Expression	Product	Expression	Product
$4.7 \times 10^1 = 4.7 \times 10$	47	$4.7 \times 10^{-1} = 4.7 \times \frac{1}{10}$	0.47
$4.7 \times 10^2 = 4.7 \times 100$	470	$4.7 \times 10^{-2} = 4.7 \times \frac{1}{100}$	0.047
$4.7 \times 10^3 = 4.7 \times 1{,}000$	4,700	$4.7 \times 10^{-3} = 4.7 \times \frac{1}{1000}$	0.0047
$4.7 \times 10^4 = 4.7 \times 10{,}000$	47,000	$4.7 \times 10^{-4} = 4.7 \times \frac{1}{10{,}000}$	0.00047

Content Standards
8.EE.4

MP Mathematical Practices
1, 3, 4, 7

4.709

3. If 4.7 is multiplied by a positive power of 10, what relationship exists between the decimal point's new position and the exponent?

Sample answer: When the power is positive, the number of the exponent gives the number of places the decimal point moves to the right in the product.

4. When 4.7 is multiplied by a negative power of 10, how does the new position of the decimal point relate to the negative exponent? **Sample answer: When the power is negative, the number of the exponent gives the number of places the decimal point moves to the left in the product.**

Powers of Ten

Multiplying a factor by a positive power of 10 moves the decimal point right. Multiplying a factor by a negative power of 10 moves the decimal point left.

a. 742,000

b. 0.061

c. 371.4

Show your work.

- If the number is greater than or equal to 1, the power of ten is positive.
- If the number is between 0 and 1, the power of ten is negative.

Examples

Write each number in standard form.

53.4 x

1. 5.34×10^4

$5.34 \times 10^4 = 53{,}400.$

2. 3.27×10^{-3}

$3.27 \times 10^{-3} = 0.00327$

Got it? Do these problems to find out.

a. 7.42×10^5 **b.** 6.1×10^{-2} **c.** 3.714×10^2

Examples

Write each number in scientific notation.

3. 3,725,000

United Kingdom Canada Mexico India

Got it? Do this problem to find out.

g. Some of the top U.S. cities visited by overseas travelers are shown in the table. Order the cities according to the number of visitors from least to greatest.

U.S. City	Number of Visitors
Boston	7.21×10^5
Las Vegas	1.3×10^6
Los Angeles	2.2×10^6
Metro D.C. area	9.01×10^5

1,3000000 } 7,21000.

g. Boston, Metro D.C. area, Las Vegas, Los Angeles

1,300,000

721,000

Example

Tutor

6. STEM **If you could walk at a rate of 2 meters per second, it would take you 1.92×10^8 seconds to walk to the moon. Is it more appropriate to report this time as 1.92×10^8 seconds or 6.09 years? Explain your reasoning.**

The measure 6.09 years is more appropriate. The number 1.92×10^8 seconds is very large so choosing a larger unit of measure is more meaningful.

Show your work.

h. 7.31 centimeters per year; the number is very small so choosing a smaller unit of measure is more meaningful.

Got it? Do this problem to find out.

h. **STEM** In an ocean, the sea floor moved 475 kilometers over 65 million years. Is it more appropriate to report this rate as 7.31×10^{-5} kilometer per year or 7.31 centimeters per year? Explain your reasoning.

Guided Practice

Check

Write each number in standard form. (Examples 1 and 2)

1. $9.931 \times 10^{5} =$ 993,100

2. $6.02 \times 10^{-4} =$ 0.000602 left

Show your work.

Write each number in scientific notation. (Examples 3 and 4)

3. $8{,}785{,}000{,}000 =$ 8.785×10^{9}

4. $0.524 =$ 5.24×10^{-1}

5. The table lists the total value of music shipments for four years. List the years from least to greatest dollar amount. (Example 5)

year 3, year 4, year 2, year 1

Year	Music Shipments ($)
1	1.22×10^{10}
2	1.12×10^{10}
3	7.15×10^{6}
4	1.06×10^{7}

6. STEM A plant cell has a diameter of 1.3×10^{-8} kilometer. Is it more appropriate to report the diameter of a plant cell as 1.3×10^{-8} kilometer or 1.3×10^{-2} millimeter? Explain your reasoning. (Example 6)

1.3×10^{-2} millimeter; the number is very small so choosing a smaller unit of measure is more meaningful.

7. **Building on the Essential Question** How is scientific notation useful in the real world?

Sample answer: Scientific notation makes it easier for scientists to write the very large or very small numbers that they work with.

Rate Yourself!

☐ I understand how to write numbers in scientific notation.

Great! You're ready to move on!

☐ I still have some questions about how to write numbers in scientific notation.

No Problem! Go online to access a Personal Tutor.

Tutor

Independent Practice

Write each number in standard form. (Examples 1 and 2)

1. $3.16 \times 10^3 =$ 3,160

2. $1.1 \times 10^{-4} =$ 0.00011

3. $2.52 \times 10^{-5} =$ 0.0000

Show your work.

Write each number in scientific notation. (Examples 3 and 4)

4. $43{,}000 =$ 4.3×10^4

5. $0.0072 =$ 7.2×10^{-3}

6. $0.0000901 =$ 9.01×1

7. The areas of the world's oceans are listed in the table. Order the oceans according to their area from least to greatest. (Example 5)

Arctic, Southern, Indian, Atlantic, Pacific

World's Oceans	
Ocean	**Area (mi^2)**
Atlantic	2.96×10^7
Arctic	5.43×10^6
ndian	2.65×10^7

8. The space shuttle can travel about 8×10^5 centimeters per second. Is it more appropriate to report this rate as 8×10^5 centimeters per second or 8 kilometers per second? Explain. (Example 6)

8 kilometers per second; the number is very large so choosing a larger unit of measure is more meaningful.

9. The inside diameter of a certain size of ring is 1.732×10^{-2} meter. Is it more appropriate to report the ring diameter as 1.732×10^{-2} meter or 17.32 millimeters? Explain. (Example 6)

17.32 millimeters; the number is small so choosing a smaller unit of measure is more meaningful.

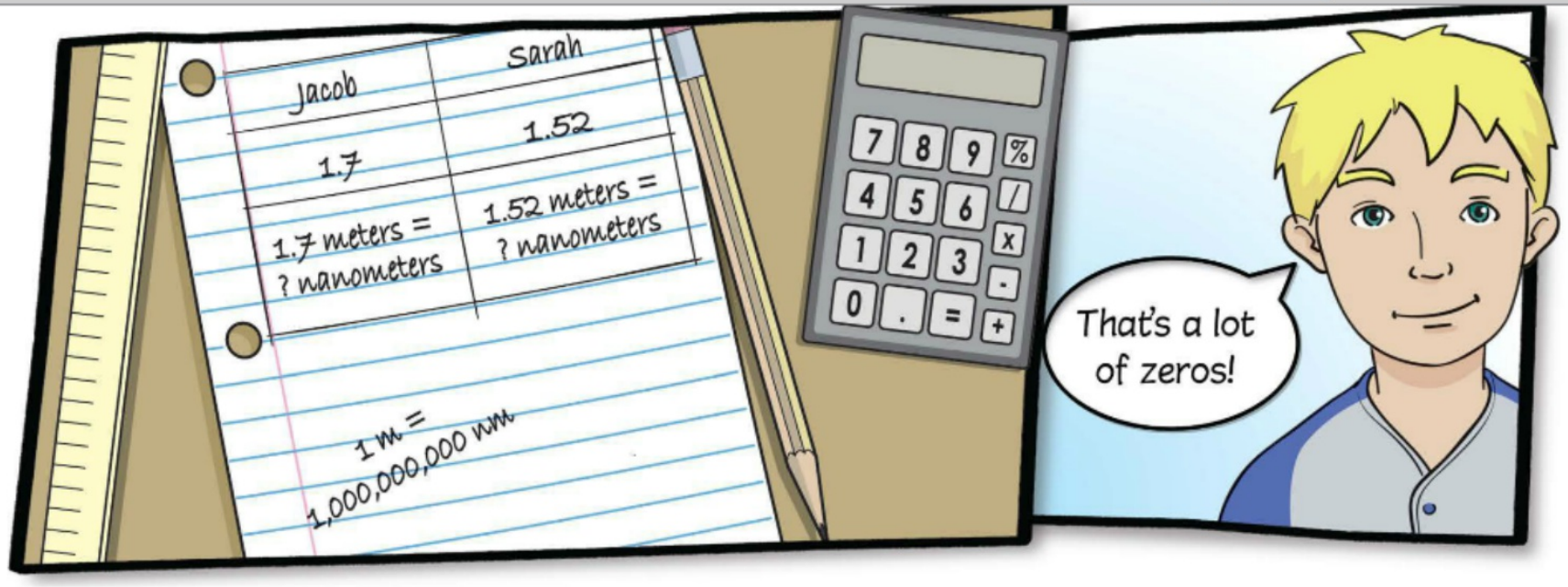
Fill in each ◯ with <, >, or = to make a true statement.

10. $678{,}000 \bigcirc 6.78 \times 10^6$

10. $678{,}000 < 6.78 \times 10^6$

11. $6.25 \times 10^3 \bigcirc 6.3 \times 10^3$

11. $6.25 \times 10^3 < 6.3 \times 10^3$



a. Find Jacob's and Sarah's heights in nanometers.

Jacob: 1,700,000,000 nanometers, Sarah: 1,520,000,000 nanometers

b. Write each height using scientific notation.

Jacob: 1.7×10^9 nanometers, Sarah: 1.52×10^9 nanometers

c. Give an example of something that would be appropriately measured by nanometers. **Sample answers: bacteria; switches inside of computers; fiber optic filament**

H.O.T. Problems Higher Order Thinking

13. MP **Justify Conclusions** Determine whether 1.2×10^5 or 1.2×10^6 is closer to one million. Explain. **1.2×10^6; 1.2×10^5 is only 120,000, but 1.2×10^6 is just over one million.**

14. MP **Persevere with Problems** Compute and express each value in scientific notation.

a. $\dfrac{(130{,}000)(0.0057)}{0.0004} =$ **1.8525×10^6**

b. $\dfrac{(90{,}000)(0.0016)}{(200{,}000)(30{,}000)(0.00012)} =$ **2×10^{-4}**

15. MP **Model with Mathematics** Write two numbers in scientific notation with values between 100 and 1,000. Then write an inequality that shows the relationship between your two numbers.

Sample answer: 3.01×10^2, 5.01×10^2; $3.01 \times 10^2 < 5.01 \times 10^2$