Lesson 4
Scientific Notation

Name: ________________________________

Prerequisite: Multiply and Divide by Powers of Ten

Study the example problem showing how to multiply a decimal number by a power of ten. Then solve problems 1–7.

Example
Find $1000 \times 0.006$.

Start by breaking $1000$ into the product of tens. Then, multiply.

$$1000 \times 0.006 = 10 \times 10 \times 10 \times 0.006$$

$$= 10 \times 0.06$$

$$= 0.6$$

This means that $1000 \times 0.006 = 6$.

B 1 Write the missing powers of 10.

a. $1000 \times 0.005 = 5$  
   $100 \times 0.005 = 0.5$

b. $0.09 \times 10 = 0.9$  
   $0.009 \times 1000 = 9$

B 2 Jane says that multiplying a decimal by 100 is the same as multiplying the decimal by three factors of 10. Is Jane correct? Explain your answer.

No; Possible explanation: There are four factors of 10 in 10,000.

Daryl explains why $8.2 \div 10,000$ is 0.00082. Complete his explanation.

There are four factors of 10 in 10,000. Each time I divide a number by a factor of 10, the result is 10 times less than the original number. For example, if I divide 8.2 by 10, the result is 0.82. This means that 0.82 is 10 times less than 8.2. So, $8.2 \div 10,000$ is 0.00082.

B 3 Complete the equations.

a. $0.004 \times 100 = 0.04$  
   $0.004 \times 10^2 = 0.4$

b. $0.4 \times 1000 = 0.4 \times 10^3 = 400$

c. $600 \div 100 = 600 \div 10^2 = 6$

d. $0.6 \div 10 = 0.06$  
   $0.6 \div 10^1 = 0.06$

C 7 Yara multiplies and divides a certain number by the same power of 10. The product she gets is 40,000 and the quotient she gets is 0.000004. Find Yara’s number and the power of 10 she used. Explain your reasoning.

0.4 and $10^4$; Possible explanation: You can start by noticing that 40,000 is a number in the ten thousands and 0.000004 is a number in the millionths, so you can divide and multiply them by a number that is between 10,000 and 1,000,000 to get Yara’s number. If you divide 40,000 by 100,000, you get 0.4. If you multiply 0.000004 by 100,000, you get 0.4, so Yara used 0.4 and 100,000, or $10^4$.
Lesson 4

Write Numbers in Scientific Notation

Study the example problem showing how to write a number in scientific notation. Then solve problems 1–10.

Example

In one year, more than 90,000,000 passengers used the Hartsfield-Jackson Atlanta International Airport in Atlanta, Georgia. Write 90,000,000 in scientific notation.

A number written in scientific notation is the product of a number that is greater than or equal to 1 and less than 10 and a power of 10.

You can think of 90,000,000 as $9 \times 10,000,000$. You can write $10,000,000$ as a product of seven 10s, so $10,000,000$ written with an exponent is $10^7$.

This means that 90,000,000 written in scientific notation is $9 \times 10^7$.

1. Suppose that more than 96,000,000 passengers used the airport in the example. Write 96,000,000 in scientific notation.

   $9.6 \times 10^7$

2. Write 64,500 in scientific notation.

   $6.45 \times 10^4$

3. Describe how you would write $5.04 \times 10^3$ in standard form. Possible answer: Because the power is $10^3$, I multiply $5.04$ by $1,000,000$, so $5.04 \times 10^3 = 5.04 \times 1,000,000 = 5,040,000$.

4. Is $21.5 \times 10^6$ in scientific notation? Explain. No; The factor 21.5 is greater than 10.

5. The number 0.003 written in scientific notation is $3 \times 10^{-3}$. Why is the exponent negative?

   Possible answer: 0.003 is the same as $3 \times 0.001$ and 0.001 is written with an exponent as $10^{-3}$.

6. Write 0.00052 in scientific notation.

   $5.2 \times 10^{-4}$

7. Is $4.23 \times 10^{-3}$ greater than 1 or less than 1? Explain how you know.

   Less than 1; Possible explanation: $10^{-3} = \frac{1}{10^3} = \frac{1}{100,000} = 0.000001$. So $4.23 \times 10^{-3} = 4.23 \times 0.000001 = 0.00000423$, which is less than 1.

8. Sylvester says that 0.000002015 written in scientific notation is $2.015 \times 10^6$. Do you agree with him? Explain why or why not.

   No; 0.000002015 is the same as $2.015 \times 0.000001$ and 0.000001 is written with an exponent as $10^{-6}$, so $0.000002015$ written in scientific notation is $2.015 \times 10^{-6}$.

9. Explain how you could write the mixed number $45\frac{3}{8}$ in scientific notation.

   Possible explanation: First write the mixed number $45\frac{3}{8}$ as a decimal: $45.375$. Then write $45.375$ in scientific notation by using $10^1$ as the power of 10: $45.375 = 4.5375 \times 10^1$.

10. Jalil makes a generalization about writing numbers in scientific notation. Complete his statement.

    When you write a number greater than or equal to 1 in scientific notation, the exponent of the power of 10 will be positive.

    When you write a number between 0 and 1 in scientific notation, the exponent of the power of 10 will be negative.
Lesson 4

Compare Numbers in Scientific Notation

Study the example problem showing how to compare two numbers written in scientific notation. Then solve problems 1–7.

Example
The total area of Rhode Island is about 1.5 \times 10^3 square miles. The total area of Georgia is about 6 \times 10^4 square miles. The total area of Georgia is about how many times the total area of Rhode Island?

Use Standard Form
1.5 \times 10^3 = 1,500
6 \times 10^4 = 60,000

Compare by dividing: \frac{60,000}{1,500} = 40

The total area of Georgia is about 40 times the total area of Rhode Island.

Use Scientific Notation

Compare the parts of 1.5 \times 10^3 and 6 \times 10^4.

\frac{1.5}{1.5} = 1 \quad \frac{10^3}{10^4} = 10^{-1}

Combine the results: 4 \times 10^3 = 40.

The total area of Georgia is about 40 times the total area of Rhode Island.

Which of the two methods shown in the example problem do you prefer? Explain why.

Possible answer: I prefer the scientific notation method. The numbers you are comparing are smaller.

The total area of Ohio is about 4.5 \times 10^4 square miles. The total area of Ohio is about how many times the total area of Rhode Island?

The total area of Ohio is about 30 times the total area of Rhode Island.

Which is greater, 9 \times 10^{-2} or 3 \times 10^{-3}? How many times greater is the number you chose than the other number? Explain your reasoning.

9 \times 10^{-2}; Possible explanation: 9 \times 10^{-2} is 300 times 3 \times 10^{-3} because 0.09 \div 0.0003 = 300.

Solve.

M 4 The total area of Kansas that is covered by water is about 5 \times 10^2 square miles. The total area of Alaska that is covered by water is about 9.5 \times 10^4 square miles. The total water area of Alaska is about how many times the total water area of Kansas?

Show your work.

Possible work:

\frac{9.5}{5} = 1.9
10^4 \div 10^2 = 10^2
1.9 \times 10^2 = 190

Solution: The total water area of Alaska is about 190 times the total water area of Kansas.

M 5 The average masses of several insects or animals are shown in the table. The average mass of a hummingbird is about how many times the average mass of a housefly?

about 300 times

C 6 Look at the table in problem 5.

a. Write the masses of the ant, bee, and housefly in order from greatest mass to least mass.

1 \times 10^{-1}, 1.2 \times 10^{-3}, 4 \times 10^{-3}

b. The mass of the insect with the greatest mass is about how many times the mass of the insect with the least mass?

about 25 times

C 7 The population of the United States is about 3.2 \times 10^8. The population of the United States is about 80 times the population of Oregon. Write the population of Oregon in scientific notation.

4 \times 10^6
Lesson 4

Scientific Notation

Solve the problems.

M 1 Which of the following expressions is equivalent to $4,325,000,000$?
A $4.325 \times 10^8$
B $4.325 \times 10^9$
C $4.325 \times 10^6$
D $4.325 \times 10^2$

Carson chose A as the correct answer. How did he get that answer?

He forgot that when you write a number greater than or equal to 1 in scientific notation, the exponent in the power of 10 will be positive.

M 2 The mass of Earth’s moon is about $7 \times 10^5$ kilograms. The mass of Jupiter is about $1.89 \times 10^{10}$ kilograms. The mass of Jupiter is about how many times the mass of Earth’s moon?

\[ \frac{1.89 \times 10^{10}}{7 \times 10^5} = 2.7 \times 10^5 \]

Solution: Jupiter’s mass is about 27,000 times the moon’s mass.

M 3 Last year a restaurant chain spent $3.3 \times 10^6$ dollars opening new restaurants. This year the restaurant will spend $9.9 \times 10^6$ dollars. Which statement is true?
A The restaurant spent $330,000,000$ dollars last year.
B This year the restaurant will spend $99,900,000$.
C The restaurant spent $6.6 \times 10^6$ dollars more this year than last year.
D This year the restaurant will spend about 0.3 times the amount it did last year.

C 4 Which of the following numbers is NOT in scientific notation?
A $4.5 \times 10^{-12}$
B $3.025 \times 10^{-9}$
C $2.1 \times 10^2$
D $1.1 \times 10^3$

5 Write $0.0000003105$ in scientific notation. Explain how you found your answer.

\[ 0.0000003105 = 3.105 \times 10^{-7} \]

Solution: $3.105 \times 10^{-7}$.

5 The area of the Pacific Ocean is about $1.56 \times 10^8$ square kilometers. The area of the East China Sea is about $1.2 \times 10^7$ square kilometers. Tell whether each statement is True or False.

a. The area of the Pacific Ocean is about 15,600,000 square kilometers.  True False
b. The area of the Pacific Ocean is about 130 times the area of the East China Sea.  False True
c. The area of the East China Sea is about 130 times the area of the Pacific Ocean.  False True
d. The area of the East China Sea is about 1,200,000 square kilometers.  False True

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