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6-5

Dividing with Scientific Notation

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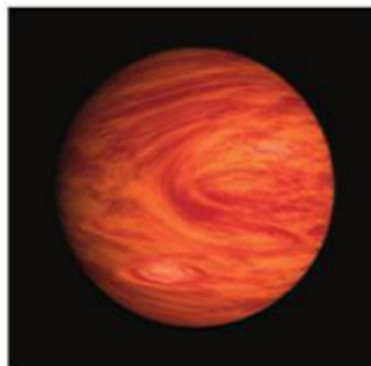
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What You'll Learn

To divide and compare numbers written in scientific notation.

Why Learn This?

Earth's mass is almost 6×10^{24} kg, and the mass of Jupiter is almost 2×10^{27} kg. You can divide the mass of Jupiter by the mass of Earth to find how many times greater Jupiter's mass is than Earth's. The rule for dividing powers with the same base applies to dividing numbers in scientific notation.



Type the green words into your notes.

Dividing in Scientific Notations - How To Steps

1. Rewrite the division problem in fraction form.
2. Separate out the coefficients & powers of 10
3. Divide the coefficients
4. Subtract the exponents in the powers of ten
5. Change your quotient to scientific notation form.

The next screen is an example of this.

EXAMPLE

Dividing Numbers in Scientific Notation

- 1 Simplify $(6.5 \times 10^6) \div (7.3 \times 10^2)$. Write the quotient in scientific notation.

$$(6.5 \times 10^6) \div (7.3 \times 10^2) = \frac{6.5 \times 10^6}{7.3 \times 10^2}$$

← Write a fraction.

$$= \frac{6.5}{7.3} \times \frac{10^6}{10^2}$$

← Separate the coefficients and the powers of ten.

$$\approx 0.89 \times \frac{10^6}{10^2}$$

← Divide the coefficients.

$$= 0.89 \times 10^4$$

← Subtract the exponents.

$$= 8.9 \times 10^{-1} \times 10^4$$

← Write 0.89 in scientific notation.

$$= 8.9 \times 10^3$$

← Add the exponents.

Example

- ① **Dividing Numbers in Scientific Notation** Simplify $(5.4 \times 10^5) \div (9.1 \times 10^2)$.
Write the quotient in scientific notation.

$$\begin{aligned}
 (5.4 \times 10^5) \div (9.1 \times 10^2) &= \frac{5.4 \times 10^5}{9.1 \times 10^2} && \leftarrow \text{Write a fraction.} \\
 &= \frac{5.4}{9.1} \times \frac{10^5}{10^2} && \leftarrow \text{Separate the coefficients and the powers of ten.} \\
 &\approx 0.59 \times \frac{10^{\boxed{5}}}{10^{\boxed{2}}} && \leftarrow \text{Divide the coefficients.} \\
 &\approx 0.59 \times 10^{\boxed{3}} && \leftarrow \text{Subtract the exponents.} \\
 &\approx \boxed{5.9} \times 10^{\boxed{-1}} \times 10^{\boxed{3}} && \leftarrow \text{Write 0.59 in scientific notation.} \\
 &\approx 5.9 \times 10^{\boxed{2}} && \leftarrow \text{Add the exponents.}
 \end{aligned}$$

**EXAMPLE Application: Astronomy**

Gridded Response The distance between the sun and a comet is about 2.79×10^8 miles. Light travels about 1.1×10^7 miles per minute. Use the formula $\text{time} = \frac{\text{distance}}{\text{speed}}$ to estimate how many minutes sunlight takes to reach the comet. Write your answer in standard form and round to the nearest tenth.

$$\begin{aligned}
 \text{time} &= \frac{\text{distance}}{\text{speed}} && \leftarrow \text{Use the formula for time.} \\
 &= \frac{2.79}{1.1} \times \frac{10^8}{10^7} && \leftarrow \text{Substitute. Write as a product of quotients.} \\
 &= \frac{2.79}{1.1} \times 10^1 && \leftarrow \text{Subtract exponents.} \\
 &\approx 2.54 \times 10^1 && \leftarrow \text{Divide.}
 \end{aligned}$$

Sunlight takes about 2.54×10^1 minutes, or 25.4 minutes, to reach the comet.

2	5	.	4
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

- 2 **Application: Astronomy** The average distance between the sun and Jupiter is about 4.8×10^8 miles. Light travels about 1.1×10^7 miles per minute. Estimate how long sunlight takes to reach Jupiter. Write your answer in standard form and round to the nearest whole number.

$$\begin{aligned} \text{time} &= \frac{\text{distance}}{\text{speed}} && \leftarrow \text{Use the formula for time.} \\ &= \frac{4.8}{1.1} \times \frac{10^8}{10^7} && \leftarrow \text{Substitute. Write as a product of quotients.} \\ &= \frac{4.8}{1.1} \times 10^{8-7} && \leftarrow \text{Subtract the exponents.} \\ &\approx 4.4 \times 10^1 && \leftarrow \text{Divide and simplify.} \end{aligned}$$

Sunlight takes about 4.4×10^1 minutes, or **44** minutes to reach Jupiter.

EXAMPLE Dividing by Numbers in Standard Form

- 3 Divide. Write each quotient in scientific notation.

a. $(-7.1 \times 10^3) \div 6.3 = \frac{-7.1 \times 10^3}{6.3} \leftarrow \text{Write as a fraction.}$

$$= \frac{-7.1}{6.3} \times 10^3 \leftarrow \text{Write as a product of quotients and a power of 10.}$$

$$\approx -1.1 \times 10^3 \leftarrow \text{Divide.}$$

b. $4.2 \div (5.5 \times 10^9) = \frac{4.2}{5.5 \times 10^9} \leftarrow \text{Write as a fraction.}$

$$= \frac{4.2}{5.5} \times 10^{-9} \leftarrow \text{Write as a product of quotients and a power of 10.}$$

$$\approx 0.76 \times 10^{-9} \leftarrow \text{Divide.}$$

$$= 7.6 \times 10^{-1} \times 10^{-9} \leftarrow \text{Write 0.76 in scientific notation.}$$

$$= 7.6 \times 10^{-10} \leftarrow \text{Add the exponents.}$$

E **Dividing by Numbers in Standard Form** Divide. Write each quotient in scientific notation.

a. $(8.2 \times 10^4) \div 5.1 = \frac{8.2 \times 10^4}{5.1}$ ← Write a fraction.
 $= \frac{8.2}{5.1} \times 10^4$ ← Separate the coefficients and the powers of ten.
 $\approx 1.6 \times 10^4$ ← Divide the coefficients.

b. $6 \div (8.3 \times 10^3) = \frac{6}{8.3 \times 10^3}$ ← Write a fraction.
 $= \frac{6}{8.3} \times 10^{-3}$ ← Separate the coefficients and power of ten.
 $\approx 0.72 \times 10^{-3}$ ← Divide the coefficients and divide the powers of ten.
 $\approx 7.2 \times 10^{-1} \times 10^{-3}$ ← Write 0.72 in scientific notation.
 $\approx 7.2 \times 10^{-4}$ ← Add the exponents.

EXAMPLE Ordering Numbers

4 Order 6.2×10^{-4} , 6.2×10^4 , 7.5×10^4 and 6.5×10^3 from least to greatest.

6.2×10^{-4} , 6.5×10^3 , 7.5×10^4 , 6.2×10^4 ← Order the numbers from least to greatest power of 10.

6.2×10^{-4} , 6.5×10^3 , 6.2×10^4 , 7.5×10^4 ← Order the numbers with the same power of 10 from least to greatest using the first factor.

- 4 **Ordering Numbers** Order 6.5×10^3 , 6.4×10^{-3} , 5.8×10^3 , and 8.9×10^2 from least to greatest.

6.4×10^{-3} , 8.9×10^2 , 6.5×10^3 , 5.8×10^3 ← Sort the numbers using the powers of ten, least to greatest.

6.4×10^{-3} , 8.9×10^2 , 5.8×10^3 , 6.5×10^3 ← Sort the numbers with the same power of ten, using the first factor.

EXAMPLE

Comparing Numbers in Scientific Notation

- 5 Estimate how many times greater 4×10^9 is than 9×10^7 .

Write a fraction with the greater number as the numerator. Then divide.

$$\frac{4 \times 10^9}{9 \times 10^7} = \frac{4}{9} \times \frac{10^9}{10^7} \quad \leftarrow \text{Write as a product of quotients.}$$

$$\approx 0.44 \times 10^2 \quad \leftarrow \text{Divide the coefficients, and divide the powers of ten.}$$

$$= 4.4 \times 10^{-1} \times 10^2 \quad \leftarrow \text{Write 0.44 in scientific notation.}$$

$$= 4.4 \times 10^1 \quad \leftarrow \text{Add exponents.}$$

$$= 44 \quad \leftarrow \text{Simplify.}$$

So 4×10^9 is about 44 times greater than 9×10^7 .

Quick Check

2. The distance between the sun and Earth is about 9.3×10^7 miles. Light travels about 1.1×10^7 miles per minute. Estimate how long sunlight takes to reach Earth. Write your answer in standard form and round to the nearest tenth.

3. Divide. Write each quotient in scientific notation.

a. $\frac{6.2 \times 10^6}{4.1}$

b. $\frac{-3.5 \times 10^3}{5}$

c. $\frac{17}{1.4 \times 10^8}$

4. Order the numbers from least to greatest.

$3 \times 10^6, 3.11 \times 10^5, 3 \times 10^{-6}, 3.8 \times 10^{-5}$

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Practice 6-5

Dividing with Scientific Notation

Divide. Write each quotient in scientific notation.

1. $\frac{6.8 \times 10^7}{3.4 \times 10^5}$

2. $\frac{7.3 \times 10^3}{4.5 \times 10^6}$

3. $\frac{1.9 \times 10^{-4}}{3.3 \times 10^1}$

4. $\frac{6.2 \times 10^7}{5.6 \times 10^{-8}}$

5. $\frac{8.2 \times 10^5}{6}$

6. $\frac{12}{4.3 \times 10^2}$

Which of the following numbers is greater?

7. 5.2×10^4 or 5.8×10^3

8. 6×10^3 or 8×10^{-3}

Estimate how many times the first number is than the second number.

9. 6×10^{12} and 2×10^{10}

10. 4×10^9 and 8×10^5

11. The height of the thermosphere is about 2.95×10^5 feet above Earth. There are 5,280 feet in 1 mile. About how many miles above earth is the thermosphere?

12. The speed of light is about 3.0×10^8 m/s. The speed of sound is about 3.4×10^2 m/s. How much faster does light travel than sound?

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