GRADE 7 ACCELERATED · UNIT 3 · THREAD A · DAY 2

Negative Exponents with Variable Bases

MA.8.AR.1.1

I can rewrite an algebraic expression with negative exponents using only positive exponents, and apply several laws of exponents to a monomial expression.

Warm-Up

1. Write as a single monomial: $(3x^2)^3$
2. Find the value: 5^{-2}
3. Which is greater, $\sqrt{80}$ or 9?
4. What is the reciprocal of $\frac{2}{3}$?

Warm-Up

1. Write as a single monomial: $(3x^2)^3$ **$27x^6$**
2. Find the value: 5^{-2} **1/25**
3. Which is greater, $\sqrt{80}$ or 9? **9**
4. What is the reciprocal of $\frac{2}{3}$? $\frac{3}{2}$

Vocabulary

negative exponent law

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

— the base moves across the fraction bar and the exponent turns positive

simplified form

for this unit: a single monomial, or a single fraction, with every exponent positive and no factor repeated

Notes

I. The pattern, with a letter

x^4	x^3	x^2	x^1	x^0	x^{-1}	x^{-2}	x^{-3}
$x \cdot x \cdot x \cdot x$	$x \cdot x \cdot x$	$x \cdot x$	x	1	$1/x$	$1/x^2$	$1/x^3$

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

Notes

II. Moving factors across the fraction bar

$$3x^{-2} = \frac{3}{x^2} \qquad y^{-3}z^{-4} = \frac{1}{y^3z^4} \qquad \frac{a^2}{b^{-3}} = a^2b^3$$

$$\frac{5x^{-4}y^2}{z^{-1}} = \frac{5y^2z}{x^4}$$

Only the factor with the negative exponent moves. Its exponent turns positive.

Notes

III. The laws with negative exponents

$$x^4 \cdot x^{-6} = x^{4+(-6)} = x^{-2} = \frac{1}{x^2} \qquad \frac{m^3}{m^7} = m^{3-7} = m^{-4} = \frac{1}{m^4}$$

$$(2y^{-3})^2 = 2^2 \cdot y^{-6} = \frac{4}{y^6}$$

Apply the law. Then rewrite so that every exponent is positive.

Example 1

$$(2x^{-3}y^{2})(6x^{5}y^{-4})$$

Write an equivalent expression with positive exponents only.

Example 1

$$(2x^{-3}y^{2})(6x^{5}y^{-4}) = 12 \cdot x^{-3+5} \cdot y^{2+(-4)}$$

$$= 12x^{2}y^{-2} = \frac{12x^{2}}{y^{2}}$$

Answer: $12x^2/y^2$

Your Turn

$$(4a^{-2}b)(a^{5}b^{-3})$$

Write an equivalent expression with positive exponents only.

Your Turn

$$(4a^{-2}b)(a^{5}b^{-3})$$

Write an equivalent expression with positive exponents only.

The a's: $a^{-2} \cdot a^{5} = a^{-2+5} = a^{3}$

The b's: $b^{1} \cdot b^{-3} = b^{1+(-3)} = b^{-2} = \frac{1}{b^{2}}$

$4 \cdot a^{3} \cdot \frac{1}{b^{2}} = \frac{4a^{3}}{b^{2}}$

Answer: $\frac{4a^{3}}{b^{2}}$

Example 2

$$\left(\frac{a^3}{4b^{-7}}\right)^5$$

Write an equivalent expression with positive exponents only.

Example 2

$$\left(\frac{a^{3}}{4b^{-7}}\right)^{5} = \frac{a^{15}}{4^{5}b^{-35}}$$

$$= \frac{a^{15}b^{35}}{1{,}024}$$

Answer: $a^{15}b^{35}/1{,}024$

Your Turn

$$\left(\frac{x^2}{3y^{-2}}\right)^3$$

Write an equivalent expression with positive exponents only.

Your Turn

$$\left(\frac{x^2}{3y^{-2}}\right)^3$$

Write an equivalent expression with positive exponents only.

Cube every part, then move the y up:

$$\left(\frac{x^2}{3y^{-2}}\right)^3 = \frac{x^6}{27y^{-6}} = \frac{x^6y^6}{27}$$

Answer: $\dfrac{x^6y^6}{27}$

Whiteboards · Question 1 of 9

$$x^{-8}$$

Answer it.

Whiteboards · Question 1 of 9

$$x^{-8}$$

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

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

Whiteboards · Question 2 of 9

$$\frac{1}{y^{-9}}$$

Answer it.

Whiteboards · Question 2 of 9

$$\frac{1}{y^{-9}}$$

$$\frac{1}{y^{-9}} = y^{9}$$

Answer: y^{9}

Whiteboards · Question 3 of 9

The brightness of a lamp from x meters away is $5x^{-2}$ units.

The lamp is 15 centimeters tall.

How bright is the lamp from 3 meters away?

Answer it.

Whiteboards · Question 3 of 9

The brightness of a lamp from x meters away is $5x^{-2}$ units.

The lamp is 15 centimeters tall.

How bright is the lamp from 3 meters away?

$$5x^{-2} = \frac{5}{x^2}$$

When $x = 3$: $\frac{5}{3^2} = \frac{5}{9}$

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

Whiteboards · Question 4 of 9

$$p^{-7}q^{-2}$$

Answer it.

Whiteboards · Question 4 of 9

$$p^{-7}q^{-2}$$

$$p^{-7}q^{-2} = \frac{1}{p^7} \cdot \frac{1}{q^2} = \frac{1}{p^7 q^2}$$

Answer: $\frac{1}{p^7 q^2}$

Whiteboards · Question 5 of 9

$$x^{3} \cdot x^{-14}$$

Which expression is equivalent?

A. $-x^{11}$

B. $1/x^{42}$

C. $1/x^{11}$

D. x^{17}

Answer it.

Whiteboards · Question 5 of 9

$$x^{3} \cdot x^{-14}$$

Which expression is equivalent?

$$x^{3} \cdot x^{-14} = x^{3+(-14)} = x^{-11}$$

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

Answer: C — $1/x^{11}$

Whiteboards · Question 6 of 9

$$(3x^{-5})^2$$

Which expression is equivalent?

A. $9/x^3$

B. $1/(9x^{10})$

C. $3/x^{10}$

D. $9/x^{10}$

Answer it.

Whiteboards · Question 6 of 9

$$(3x^{-5})^2$$

Which expression is equivalent?

$$(3x^{-5})^2 = 3^2 \cdot x^{-5 \cdot 2} = 9x^{-10}$$

$$9x^{-10} = \frac{9}{x^{10}}$$

Answer: D — $9/x^{10}$

Whiteboards · Question 7 of 9

$$\frac{a^2}{a^{11}}$$

Answer it.

Whiteboards · Question 7 of 9

$$\frac{a^{2}}{a^{11}}$$

$$\frac{a^{2}}{a^{11}} = a^{2-11} = a^{-9}$$

$$a^{-9} = \frac{1}{a^{9}}$$

Answer: $\frac{1}{a^{9}}$

Whiteboards · Question 8 of 9

Find the value of n:

$$x^{-5} \cdot x^{n} = x^{2}$$

Answer it.

Whiteboards · Question 8 of 9

Find the value of n:

$$x^{-5} \cdot x^{n} = x^{2}$$

Same base, so the exponents add: $-5 + n = 2$

$n = 2 + 5 = 7$

Answer: $n = 7$

Whiteboards · Question 9 of 9

How are x^5 and x^{-5} related?

Explain, and give the value of each when $x = 2$.

Write your answer in sentences.

Whiteboards · Question 9 of 9

How are x^5 and x^{-5} related?

Explain, and give the value of each when $x = 2$.

$x^{-5} = \frac{1}{x^5}$, the reciprocal of x^5

When $x = 2$: $2^5 = 32$ and $2^{-5} = \frac{1}{32}$

Answer: x^{-5} is the reciprocal of x^5. When $x = 2$: $x^5 = 32$ and $x^{-5} = 1/32$.

Independent Set

1. Rewrite using only positive exponents. m^{-6}
2. Rewrite using only positive exponents. $5y^{-3}$
3. Rewrite using only positive exponents. $\frac{1}{x^{-7}}$
4. Simplify. Use positive exponents only. $x^{2} \cdot x^{-9}$
5. Simplify. Use positive exponents only. $(2m^{-5})^{3}$
6. Find the value of n. $y^{-3} \cdot y^{n} = y^{4}$

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

Variables with negative exponents — 2NL
Multiply and divide powers: variable bases — 85P