

Get out your homework from Friday and have it ready to check. Grab a Warm Up from the table in the front of the room and get to work!

We will have a Target Check tomorrow and a quiz on Friday!

Classwork - Simplifying Expressions with Negative Exponents

$$(3 \cdot 5) \cdot (x^3 \cdot x^2)$$

1) $3x^3 \cdot 5x^2$

$$15x^5$$

2) $-4ac^3 \cdot -8a^4$

$$32a^5c^3$$

$$(5)^3 \cdot (9^4)^3$$

3) $(5g^4)^3$

$$125g^{12}$$

4) $(-7h^2j^4)^2$

$$(-7)^2 \cdot (h^2)^2 \cdot (j^4)^2$$

$$49 \cdot h^4 \cdot j^8 \rightarrow 49h^4j^8$$

5) $\frac{8x^5}{4x^2}$

$$2x^3$$

6) $\frac{10y^9}{15y^4}$

$$\frac{2}{3} \cdot y^5$$

$$\frac{2y^5}{3}$$

Simplify.

1. $(7^2)^3$

7^6 or 117,649

2. $(3^2)^6$

3^{12} or 531,441

3. $(8^3)^2$

8^6 or 262,144

4. $(9^4)^2$

9^8 or 43,046,721

5. $(d^7)^6$

d^{42}

6. $(m^5)^5$

m^{25}

7. $(h^6)^3$

h^{18}

8. $(z^7)^3$

z^{21}

9. $[(4^3)^2]^2$

4^{12} or 16,777,216

10. $(-5a^2b^7)^7$

$-78,125a^{14}b^{49}$

11. $(2m^5g^{11})^6$

$64m^{30}g^{66}$

12. $[(2^3)^3]^2$

2^{18} or 262,144

13. $(7a^5b^6)^4$

$2,401a^{20}b^{24}$

14. $(7m^3n^{11})^5$

$16,807m^{15}n^{55}$

15. $(-3w^3z^8)^5$

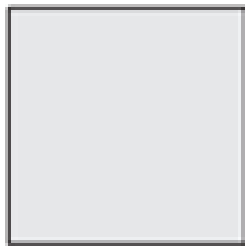
$-243w^{15}z^{40}$

16. $(-7r^4s^{10})^4$

$2,401r^{16}s^{40}$

GEOMETRY Express the area of each square below as a monomial.

17.



$6g^3h^5$

$$(6g^3h^5)^2$$

$$36g^6h^{10}$$

18.

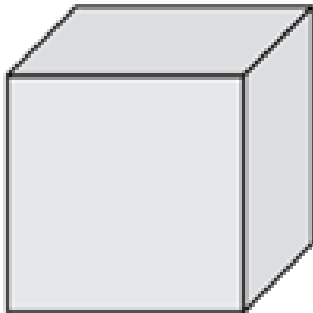


$13d^5e$

$$169d^{10}e^2$$

GEOMETRY Express the volume of each cube below as a monomial.

19.

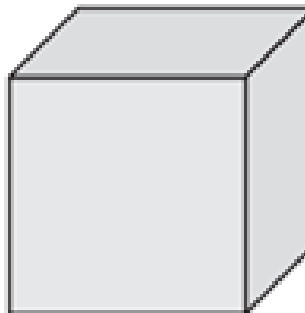


$7c^5d^2$

$$343c^{15}d^6$$

$$(7c^5d^2)^3$$

20.



$6r^7s^8$

$$216r^{21}s^{24}$$



Real-World Link

Insects The table shows the approximate wing beats per minute for certain insects.

Insect	Wing Beats per Minute
house fly	10,000
small butterfly	100

1. Write a ratio in simplest form that compares the number of wing beats

for a butterfly to a housefly.

$$\frac{\boxed{}}{\boxed{}}$$

2. Write the ratio as a fraction with an exponent in the denominator and as a decimal.

$$\frac{\boxed{}}{\boxed{}} : \boxed{}$$

3. Complete the 1st 4 rows of the table showing the exponential and standard forms of power of 10.

4. What operation is performed when you move down the table?

5. What happens to the exponent?

6. Extend the table to include the next three entries.

Exponential Form	Standard Form
10^3	
$10^{\boxed{}}$	100
10^1	
10^0	

Zero and Negative Exponents

Words Any nonzero number to the zero power is 1. Any nonzero number to the negative n power is the multiplicative inverse of its n th power.

Examples **Numbers**

$$5^0 = 1$$

$$7^{-3} = \frac{1}{7} \cdot \frac{1}{7} \cdot \frac{1}{7} \text{ or } \frac{1}{7^3}$$

Algebra

$$x^0 = 1, x \neq 0$$

$$x^{-n} = \frac{1}{x^n}, x \neq 0$$

You can use exponents to represent very small numbers.

Negative powers are the result of repeated division.

Examples

Tutor



Write each expression using a positive exponent.

1. 6^{-3}

$$6^{-3} = \frac{1}{6^3}$$

Definition of
negative exponent

2. a^{-5}

$$a^{-5} = \frac{1}{a^5}$$

Definition of
negative exponent

P.44

$$7^{-3} = \frac{1}{7^3}$$

Got it? Do these problems to find out.

a. $7^{-2} = \frac{1}{7^2}$

b. b^{-4}

c. $5^0 = 1$

d. m^{-3}

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

Examples

Tutor

Write each fraction as an expression using a negative exponent other than -1 .

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

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

Definition of negative exponent

4. $\frac{1}{36}$

$$\frac{1}{36} = \frac{1}{6^2}$$

Definition of exponent

$$= 6^{-2}$$

Definition of negative exponent

Got it? Do these problems to find out.

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

f. $\frac{1}{4} \rightarrow \frac{1}{2^2} = 2^{-2}$

g. $\frac{1}{c^5} = c^{-5}$

h. $\frac{1}{27}$



Example



5. **STEM** One human hair is about 0.001 inch in diameter.
Write the decimal as a power of 10.

$$\begin{aligned}0.001 &= \frac{1}{1,000} && \text{Write the decimal as a fraction.} \\ &= \frac{1}{10^3} && 1,000 = 10^3 \\ &= 10^{-3} && \text{Definition of negative exponent}\end{aligned}$$

A human hair is 10^{-3} inch thick.

Got it? Do this problem to find out.

- i. **STEM** A water molecule is about 0.0000000001 meter long.
Write the decimal as a power of 10.

Multiply and Divide with Negative Exponents

The Product of Powers and the Quotient of Powers rules can be used to multiply and divide powers with negative exponents.

Examples



Simplify each expression.

6. $5^3 \cdot 5^{-5}$

$$5^3 \cdot 5^{-5} = 5^{3 + (-5)}$$

Product of Powers

$$= 5^{-2}$$

Simplify.

$$= \frac{1}{5^2} \text{ or } \frac{1}{25}$$

Write using positive exponents. Simplify.

7. $\frac{w^{-1}}{w^{-4}}$

$$\frac{w^{-1}}{w^{-4}} = w^{-1 - (-4)}$$

Quotient of Powers

$$= w^{(-1) + 4} \text{ or } w^3$$

Subtract the exponents.

j) $3^{-6} = \frac{1}{3^6}$

k) $11^{-2} = \frac{1}{11^2}$

Got it? Do these problems to find out.

j. $3^{-8} \cdot 3^2$

k. $\frac{11^2}{11^4}$

l. $n^9 \cdot n^{-4}$

m. $\frac{b^{-4}}{b^{-7}}$