GRADE 7 ACCELERATED · UNIT 3 · LESSONS 6–7

Evaluating and Equivalent Expressions

MA.8.NSO.1.3

I can evaluate an expression with integer exponents using the laws, and decide whether two expressions with different bases are equivalent.

Warm-Up

1. Rewrite with a positive exponent, then evaluate: $\left(\frac{2}{3}\right)^{-2}$
2. Find the value: $\frac{1}{5^{-2}}$
3. Find the value: $\frac{10^6}{10^4}$
4. Write 64 as a power of 2, of 4, and of 8.

Warm-Up

1. Rewrite with a positive exponent, then evaluate: $\left(\frac{2}{3}\right)^{-2}$

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

2. Find the value: $\frac{1}{5^{-2}}$ **25**

3. Find the value: $\frac{10^{6}}{10^{4}}$ **100**

4. Write 64 as a power of 2, of 4, and of 8. 2^{6}, 4^{3}, 8^{2}

Vocabulary

common base

one base both expressions can be written with: 8^5 and 2^9 share the base 2, because $8 = 2^3$

equivalent

same value; the laws of exponents turn one form into the other

Notes

I. Two students, two plans, one value

Melanie: $\dfrac{5^{-2} \cdot 5^{5}}{5} = \dfrac{5^{3}}{5} = 5^{2} = 25$

Adonis: $\dfrac{5^{-2} \cdot 5^{5}}{5} = \dfrac{\frac{1}{25} \cdot 3125}{5} = \dfrac{125}{5} = 25$

Apply the laws first, evaluate last. The value is the same; the arithmetic is smaller.

Notes

II. Every law, one expression

$$\frac{(6^2)^{-3}}{6^{-5}} = \frac{6^{-6}}{6^{-5}} = 6^{-6-(-5)} = 6^{-1} = \frac{1}{6}$$

Find the step that broke:

$\left(\frac{1}{5}\right)^4 \cdot \left(\frac{1}{5}\right)^{-2} = \left(\frac{1}{5}\right)^{-8}$ — wrong: multiplied; should be $\left(\frac{1}{5}\right)^2$

$\left(\frac{3}{2}\right)^{-3} = \frac{2^{-3}}{3^{-3}}$ — wrong: flipped, kept the minus; should be $\left(\frac{2}{3}\right)^3$

Notes

III. Different bases, same value — rewrite to a common base

Base	Square	Cube	Fourth
2	$2^2 = 4$	$2^3 = 8$	$2^4 = 16$
3	$3^2 = 9$	$3^3 = 27$	$3^4 = 81$
5	$5^2 = 25$	$5^3 = 125$	$5^4 = 625$

$$8^5 = (2^3)^5 = 2^{15} \qquad 9^4 = (3^2)^4 = 3^8$$

$$2^3 \cdot 4^3 = 2^3 \cdot (2^2)^3 = 2^3 \cdot 2^6 = 2^9$$

Notes

IV. Testing equivalence: Xavier's claim

$$\left(\frac{1}{4}\right)^2 \cdot 2^{-3} = 2^{-4} \cdot 2^{-3} = 2^{-7} \qquad \left(\frac{1}{2}\right)^4 \cdot 4^{-1} = 2^{-4} \cdot 2^{-2} = 2^{-6}$$

Same base, then compare exponents.

$2^{-7} \neq 2^{-6}$ — so Xavier is wrong.

Example 1

$$\left(\frac{3}{4}\right)^{-2} \cdot 3$$

Find the value.

Example 1

$$\left(\frac{3}{4}\right)^{-2} \cdot 3 = \left(\frac{4}{3}\right)^{2} \cdot 3$$

$$\frac{16}{9} \cdot 3 = \frac{16}{3}$$

Answer: 16/3

Your Turn

$$\left(\frac{2}{5}\right)^{-2} \cdot 2$$

Find the value.

Your Turn

$$\left(\frac{2}{5}\right)^{-2} \cdot 2$$

Find the value.

Flip the fraction: $\left(\frac{2}{5}\right)^{-2} = \left(\frac{5}{2}\right)^{2} = \frac{25}{4}$

$\frac{25}{4} \cdot 2 = \frac{25}{2}$

Answer: $\frac{25}{2}$

Example 2

Are $3^2 \cdot 6^3$ and $\frac{(3 \cdot 2)^5}{2^2}$ equivalent?

Rewrite both with the bases 3 and 2, then compare.

Example 2

$$3^2 \cdot 6^3 = 3^2 \cdot 3^3 \cdot 2^3 = 3^5 \cdot 2^3$$

$$\frac{(3 \cdot 2)^5}{2^2} = \frac{3^5 \cdot 2^5}{2^2} = 3^5 \cdot 2^3$$

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

Answer: Yes — both are $3^5 \cdot 2^3 = 1944$

Your Turn

Are $2^2 \cdot 10^3$ and $\frac{(2 \cdot 5)^5}{5^2}$ equivalent?

Your Turn

Are $2^2 \cdot 10^3$ and $\frac{(2 \cdot 5)^5}{5^2}$ equivalent?

$$2^2 \cdot 10^3 = 2^2 \cdot 2^3 \cdot 5^3 = 2^5 \cdot 5^3$$

$$\frac{(2 \cdot 5)^5}{5^2} = \frac{2^5 \cdot 5^5}{5^2} = 2^5 \cdot 5^3$$

$$2^5 \cdot 5^3 = 32 \cdot 125 = 4{,}000$$

Answer: Yes — $2^5 \cdot 5^3 = 4000$

Whiteboards · Question 1 of 9

$$\frac{(-7)^5}{(-7)^0 \cdot (-7)^2}$$

Answer it.

Whiteboards · Question 1 of 9

$$\frac{(-7)^5}{(-7)^0 \cdot (-7)^2}$$

Bottom: $(-7)^0 \cdot (-7)^2 = (-7)^2$

$$\frac{(-7)^5}{(-7)^2} = (-7)^{5-2} = (-7)^3 = -343$$

Answer: −343

Whiteboards · Question 2 of 9

$$\frac{\left(\frac{3}{4}\right)^{-3} \cdot \left(\frac{3}{4}\right)^{0}}{\left(\frac{3}{4}\right)^{-2}}$$

Answer it.

Whiteboards · Question 2 of 9

$$\frac{\left(\frac{3}{4}\right)^{-3} \cdot \left(\frac{3}{4}\right)^{0}}{\left(\frac{3}{4}\right)^{-2}}$$

Top: $\left(\frac{3}{4}\right)^{-3} \cdot \left(\frac{3}{4}\right)^{0} = \left(\frac{3}{4}\right)^{-3}$

$\left(\frac{3}{4}\right)^{-3-(-2)} = \left(\frac{3}{4}\right)^{-1} = \frac{4}{3}$

Answer: $\frac{4}{3}$

Whiteboards · Question 3 of 9

$$\frac{(2^{-1})^3 \cdot \left(\frac{1}{2}\right)^{-4}}{2 \cdot 2^2}$$

Answer it.

Whiteboards · Question 3 of 9

$$\frac{(2^{-1})^3 \cdot \left(\frac{1}{2}\right)^{-4}}{2 \cdot 2^2}$$

Top: $(2^{-1})^3 = 2^{-3}$ and $\left(\frac{1}{2}\right)^{-4} = 2^4$, so $2^{-3} \cdot 2^4 = 2^1$

Bottom: $2 \cdot 2^2 = 2^3$

$\frac{2^1}{2^3} = 2^{1-3} = 2^{-2} = \frac{1}{4}$

Answer: $\frac{1}{4}$

Whiteboards · Question 4 of 9

One flash drive holds 2^{20} megabytes.

Another holds 16^{5} megabytes. The first one costs 45 dollars.

Which holds more — or is it the same? Show why.

Answer it.

Whiteboards · Question 4 of 9

One flash drive holds 2^{20} megabytes.

Another holds 16^5 megabytes. The first one costs 45 dollars.

Which holds more — or is it the same? Show why.

$$16 = 2^4$$

$$16^5 = (2^4)^5 = 2^{4 \cdot 5} = 2^{20}$$

Answer: The same: $16^5 = (2^4)^5 = 2^{20}$

Whiteboards · Question 5 of 9

25^7

Which expression is equivalent?

A. 5^{49}

B. 5^7

C. 5^{14}

D. 5^9

Answer it.

Whiteboards · Question 5 of 9

$$25^7$$

Which expression is equivalent?

$25 = 5^2$

$25^7 = (5^2)^7 = 5^{2 \cdot 7} = 5^{14}$

Answer: C — 5^{14}

Whiteboards · Question 6 of 9

$$\left(\frac{1}{4}\right)^4 \cdot 2^{-5}$$

Which expression is equivalent?

A. 2^{-13}

B. 2^{13}

C. 2^{-9}

D. 2^{-40}

Answer it.

Whiteboards · Question 6 of 9

$$\left(\frac{1}{4}\right)^4 \cdot 2^{-5}$$

Which expression is equivalent?

$$\left(\frac{1}{4}\right)^4 = (2^{-2})^4 = 2^{-8}$$

$$2^{-8} \cdot 2^{-5} = 2^{-8+(-5)} = 2^{-13}$$

Answer: A — 2^{-13}

Whiteboards · Question 7 of 9

$$2^5 \cdot 4^8$$

Answer it.

Whiteboards · Question 7 of 9

$$2^5 \cdot 4^8$$

$$4^8 = (2^2)^8 = 2^{16}$$

$$2^5 \cdot 2^{16} = 2^{5+16} = 2^{21}$$

Answer: 2^{21}

Whiteboards · Question 8 of 9

$$4^{7} \cdot 4^{-2}$$

Answer it.

Whiteboards · Question 8 of 9

$$4^7 \cdot 4^{-2}$$

$$4^7 \cdot 4^{-2} = 4^{7+(-2)} = 4^5$$

$$4^5 = (2^2)^5 = 2^{10}$$

Answer: 2^{10}

Whiteboards · Question 9 of 9

Xavier says $\left(\frac{1}{9}\right)^2 \cdot 3^{-5}$ and $\left(\frac{1}{3}\right)^6 \cdot 9^{-1}$ are equivalent because both can be written as 3^{-9}. Do you agree?

Write your answer in sentences.

Whiteboards · Question 9 of 9

Xavier says $\left(\frac{1}{9}\right)^2 \cdot 3^{-5}$ and $\left(\frac{1}{3}\right)^6 \cdot 9^{-1}$ are equivalent because both can be written as 3^{-9}. Do you agree?

First: $\left(\frac{1}{9}\right)^2 \cdot 3^{-5} = 3^{-4} \cdot 3^{-5} = 3^{-9}$

Second: $\left(\frac{1}{3}\right)^6 \cdot 9^{-1} = 3^{-6} \cdot 3^{-2} = 3^{-8}$

Answer: No — the second is 3^{-8}, not 3^{-9}

Independent Set

1. Find the value. $\dfrac{(-5)^4}{(-5)^0 \cdot (-5)^2}$

2. Find the value. $\left(\frac{2}{3}\right)^{-2} \cdot \left(\frac{2}{3}\right)^3$

3. Write as a power of 2. 16^3

4. Write as a power of 3. $27^2 \cdot 9$

5. Are 4^{-2} and 2^{-4} equivalent? Show why.

6. Find the value. $(3^{-1})^2 \cdot 3^5$

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 — 6T7

Identify equivalent expressions involving exponents II — QDM