10.1 Exponents

Review – Parts of an Exponent

4^3

_____ ← base

_____ ← exponent

_____ ← power

Example 1

Write each product using exponents

1) $5 \bullet 5 \bullet 5$

2) $m \bullet m \bullet m \bullet m \bullet m \bullet m$

3) $a \bullet b \bullet b \bullet a \bullet b$

4) $-4 \bullet -4 \bullet -4$

5) $\frac{1}{2} \bullet \frac{1}{2} \bullet \frac{1}{2} \bullet \frac{1}{2}$

On Your Own

Write each product using exponents

6) $(-7)(-7)(-7)$

7) $\pi \bullet \pi \bullet r \bullet r \bullet r$

8) $\frac{1}{4} \bullet \frac{1}{4} \bullet \frac{1}{4} \bullet \frac{1}{4} \bullet \frac{1}{4}$

9) $0.3 \bullet 0.3 \bullet 0.3 \bullet x \bullet x$

Review – Order of Operations

P
E
M
D
A
S

Practice

Simplify the following

10) $9+6\times4-7$

11) $24\div(3\bullet5-7)$

P E M D A S

Left →Right Left →Right

12) $(4-2)^3-5$

13) $8+2\times9^2$

P E M D A S

Left →Right Left →Right

14) $6+2^3\div8$

15) $100-5^2\times4$

Important!!

$$(-4)^2 \quad vs \quad -4^2$$

Evaluation each expression

16) -2^4

17) $(-2)^4$

On Your Own

Evaluation each expression

18) $3+2\bullet 3^4$

19) $3^3-8^2\div 2$

On Your Own

Evaluation each expression

20) -5^4

21) $\left(-\frac{1}{6}\right)^3$

22) $\left|-3^3\div 9\right|$

Evaluating with negative numbers

Evaluate x^3 if $x=-2$

10.2

Product of Powers Property

Do Now

Evaluate the following

1) $2^3 =$

2) $3^2 =$

3) $(-2)^4 =$

4) $-2^4 =$

Product of Powers Property

Example 1

$$a^2 \bullet a^3$$

Example 2

$$m^3 \bullet m^4$$

Let' see...

1) $a^7 \bullet a^8$

2) $f^5 \bullet f^9$

3) $5^2 \bullet 5^3$

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

5) $x \bullet x^2 \bullet x^3$

The Product of Powers Property:

To multiply powers with the same base _____

_____.

...with coefficients

6) $(5m^7)(8m^8)$

7) $(-7x^4y^3)(4x^2y^6)$

Let' see...

6) $(5^2)^3$

7) $(x^3)^4$

8) $\left[\left(\frac{3}{4}\right)^2\right]^4$

9) $\left[(-8)^4\right]^6$

The Power of Powers Property:

To find a power of a power _____ .

Power of Powers Property

Example 3

$(n^2)^3$

Example 4

$(c^7)^5$

Power of Product Property

Example 5

$(2d^4)^3$

Example 6

$(-4m^2)^3$

Let' see...

10) $(5d^4)^3$

11) $(-8d^7)^2$

12) $(-3x^2y^5)^3$

13) $(24 \bullet 13)^8$

The Power of Products Property:

_____

_____ .

Practice

14) $(-5)^2(-5)^7$

15) $(6^3)^4$

16) $x \bullet (3x)^4$

17) $-(2d)^6$

10.3

Quotient of Powers Property

8-2 Exponent Properties with Quotients

Example 1

$$\frac{x^5}{x^3}$$

Example 2

$$\frac{n^7}{n^3}$$

The Quotient of Powers Property:

_____base & _____ the exponents.

Practice

Simplify

1) $\frac{x^9}{x^5}$

2) $\frac{x^8}{x^3}$

3) $\frac{x^{16}}{x^9}$

4) $\frac{x^{17}}{x^8}$

5) $\frac{8^{10}}{8^4}$

6) $\frac{4^7}{4^6}$

Practice

Simplify

7) $\frac{x^{24}}{x^{16}}$

8) $\frac{1}{(-5)^4} \bullet (-5)^{11}$

9) $\frac{x^3 y}{x^2}$

10) $\dfrac{3^4 \bullet 3^2}{3^3}$

11) $\dfrac{5^6 \bullet 5^2}{5^4}$

12) $\dfrac{\boldsymbol{z}^6}{\boldsymbol{z}^2} \bullet \dfrac{\boldsymbol{z}^8}{\boldsymbol{z}^5}$

13) $\dfrac{\boldsymbol{a}^{10}}{\boldsymbol{a}^6} \bullet \dfrac{\boldsymbol{a}^7}{\boldsymbol{a}^4}$

14) $\dfrac{\boldsymbol{d}^5}{\boldsymbol{d}} \bullet \dfrac{\boldsymbol{d}^9}{\boldsymbol{d}^8}$

15) $\dfrac{2^{15}}{2^3 \bullet 2^5}$

Solve for the missing exponent...

16) $\dfrac{12^9}{12^{\boldsymbol{?}}} = 12^5$

10.4

Zero and Negative Exponents

Do Now

Simplify.

1) $h^2 \cdot h^4$

2) $z \cdot z^{12}$

3) $\left(y^2\right)^4$

4) $\left(x^2 y^3\right)^3$

5) $\left(5a^8\right)^2$

6) $\frac{x^8}{x^3}$

7) $\frac{a^9 b}{a^2}$

Understanding Zero Exponents

Use the pattern to find the zero exponent result:

	Simplified Exponent	Evaluate
$\frac{2^6}{2^2}$		
$\frac{2^6}{2^3}$		
$\frac{2^6}{2^4}$		
$\frac{2^6}{2^5}$		
$\frac{2^6}{2^6}$		

Zero Exponent Rule

Any number to the zero power equals to _____.

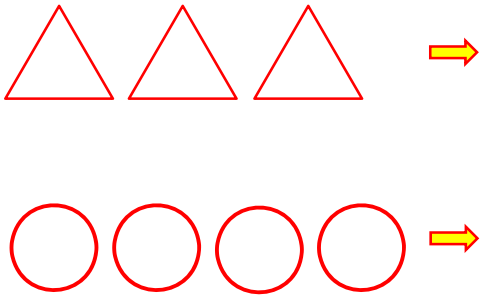
a) 4^0

b) 17^0

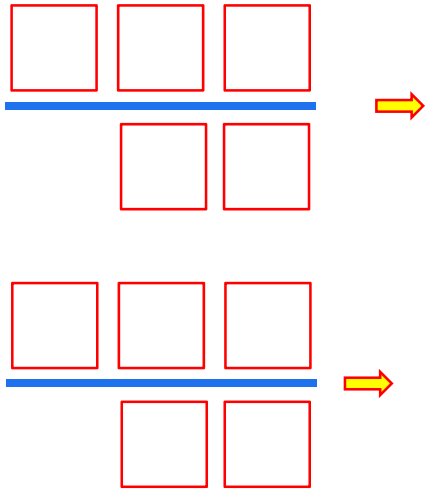
c) 125^0

d) $5{,}785{,}123^0$

Understanding: Gathering and Cancelling Activity



Understanding: Gathering and Cancelling Activity



Understanding: Gathering and Cancelling Activity

Gather and cancel as much as possible. ***(Order of shapes doesn't matter)***

1) □□□□□△△△○○○○

2) 3 △△○4 ○○2 6

3) 5 4 2 7 3 □

4) 2 4 ○ 7

Understanding: Gathering and Cancelling Activity

Gather and cancel as much as possible. ***(Order of shapes doesn't matter)***

5) □□□□□△△△○○○○

□□△△△○○

6) □□△△△△△△○○○○○○

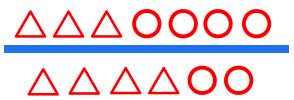
△△△△○○

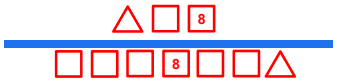
7) □□□□△△△△○○

□△○○□□□

Understanding: Gathering and Cancelling Activity

Gather and cancel as much as possible. ***(Order of shapes doesn't matter)***

8) 

9) 

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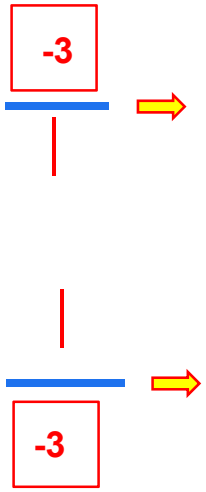
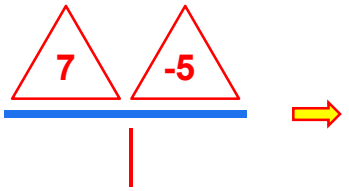
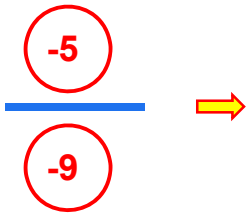
Understanding: Gathering and Cancelling Activity



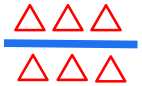
Understanding: Gathering and Cancelling Activity





Understanding: Gathering and Cancelling Activity

Gather and cancel as much as possible. ***(Order of shapes doesn't matter)***

11) 

12) 

13) 

Understanding: Gathering and Cancelling Activity

Gather and cancel as much as possible. ***(Order of shapes doesn't matter)***

14) 

15) 

13) 

10-4 Define and Use Zero and Neg. Exponents

Use the pattern to find zero exponent and negative exponents results:

2^4	
2^3	
2^2	
2^1	
2^0	
2^{-1}	
2^{-2}	
2^{-3}	

RULES:

- ANY number to the zero power equals _____.
- a^{-n} is the _____ of a^n.

Evaluate

1) 4^{-2}

2) 8^0

3) $(-24)^0$

4) 2^{-3}

5) $\dfrac{1}{2^{-4}}$

6) $(-5)^{-3}$

Practice

Simplify

1) 10^{-3}

2) $(-2)^{-6}$

3) 7^0

4) $\dfrac{1}{5^{-4}}$

5) $10^{-5} \bullet 10^7$

10.4

Zero and Negative Exponents (Part 2)

Do Now:

Simplify. Write your answer as a power.

1) $\dfrac{5^4 \bullet 5^2}{5^3}$

2) $\dfrac{2^{11} \bullet 2^5}{2^{13}}$

3) $\dfrac{a^{13} \bullet a^{11}}{a^{12}}$

8-3 Define and Use Zero and Neg. Exponents

Use the pattern to find zero exponent and negative exponents results:

2^4	
2^3	
2^2	
2^1	
2^0	
2^{-1}	
2^{-2}	
2^{-3}	

RULES:

- ANY number to the zero power equals _____.
- a^{-n} is the _____ of a^n.

Evaluate

1) 4^{-2}

2) 8^0

3) $(-24)^0$

4) $\left(\dfrac{1}{4}\right)^{-3}$

5) $\dfrac{1}{2^{-4}}$

6) $(-5)^{-3}$

Practice

Evaluate

7) $\frac{1}{3^{-4}}$

8) $(4^{-2})^{-2}$

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

10) $(5^{-3})^{-1}$

Practice

Evaluate

11) $2^4 \bullet 2^4 \bullet 2^4$

12) $(-3)^5 \bullet (-3)^{-5}$

Practice

Simplify

13) $3f^{-4}$

14) $(3f)^{-4}$

15) $\frac{a^{-7}}{b^{4}}$

16) $\frac{m^{6}}{n^{-7}}$

Practice

Simplify

17) $\frac{c^{-2}}{d^{-3}}$

18) $6x^{-2}yz^{-4}$

Practice

Simplify

1) 10^{-3}

2) $(-2)^{-6}$

3) 7^{0}

4) $\dfrac{1}{5^{-4}}$

5) $10^{-7} \bullet 10^{5}$

Practice

Simplify

6) x^{-7}

7) $6y^{-4}$

8) $a^{2}b^{-4}$

9) $3x^{-2}y^{-5}$

10) $\dfrac{1}{3x^{-3}y^{-7}}$

Practice

Simplify.

1. 5^{-3}

2. $(-8)^{0}$

Practice

Simplify.

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

4. $\dfrac{15^{-4}}{15^{-4}}$

Practice

Simplify.

5. $10^{-1} \cdot 10^{-2}$

6. $\frac{1}{3^{-4}} \cdot \frac{1}{3^{6}}$

Practice

Simplify.

7. $27^{-18} \cdot 27^{18}$

8. $\frac{4^{-7}}{4^{2} \cdot 4^{-5}}$

Practice

Simplify.

10. $\frac{14u^{-4}}{7u^{8}}$

11. $\frac{18w^{-8}}{w^{-5}}$

Practice

Simplify.

12. $y^{5} \cdot z^{-3}$

13. $\frac{2^{-3} \cdot a^{0} \cdot b^{5}}{b^{-4}}$

10.5

Reading Scientific Notation

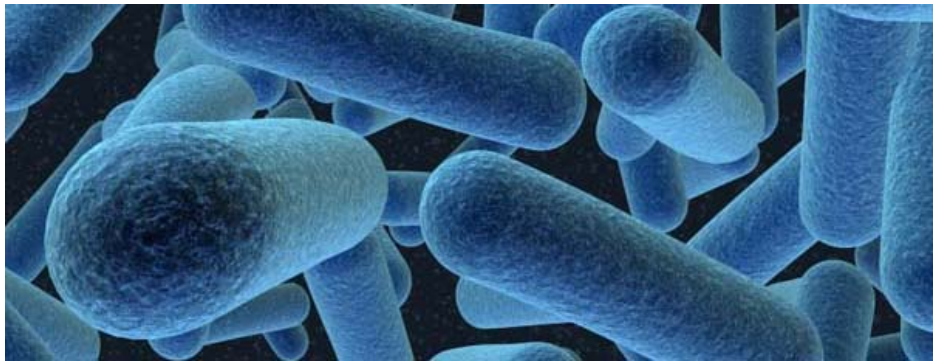
Evaluate the expression.

1. 10^3 **2.** 10^{-4} **3.** 10^5

4. 10^{-2} **5.** 10^{10} **6.** 10^{-5}

Distance from Earth to the Sun

150,000,000 km



Size of Bacterium

0.0000625 cm

Scientific Notation

This is way of writing very big or small numbers in an easier way.

150

1,500

15,000

Scientific Notation

A number is expressed in scientific notation when it is in the form

where a is _____
and n is an _____.

Tell whether the number is written in scientific notation. Explain.

a. 5.9×10^{-6}

b. 0.9×10^{8}

Scientific Notation

This is way of writing very big or small numbers in an easier way.

150,000,000

Something you should know…

The relationship between decimals and negative exponents….

.1

.01

.001

Something you should know…

The relationship between decimals and negative exponents….

.0001

.00001

Scientific Notation

This is way of writing very big or small numbers in an easier way.

.062

.0062

.00062

Scientific Notation

This is way of writing very big or small numbers in an easier way.

0.0000625

Standard Form

Write the following in standard form:

1) 2.5×10^{3}

2) 3.94×10^{-4}

3) 6.47×10^{6}

4) 7.83×10^{-7}

5) 2.5×10^{2}

6) a. Write 3.22×10^{-4} in standard form.

b. Write 7.9×10^{5} in standard form.

7) An object with a lesser density than water will float. An object with a greater density than water will sink. Use each given density (in kilograms per cubic meter) to explain what happens when you place a brick and an apple in water.

Water: 1.0×10^{3} **Brick:** 1.84×10^{3} **Apple:** 6.41×10^{2}

8)

A female flea consumes about 1.4×10^{-5} liter of blood per day.

A dog has 100 female fleas. How much blood do the fleas consume per day?

Scientific Notation

Write the following in scientific notation:

9) $64,830,000,000,000$

10) 0.00000000089

11) $118,000,000,000,000$

12) 0.000000000000025

13) 67

14) A large corporation purchased a video-sharing website for $1,650,000,000. Write this number in scientific notation.

15) The 2004 Indonesian earthquake slowed the rotation of Earth, making the length of a day 0.00000268 second shorter. Write this number in scientific notation.

16)

An album receives an award when it sells 10,000,000 copies.

An album has sold 8,780,000 copies. How many more copies does it need to sell to receive the award?

17) **The table shows when the last three geologic eras began. Order the eras from earliest to most recent.**

Era	Began
Paleozoic	5.42×10^8 years ago
Cenozoic	6.55×10^7 years ago
Mesozoic	2.51×10^8 years ago

10.7

Operations in Scientific Notation (Day 1)

Rules for Operations

To make scientific notation have a bigger exponent:

- **Move the decimal left**
- **Add the number of times you moved the decimal to the exponent.**

1) 2.4×10^{3}

2) 7.1×10^{7}

3) 8.2×10^{-9}

4) 4.6×10^{-4}

Fixing non-scientific notation

1) 35×10^{8}

2) 215×10^{9}

3) $4{,}587\times10^{2}$

Fixing non-scientific notation

4) 0.15×10^{7}

5) 0.00057×10^{9}

6) $.05782\times10^{2}$

Find the sum or difference. Write your answer in scientific notation.

a. $(4.6 \times 10^3) + (8.72 \times 10^3)$

b. $(3.5 \times 10^{-2}) - (6.6 \times 10^{-3})$

Find the sum or difference. Write your answer in scientific notation.

c. $(2.1 \times 10^{-4}) + (9.74 \times 10^{-4})$

d. $(4.7 \times 10^5) - (7.2 \times 10^3)$

Find the sum or difference. Write your answer in scientific notation.

e. $(8.2 \times 10^2) + (3.41 \times 10^{-1})$

Practice

1) $\left(17 \times 10^{12}\right) + \left(255 \times 10^{12}\right)$

2) $\left(340 \times 10^{-6}\right) - \left(285 \times 10^{-6}\right)$

Practice

3) $\left(7.545\times10^{8}\right)+\left(4.55\times10^{7}\right)$

4) $\left(8.7\times10^{7}\right)-\left(5.5\times10^{6}\right)$

Chapter 10 Review

Write the product using exponents.

1. $(-15) \cdot (-15) \cdot (-15)$

2. $\left(\frac{1}{12}\right) \cdot \left(\frac{1}{12}\right) \cdot \left(\frac{1}{12}\right) \cdot \left(\frac{1}{12}\right) \cdot \left(\frac{1}{12}\right)$

Evaluate the expression.

3. -2^3

4. $10 + 3^3 \div 9$

Simplify the expression. Write your answer as a power.

5. $9^{10} \cdot 9$

6. $(6^6)^5$

7. $(2 \cdot 10)^7$

8. $\frac{(-3.5)^{13}}{(-3.5)^9}$

Evaluate the expression.

9. $5^{-2} \cdot 5^{2}$

10. $\dfrac{-8}{(-8)^{3}}$

Write the number in standard form.

11. 3×10^{7}

12. 9.05×10^{-3}

Evaluate the expression. Write your answer in scientific notation.

13. $(7.8 \times 10^{7}) + (9.9 \times 10^{7})$

14. $(6.4 \times 10^{5}) - (5.4 \times 10^{4})$

Evaluate the expression. Write your answer in scientific notation.

15. $(3.1 \times 10^{6}) \times (2.7 \times 10^{-2})$

16. $(9.6 \times 10^{7}) \div (1.2 \times 10^{-4})$

17. CRITICAL THINKING Is $(xy^2)^3$ the same as $(xy^3)^2$? Explain.

19. TASTE BUDS There are about 10,000 taste buds on a human tongue. Write this number in scientific notation.

20. LEAD From 1978 to 2008, the amount of lead allowed in the air in the United States was 1.5×10^{-6} gram per cubic meter. In 2008, the amount allowed was reduced by 90%. What is the new amount of lead allowed in the air?

Chapter 10 Review 2

RULES:

• ANY number to the zero power equals _____.

• a^{-n} is the _____ of a^n.

Evaluate

1) $5^0 \bullet 5^3$

2) 158^0

3) $\dfrac{4^3}{4^5}$

4) $\dfrac{-3}{(-3)^5}$

Evaluate

5) $48 \bullet 2^{-4} + 5$

6) $3^{-1} \bullet 3^{-3}$

7) $\dfrac{1}{5^{-3}} \bullet \dfrac{1}{5^6}$

Simplify. Write the expression using only positive exponents.

8) $6y^{-4}$

9) $8^{-2} \bullet a^7$

10) $\dfrac{9c^3}{c^{-4}}$

11) $\dfrac{5b^{-2}}{b^{-3}}$

Simplify. Write the expression using only positive exponents.

12) $\dfrac{8x^3}{2x^9}$

13) $3d^{-4} \bullet 4d^4$

Simplify. Write the expression using only positive exponents.

14) $\dfrac{3^{-2} \bullet k^0 \bullet w^0}{w^{-6}}$