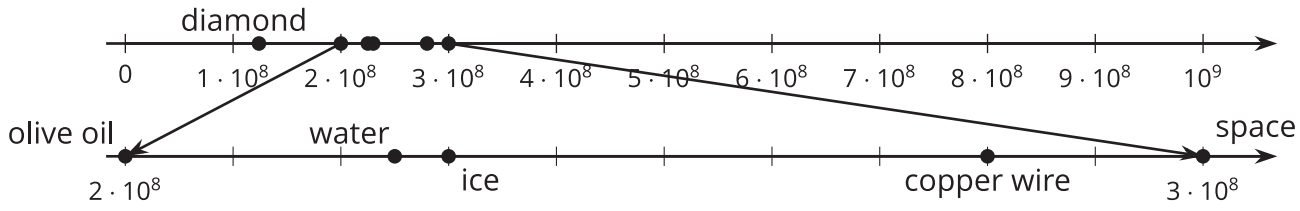
Definition of Scientific Notation

Let's use scientific notation to describe large and small numbers.

11.1 Notice and Wonder: Scientific Notation

What do you notice? What do you wonder?

material	speed (meters per second)
space	300,000,000
water	2.25×10^8
copper (electricity)	280,000,000
diamond	124×10^6
ice	2.3×10^8
olive oil	0.2×10^9



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11.2 The "Science" of Scientific Notation

The table shows the speed of light through different materials.

material	speed (meters per second)
space	300,000,000
water	2.25×10^8
copper (electricity)	280,000,000
diamond	124×10^6
ice	2.3×10^8
olive oil	0.2×10^9

1. Circle the speeds that are written in scientific notation.
2. Write the others using scientific notation.

11.3 Card Sort: Scientific Notation Matching

Your teacher will give you a set of cards. Take turns with your partner to match a number written as a decimal with a number written as a multiple of a power of 10.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to the explanation. If you disagree, discuss your thinking, and work to reach an agreement.

Are you ready for more?

1. What is $9 \times 10^{-1} + 9 \times 10^{-2}$? Express your answer as:
   a. A decimal

   b. A fraction

2. What is $9 \times 10^{-1} + 9 \times 10^{-2} + 9 \times 10^{-3} + 9 \times 10^{-4}$? Express your answer as:
   a. A decimal

   b. A fraction

3. The answers to the two previous questions should have been close to 1. What power of 10 would you have to go up to if you wanted your answer to be so close to 1 that it was only $\frac{1}{1{,}000{,}000}$ off?

4. What power of 10 would you have to go up to if you wanted your answer to be so close to 1 that it was only $\frac{1}{1{,}000{,}000{,}000}$ off? Can you keep adding numbers in this pattern to get as close to 1 as you want? Explain or show your reasoning.

5. Imagine a number line that goes from your current position (labeled 0) to the door of the room you are in (labeled 1). In order to get to the door, you will have to pass the points 0.9, 0.99, 0.999, etc. The Greek philosopher Zeno argued that you will never be able to go through the door, because you will first have to pass through an infinite number of points. What do you think? How would you reply to Zeno?

Lesson 11 Summary

The total value of all the quarters made in 2014 was 400 million dollars. There are many ways to express this using powers of 10. We could write this as $400 \cdot 10^6$ dollars, $40 \cdot 10^7$ dollars, $0.4 \cdot 10^9$ dollars, or many other ways. One special way to write this quantity is called **scientific notation**, where the first factor is a number greater than or equal to 1, but less than 10, and the second factor is an integer power of 10

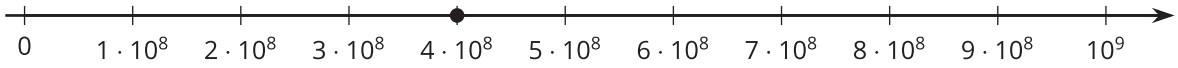
In scientific notation,

400 million dollars

would be written as

4×10^8 dollars.

Writing the number this way shows exactly where it lies between two consecutive powers of 10. The 10^8 shows us the number is between 10^8 and 10^9. The 4 shows us that the number is 4 tenths of the way to 10^9.



For scientific notation, the "×" symbol is the standard way to show multiplication instead of the dot symbol. Some other examples of scientific notation are 1.2×10^{-8}, 9.99×10^{16}, and 7×10^{12}.