

Sec 4.5 Negative Exponents

Section 4.5: Negative Exponents and Reciprocals

Recall: $a^m \div a^n = a^{m-n}$

Example 1

1a) Use this exponent rule to complete the table.

Example	Rule	Power Form	Product Form	Another Power Form
$\frac{10^5}{10^3}$				
$\frac{10^3}{10^5}$				
$\frac{x^4}{x}$				
$\frac{x}{x^4}$				

1b) Compare the two columns that contain Power Form.
What do you notice?

1c) Write an exponent rule for writing negative exponents into positive exponents.

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Powers with Negative Exponents

$$x^{-n} = \frac{1}{x^n} \quad \text{or} \quad \frac{1}{x^{-n}} = x^n$$

n: is a rational number

x: is a non zero number

Example 2 Rewrite each with a positive exponent and then evaluate.

a) 3^{-2}

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

c) $\frac{1}{2^{-3}}$

d) $\frac{-1}{4^{-2}}$

Example 3: Your Turn

e) $(-7)^{-2}$

f) $\left(\frac{10}{3}\right)^{-3}$

g) $\frac{1}{3^{-3}}$

h) $\frac{-1}{10^{-4}}$

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Example 4 Given that $3^8 = 6561$, what is 3^{-8} ?

Example 5 Write each expression as a single power with a positive exponent.

a) $5^{-1} \times 5^{-3}$

b) $(-3)^2 \times (-3)^{-7}$

c) $4^2 \div 4^{-2}$

d) $\frac{(-2)^{-4}}{(-2)^{-2}}$

e) $\frac{3^{-4} \times 3^{-1}}{3^2}$

f) $\frac{2^5}{2^{-1}} \times \frac{2^{-3}}{2^2}$

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Example 6 Evaluate using a calculator.

a) $(0.3)^{-4}$

b) $(-1.5)^{-3}$



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Math 1201

Extra Practice Worksheet

Negative Exponents

1. Write each power using a positive exponent then evaluate.

a) 2^{-4}

b) $(-3)^{-1}$

c) $\frac{1}{5^{-2}}$

d) -8^{-2}

e) $(-4)^{-3}$

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

2. Write as a single power with a positive exponent.

a) $6^{-5} \times 6^3$

b) $2^{-6} \times 2^{-2} \times 2^5$

c) $\frac{5^{-7}}{5^{10}}$

d) $\frac{8^5 \times 8^{-11}}{8^{-3}}$

e) $\frac{3^{-3}}{3^5 \times 3^{-2}}$

f) $\frac{2^2}{2^{-4}} \times \frac{2^{-2}}{2^2}$

3. Given that $5^3 = 125$, what is 5^{-3} ?

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Negative Fractional Exponents

↳ To make an exponent positive, we take the reciprocal the base; do not take the reciprocal the exponent.

Example 7 Review: a) $5^{-3} =$

b) $25^{\frac{1}{2}} =$

c) $8^{-\frac{2}{3}} =$

Example 8 Write each power with a positive exponent.

a) $5^{-\frac{3}{2}}$

b) $-4^{-\frac{1}{2}}$

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

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Example 9 Evaluate each power without using a calculator.

a) $36^{-\frac{1}{2}}$

b) $\left(\frac{1}{8}\right)^{-\frac{1}{3}}$

c) $8^{-\frac{2}{3}}$

d) $\left(\frac{9}{16}\right)^{-\frac{3}{2}}$

Example 10: Your Turn

e) $-64^{-\frac{1}{3}}$

f) $\left(\frac{25}{36}\right)^{-\frac{1}{2}}$

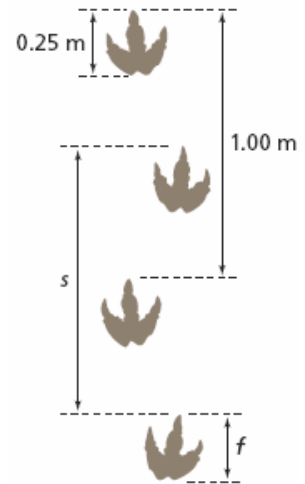
g) $27^{-\frac{2}{3}}$

h) $\left(\frac{1}{16}\right)^{-\frac{5}{4}}$

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Example 11

Paleontologists use measurements from fossilized dinosaur tracks and the formula $v = 0.155s^{\frac{5}{3}}f^{-\frac{7}{6}}$ to estimate the speed at which the dinosaur travelled. In the formula, v , is the speed in m/s , s is the distance between successive footprints of the same foot, and f is the foot length in meters. Use the measurements in the diagram to estimate the speed of the dinosaur.



Work Book Questions

p.233-234 #6ac, 7bc, 8acef,
9aceg, 12, 16

Extra Practice Questions

p.233-234 #3, 4, 5, 8bdf, 9bdfh
13, 15