

Operations with Expressions Written in Scientific Notation

Strand: Expressions and Operations
Topic: Operations with expressions written in scientific notation
Primary SOL: A.2 The student will perform operations on polynomials, including
 a) applying laws of exponents to perform operations on expressions
Related SOL: A.1a

Materials

- Scientifically Speaking activity sheet (attached)

Vocabulary

base, exponent, power, scientific notation, standard form

Student/Teacher Actions: What should students be doing? What should teachers be doing?

- Review scientific notation, and ask students how scientific notation and the laws of exponents are connected.

In pairs, give students the following examples:

A	B
$7.7 \times 10^7 + 6.2 \times 10^6$ $= 77 \times 10^6 + 6.2 \times 10^6$ $= (77 + 6.2) \times 10^6$ $= (83.2) \times 10^6$ $= 8.32 \times 10^7$	$3.5x^5 + 7.2x^5$ $= (3.5 + 7.2)x^5$ $= 10.7x^5$
$2.2 \times 10^2 - 2.2 \times 10^{-1} - 2.2 \times 10^{-3}$ $= 220,000 \times 10^{-3} - 220 \times 10^{-3}$ $\quad - 2.2 \times 10^{-3}$ $= (220,000 - 220 - 2.2) \times 10^{-3}$ $= 219777.8 \times 10^{-3}$ $= 2.197778 \times 10^2$	$15x^{-2} - 12x^2 - 9.5x^{-2}$ $= 15x^{-2} - 9.5x^{-2} - 12x^2$ $= (15 - 9.5)x^{-2} - 12x^2$ $= 5.5x^{-2} - 12x^2$
$\frac{3 \times 10^5}{(3 \times 10^2)(2 \times 10^4)}$ $= \frac{3 \times 10^5}{(3 \times 2 \times 10^2 \times 10^4)}$ $= \frac{3 \times 10^5}{(6 \times 10^6)}$	$\frac{216 x^4}{(3x^2)(2x^4)}$ $= \frac{216 x^4}{6x^6}$ $= \frac{216 x^4}{6x^6}$

A	B
$= \frac{3}{6} \times \frac{10^5}{10^6}$ $= .5 \times 10^{-1}$ $= 5 \times 10^{-2}$	$= \frac{36}{x^2}$

For each example in column A, ask students to compare operations under scientific notation to corresponding examples in column B using laws of exponents.

- Distribute the Scientifically Speaking activity sheet for students to complete.
- Summarize the lesson by having students discuss how they used the laws of exponents to find solutions to the problems. Ask students what they would have done if they had not known the laws of exponents. Ask, *“Did knowing the laws or rules of exponents make it easier? Why? Would scientific notation be as beneficial if you didn’t know the laws of exponents? Why, or why not?”*

Assessment

- Questions**
 - How are the laws of exponents and scientific notation connected?
 - How is knowing the laws of exponents helpful when operating with numbers in scientific notation?
- Journal/writing prompts**
 - Describe a situation in which you would not only use scientific notation but perform operations on numbers in scientific notation.
 - If you are given a number in standard form, explain how you know which way to move the decimal point and how you know you have written the number in scientific notation accurately.
- Other Assessments**
 - Ask students to create a graphic organizer demonstrating the rules of adding, subtracting, multiplying, and dividing with scientific notation.
 - Ask students to create a graphic organizer demonstrating the rules of adding, subtracting, multiplying, and dividing with exponents.

Extensions and Connections (for all students)

- Have students find real-life examples of numbers that can be written in scientific notation and create their own problems with these numbers.
- In Chemistry, scientific notation is used to represent large numbers, such as the number of atoms in a rock or something minuscule, such as the weight of an atom.
- Scientific notation can be used to express numbers in all subject areas. In astronomy, it is critical to use scientific notation when measuring the mass and diameter of planets and distances from one part of the universe to another.

Strategies for Differentiation

- If necessary, set up some selected word problems for students.
- Read through the problems with students, having them highlight important information and discuss which operations will be needed.

Mathematics Instructional Plan – Algebra I

- Create, or ask students to create, a graphic organizer for operations with scientific notation and laws of exponents.
- Allow students to use calculators to compute answers, if they need support.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

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Scientifically Speaking

Name _____ Date _____

Set up the following word problems, and apply the laws of exponents to perform the indicated operations on the expressions. Show your work.

1. The mass of one molecule of water is 2.99×10^{-23} g. If a cylinder contains 2.93×10^{70} molecules of water, what is the mass of the water in the container?
2. A drop of water has an approximate mass of 5×10^{-2} g. Given the mass of one molecule of water is 2.99×10^{-23} g, how many molecules are in one drop of water?
3. There are 3 atoms in each molecule of water. How many atoms are in one drop of water?
4. The average distance from the sun to the Earth is 1.49×10^8 km. The speed of light is 3×10^5 km/s. How long does it take for light from the sun to reach the Earth?
5. The average distance from the sun to Neptune is 4.5043×10^9 km. How long does it take for light from the sun to reach Neptune?
6. The populations of the United States, Canada, and Mexico are approximately 3.07×10^8 , 3.33×10^7 , and 1.06×10^8 respectively. What is the combined population of these three countries?