**10.1 Exponents**

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| **Standards**8.EE.1 | **Learning Objectives (I can…)*** Write expressions using integer exponents
* Evaluate expressions involving integer exponents
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A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is a product of repeated factors. The **\_\_\_\_\_\_\_\_\_\_\_\_\_**of a power is the common factor. The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of a power indicates the number of times the base is used as a factor.



**Example 1:** Writing Expressions Using Exponents

**Write each product using exponents**

1. $\left(-7\right)∙\left(-7\right)∙(-7)$
2. $π∙π∙r∙r∙r$

**On Your Own:**

1. $\frac{1}{4}∙\frac{1}{4}∙\frac{1}{4}∙\frac{1}{4}∙\frac{1}{4}$ **2.** $0.3∙0.3∙0.3∙0.3∙x∙x$

**Example 2:** Evaluating Expressions

**Evaluate each expression.**

1. $(-2)^{4}$
2. $-2^{4}$

**Example 3:** Using Order of Operations

**Evaluate each expression.**

1. $3+2∙3^{4}$
2. $3^{3}-8^{2}÷2$

**On Your Own:**

1. $-5^{4}$ **4.** $(-\frac{1}{6})^{3}$ **5.** $\left|-3^{3}÷27\right|$ **6.** $9-2^{5}∙0.5$

**Example 4:** Real Life Application

**In sphering, a person is secured inside a small, hollow sphere that is surrounded by a larger sphere. The space between the spheres is inflated with air. What is the volume of the inflated space?**

You can find the radius of each sphere by dividing each diameter given in the diagram by 2.



**On Your Own:**

**7. WHAT IF?** The diameter of the inner sphere is 1.8 meters. What is the volume of the inflated space?

**10.2 Product of Powers Property**

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| --- | --- |
| **Standards**8.EE.1 | **Learning Objectives (I can…)*** Multiply powers with the same base
* Find a power of a power
* Find a power of a product
 |

**Key Idea**

**Product of Powers Property**

**Words:** To multiply powers with the same base, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ their exponents.

**Numbers: Algebra:**

**Power of Power Property**

**Words:** To find a power of a power, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the exponents.

**Numbers: Algebra:**

**Power of a Product Property**

**Words:** To find a power of a product, find the power of each factor and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Numbers: Algebra:**

**Example 1:** Multiplying Powers with the Same Base

1. $2^{4}∙2^{5}$
2. $-5∙(-5)^{6}$
3. $x^{3}∙x^{7}$

**Example 2:** Finding a Power of a Power

1. $(3^{4})^{3}$
2. $(w^{5})^{4}$

**Example 3:** Finding a Power of a Product

1. $(2x)^{3}$
2. $(3xy)^{2}$

**Example 4:** Simplifying an Expression

**A gigabyte (GB) of computer storage space is** $2^{30}$ **bytes. The details of a computer are shown. How many bytes of total storage space does the computer have?**





The computer has 64 gigabytes of total storage space. Notice that you can write 64 as a power, $2^{6}$. Use a model to solve the problem.

**10.3 Quotient of Powers Property**

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| **Standards**8.EE.1 | **Learning Objectives (I can…)*** Divide powers with the same base
* Simplify expressions involving the quotient of powers
 |

**Key Idea**

**Quotient of Powers Property**

**Words:** To divide powers with the same base, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ their exponents.

**Numbers: Algebra:**

**Example 1:** Dividing Powers with the Same Base

1. $\frac{2^{6}}{2^{4}}$
2. $\frac{(-7)^{9}}{(-7)^{3}}$
3. $\frac{h^{7}}{h^{6}}$

**On Your Own:**

1. $\frac{9^{7}}{9^{4}}$ 3. $\frac{(-8)^{8}}{(-8)^{4}}$
2. $\frac{4.2^{6}}{4.2^{5}}$ 4. $\frac{x^{8}}{x^{3}}$

**Example 2:** Simplifying an Expression

 **Simplify** $\frac{3^{4}∙3^{2}}{3^{3}}$ **. Write your answer as a power.**



$\frac{3^{4}∙3^{2}}{3^{3}}$

**Example 3:** Simplifying an Expression

 **Simplify** $\frac{a^{10}}{a^{6}}∙\frac{a^{7}}{a^{4}}$ **. Write your answer as a power.**

**On Your Own:**

1. $\frac{2^{15}}{2^{3}∙2^{5}}$ **6.** $\frac{d^{5}}{d}∙\frac{d^{9}}{d^{8}}$ **7.** $\frac{5^{9}}{5^{4}}∙\frac{5^{5}}{5^{2}}$

**Example 4:** Real-Life Application

**The projected population of Tennessee in 2030 is about** $5∙5.9^{8}$**. Predict the average number of people per square mile in 2030.**

Use a model to solve the problem.

**On Your Own:**

**The projected population of Alabama in 2030 is about** $2.25∙2^{21}$**. The land area of Alabama is about** $2^{17}$ **square kilometers. Predict the average number of people per square kilometer in 2030.**

**10.4 Zero and Negative Exponents**

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| **Standards**8.EE.1 | **Learning Objectives (I can…)*** Evaluate expressions involving numbers with zero as an exponent
* Evaluate expressions involving negative integer exponents
 |

**Key Idea**

**Zero Exponents**

**Words:** For any nonzero number *a*,\_\_\_\_\_\_\_\_\_\_\_\_\_. The power $0^{0}$ is undefined.

**Numbers: Algebra:**

**Negative Exponents**

**Words:** For any integer *n* and any nonzero number *a*, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the reciprocal of $a^{n}$.

**Numbers: Algebra:**

**Example 1:** Evaluating Expressions

1. $3^{-4}$
2. $(-8.5)^{-4}∙(-8.5)^{4}$
3. $\frac{2^{6}}{2^{8}}$

**On Your Own:**

**Evaluate the expression.**

1. $4^{-2}$ **2.** $(-2)^{-5}$ **3.** $6^{-8}∙6^{8}$
2. $\frac{(-3)^{5}}{(-3)^{6}}$ **5.** $\frac{1}{5^{7}}∙\frac{1}{5^{-4}}$ **6.** $\frac{4^{5}∙ 4^{-3}}{4^{2}}$

**Example 2:** Simplifying Expressions

1. $-5x^{0}$
2. $\frac{9y^{-3}}{y^{5}}$

**On Your Own:**

1. $8x^{-2}$ **8.** $b^{0}∙b^{-10}$ **9.** $\frac{z^{6}}{15z^{9}}$

**Example 3:** Real-Life Application

**A drop of water leaks from a faucet every second. How many liters of water leak from the faucet in 1 hour?**

Convert 1 hour to seconds.

**On Your Own:**

**10. WHAT IF?** The faucet leaks water at a rate of 5−5 liter per second. How many liters of water leak from the faucet in 1 hour?

**10.5 Reading Scientific Notation**

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| --- | --- |
| **Standards**8.EE.38.EE.4 | **Learning Objectives (I can…)*** Identify numbers written in scientific notation
* Write numbers in scientific notation
* Compare numbers in scientific notation
 |

**Key Idea**

**Scientific Notation**

A number is written in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** when it is represented as the product of a factor and a power of 10. The factor must be greater than or equal to \_\_\_\_\_\_\_ and less than \_\_\_\_\_\_\_.



**Example 1:** Identifying Numbers Written in Scientific Notation

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

1. $5.9 ×10^{-6}$
2. $0.9×10^{8}$

**Key Idea**

**Writing Numbers in Standard Form**

The absolute value of the exponent indicates how many places to move the decimal point.

* If the exponent is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, move the decimal point to the \_\_\_\_\_\_\_\_\_\_\_.
* If the exponent is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, move the decimal point to the \_\_\_\_\_\_\_\_\_\_\_.

**Example 2:** Writing Numbers in Standard Form

1. **Write** $3.22 ×10^{-4}$ **in standard form.**
2. **Write** $7.9×10^{5}$ **in standard form.**

**On Your Own:**

1. Is $12×10^{4}$ written in scientific notation? Explain.

**Write the number in standard form.**

1. $6×10^{7}$ **3.** $9.9×10^{-5}$ **4.** $1.285×10^{4}$

**Example 3:** Comparing Numbers in Scientific Notation

**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.**



**Example 4:** Real-Life Application

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



**On Your Own:**

1. **WHAT IF?** In Example 3, the density of lead is 1.14 × 104 kilograms per cubic meter. What happens when you place lead in water?
2. **WHAT IF?** In Example 4, a dog has 75 female fleas. How much blood do the fleas consume per day?

**10.6 Writing Scientific Notation**

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| --- | --- |
| **Standards**8.EE.38.EE.4 | **Learning Objectives (I can…)*** Write large and small numbers in scientific notation
* Perform operations with numbers written in scientific notation
 |

**Key Idea**

**Writing Numbers in Scientific Notation**

**Step 1:** Move the decimal point so it is located to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the leading nonzero digit.

**Step 2:** Count the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_you moved the decimal point. This indicates the exponent of the power of \_\_\_\_\_\_\_\_\_\_\_\_\_\_, as shown below.

***Number Greater Than or Equal to 10 Number Between 0 and 1***

Use a \_\_\_\_\_\_\_\_\_\_\_\_\_ exponent when Use a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ exponent when

you move the decimal point you move the decimal point to

to the left. the right.



**Example 1:** Writing Large Numbers in Scientific Notation

**Google purchased YouTube for $1,650,000,000. Write this number in scientific notation.**



**Example 2:** Writing Small Numbers in Scientific Notation

**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.**

**On Your Own:**

**Write the number in scientific notation.**

1. 500,000 **2.** 25,000,000 **3.** 683
2. 0.005 **5.** 0.00000033 **6.** 0.000506

**Example 3:** Using Scientific Notation

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





**Example 3:** Real-Life Application

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



**10.7 Operations in Scientific Notation**

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| --- | --- |
| **Standards**8.EE.38.EE.4 | **Learning Objectives (I can…)*** Add, subtract, multiply, and divide numbers written in scientific notation.
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To add or subtract numbers written in scientific notation with the same power of 10, add or subtract the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When the numbers have different powers of 10, first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the numbers so they have the same power of 10.

**Example 1:** Adding and Subtracting Numbers in Scientific Notation

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

1. $(4.6 ×10^{3})+(8.72×10^{3})$
2. $\left(3.5×10^{-2}\right)-(6.6×10^{-3})$

**On Your Own:**

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

1. $\left(3×10^{2}\right)+(3.41×10^{-1})$ **2.** $\left(7.9×10^{-5}\right)-(4.5×10^{-5})$

To multiply or divide numbers written in scientific notation, multiply or divide the factors and powers of 10 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Example 2:** Multiplying Numbers in Scientific Notation

**Find** $(3×10^{-5})×(5×10^{-2})$**. Write your answer in scientific notation.**

**Example 3:** Dividing Numbers in Scientific Notation

**Find** $\frac{1.5×10^{-8}}{6×10^{7}}$**. Write your answer in scientific notation.**

**On Your Own:**

**Find the product or quotient. Write your answer in scientific notation.**

1. $6×(8×10^{-5})$ **4.** $(7×10^{2})×(3×10^{5})$
2. $\left(9.2×10^{12}\right)÷4.6$ **6.** $(1.5×10^{-3})÷(7.5×10^{2})$



**Example 4:** Real-Life Application

**How many times greater is the diameter of the Sun than the diameter of Earth?**

Write the diameter of the Sun in scientific notation.