GRADE 7 ACCELERATED · UNIT 3 · LESSON 4

Negative Exponent Law

MA.8.NSO.1.3

I can rewrite a power with a negative exponent using a positive exponent, and evaluate it.

Warm-Up

1. Find the value: $\frac{5^4 \cdot 5^0}{5^2}$
2. Which is greater, $\sqrt{30}$ or 5.5?
3. Solve $-3x = 21$
4. What is the reciprocal of $\frac{3}{4}$? What is the opposite of $\frac{3}{4}$?

Warm-Up

1. Find the value: $\frac{5^4 \cdot 5^0}{5^2}$ **25**
2. Which is greater, $\sqrt{30}$ or 5.5? **5.5**
3. Solve $-3x = 21$ **$x = -7$**
4. What is the reciprocal of $\frac{3}{4}$? What is the opposite of $\frac{3}{4}$?

   $\frac{4}{3}$ and $-\frac{3}{4}$

Vocabulary

negative exponent law

$a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$, for nonzero a

reciprocal

the number that multiplies a given number to give 1: the reciprocal of 8 is $\frac{1}{8}$

opposite

the number the same distance from 0 on the other side: the opposite of 8 is −8. A negative exponent asks for a reciprocal, never an opposite.

Notes

I. The pattern keeps going past zero

2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
16	8	4	2	1	1/2	1/4	1/8

$$2^{-1} = \frac{1}{2^1} \qquad 2^{-2} = \frac{1}{2^2} = \frac{1}{4} \qquad 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$$

Notes

II. The negative exponent law

$$a^{-n} = \frac{1}{a^n} \qquad \frac{1}{a^{-n}} = a^n \qquad (a \neq 0)$$

$$5^{-2} = \frac{1}{5^2} = \frac{1}{25} \qquad \text{but} \qquad -5^2 = -25 \qquad \text{and} \qquad (-5)^2 = 25$$

A negative exponent means reciprocal. It never means a negative value.

The base keeps its own sign: $(-2)^{-3} = \frac{1}{(-2)^3} = \frac{1}{-8} = -\frac{1}{8}$

Notes

III. The laws still work with negative exponents

$$6^{-2} \cdot 6^5 = \frac{1}{6^2} \cdot 6^5 = \frac{7776}{36} = 216$$

or $$6^{-2} \cdot 6^5 = 6^{-2+5} = 6^3 = 216$$

$$\frac{9^{-5}}{9^3} = 9^{-5-3} = 9^{-8} = \frac{1}{9^8}$$

Add, subtract and multiply exponents exactly as before — the exponents are just integers now.

Example 1

$$\frac{2^{-3}}{9^{-2}}$$

Rewrite with positive exponents, then find the value.

Example 1

$$\frac{2^{-3}}{9^{-2}} = \frac{9^2}{2^3}$$

$$\frac{9^2}{2^3} = \frac{81}{8} = 10.125$$

Answer: 81/8 = 10.125

Your Turn

$$\frac{3^{-2}}{5^{-1}}$$

Rewrite with positive exponents, then find the value.

Your Turn

$$\frac{3^{-2}}{5^{-1}}$$

Rewrite with positive exponents, then find the value.

$3^{-2} = \frac{1}{3^2}$ and $\frac{1}{5^{-1}} = 5^1$

$\frac{3^{-2}}{5^{-1}} = \frac{5^1}{3^2} = \frac{5}{9}$

Answer: $\frac{5}{9}$

Example 2

$$\frac{7^0}{7^{-4}}$$

Find the value.

Example 2

$$\frac{7^{0}}{7^{-4}} = 7^{0-(-4)} = 7^{4}$$

$$\frac{7^{0}}{7^{-4}} = \frac{1}{7^{-4}} = 7^{4}$$

$$7^{4} = 2401$$

Answer: 2,401

Your Turn

$$\frac{(-8)^{-4}}{(-8)^{-6}}$$

Find the value.

Your Turn

$$\frac{(-8)^{-4}}{(-8)^{-6}}$$

Find the value.

$$\frac{(-8)^{-4}}{(-8)^{-6}} = (-8)^{-4-(-6)} = (-8)^{2}$$

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

Answer: 64

Whiteboards · Question 1 of 9

$$8^{-3}$$

Answer it.

Whiteboards · Question 1 of 9

$$8^{-3}$$

$$8^{-3} = \frac{1}{8^3}$$

Answer: $\frac{1}{8^3}$

Whiteboards · Question 2 of 9

A sheet of paper 30 centimeters long is folded in half 7 times.

Each fold makes the top layer half as big.

What fraction of the whole sheet is the top layer after 7 folds?

Answer it.

Whiteboards · Question 2 of 9

A sheet of paper 30 centimeters long is folded in half 7 times.

Each fold makes the top layer half as big.

What fraction of the whole sheet is the top layer after 7 folds?

Each fold halves it: $\left(\frac{1}{2}\right)^7 = \frac{1}{2^7}$

$2^7 = 128$, so $\frac{1}{2^7} = \frac{1}{128}$

Answer: $\frac{1}{128}$

Whiteboards · Question 3 of 9

$$\frac{1}{10^{-2}}$$

Answer it.

Whiteboards · Question 3 of 9

$$\frac{1}{10^{-2}}$$

$$\frac{1}{10^{-2}} = 10^{2}$$

$$10^{2} = 100$$

Answer: $10^{2} = 100$

Whiteboards · Question 4 of 9

$$(-3)^{-3}$$

Answer it.

Whiteboards · Question 4 of 9

$$(-3)^{-3}$$

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

$$(-3)^3 = -27, \quad \text{so} \quad \frac{1}{(-3)^3} = -\frac{1}{27}$$

Answer: $-\frac{1}{27}$

Whiteboards · Question 5 of 9

$$7^{-2}$$

Which is the value?

A. 1/14

B. 1/49

C. –49

D. –14

Answer it.

Whiteboards · Question 5 of 9

$$7^{-2}$$

Which is the value?

$$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$$

Answer: B — 1/49

Whiteboards · Question 6 of 9

$$4^{-3} \cdot 4^{7}$$

Which expression is equivalent?

A. 4^{-21}

B. 16^{4}

C. 4^{-10}

D. 4^{4}

Answer it.

Whiteboards · Question 6 of 9

$$4^{-3} \cdot 4^{7}$$

Which expression is equivalent?

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

Answer: D — 4^4

Whiteboards · Question 7 of 9

$$3^{-4} \cdot 3^{4}$$

Answer it.

Whiteboards · Question 7 of 9

$$3^{-4} \cdot 3^{4}$$

$$3^{-4} \cdot 3^{4} = 3^{-4+4} = 3^{0} = 1$$

Answer: 1

Whiteboards · Question 8 of 9

$$\frac{11^{-4}}{11^{2}}$$

Answer it.

Whiteboards · Question 8 of 9

$$\frac{11^{-4}}{11^{2}}$$

$$\frac{11^{-4}}{11^{2}} = 11^{-4-2} = 11^{-6}$$

$$11^{-6} = \frac{1}{11^{6}}$$

Answer: $\frac{1}{11^{6}}$

Whiteboards · Question 9 of 9

Ellen says the value of 12^{-2} is -144.

Explain why she is wrong, and show the correct value.

Write your answer in sentences.

Whiteboards · Question 9 of 9

Ellen says the value of 12^{-2} is -144.

Explain why she is wrong, and show the correct value.

A negative exponent means the reciprocal, not the opposite.

$$12^{-2} = \frac{1}{12^2} = \frac{1}{144}$$

Answer: $12^{-2} = 1/12^2 = 1/144$

Independent Set

1. Rewrite with a positive exponent. Do not evaluate. 9^{-2}
2. Find the value. 3^{-4}
3. Find the value. $(-4)^{-2}$
4. Find the value. $\dfrac{1}{10^{-3}}$
5. Find the value. $5^{2} \cdot 5^{-5}$
6. Find the value of n. $2^{n} = \dfrac{1}{16}$

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

Understanding negative exponents — YBB

Evaluate powers with negative exponents — WGS