^2 = \frac{4^{14}}{4^8}$.

Do they get the same value? Explain.

Write your answer in sentences.

Whiteboards · Question 9 of 9

Winston writes $\left(\frac{4^7}{4^4}\right)^2 = (4^3)^2$. Yvette writes $\left(\frac{4^7}{4^4}\right)^2 = \frac{4^{14}}{4^8}$.

Do they get the same value? Explain.

Winston: $(4^3)^2 = 4^{3 \cdot 2} = 4^6$

Yvette: $\frac{4^{14}}{4^8} = 4^{14-8} = 4^6$

$4^6 = 4{,}096$

Answer: Yes — both give $4^6 = 4{,}096$

Independent Set

1. Find the value. $\dfrac{4^2 \cdot 4^0}{4^1}$

2. Find the value. $(2^0 \cdot 2^3)^2$

3. Write as one power. $\left(\dfrac{5^8}{5^5}\right)^3$

4. Find the value. $0.2^2 \cdot (0.2^1)^2$

5. Find the value. $\dfrac{(-3)^3 \cdot (-3)^0}{(-3)^2}$

6. Show that $\left(\dfrac{10^4}{10^2}\right)^2$ and $\dfrac{10^8}{10^4}$ have the same value.

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 expressions using properties of exponents — ZE9