8.4 Use Scientific Notation

Goal • Read and write numbers in scientific notation.

Your Notes

VOCABULARY

Scientific notation A number is written in scientific notation when it is of the form $c \times 10^n$ where $1 \leq c < 10$ and n is an integer.

SCIENTIFIC NOTATION

A number is written in scientific notation when it is of the form $c \times 10^n$ where $1 \leq c < 10$ and n is an integer.

Number	Standard form	Scientific notation
Sixteen million	16,000,000	1.6×10^7
Two hundredths	0.02	2×10^{-2}

Example 1 *Write numbers in scientific notation*

a. $7{,}820{,}000 = 7.82 \times 10^{6}$ Move decimal point 6 places to the left. Exponent is 6.

b. $0.00401 = 4.01 \times 10^{-3}$ Move decimal point 3 places to the right. Exponent is -3.

Example 2 *Write numbers in standard form*

a. $3.89 \times 10^9 = 3{,}899{,}000{,}000$ Exponent is 9. Move decimal point 9 places to the right.

b. $9.097 \times 10^{-5} = 0.00009097$ Exponent is -5. Move decimal point 5 places to the left.

Your Notes

✔ ***Checkpoint*** **Complete the following exercise.**

1. Write the number 0.0899 in scientific notation. Then write the number 6.0001×10^7 in standard form.

8.99×10^{-2}; 60,001,000

Example 3 ***Order numbers in scientific notation***

Order 3.2×10^{-4}, 0.0004, and 2.8×10^{-5} from least to greatest.

Solution

Step 1 **Write** each number in scientific notation, if necessary.

$0.0004 =$ 4×10^{-4}

Step 2 **Order** the numbers. First order the numbers with different powers of 10. Then order the numbers with the same power of 10.

Because 10^{-5} $<$ 10^{-4}, you know that 2.8×10^{-5} is less than both 3.2×10^{-4} and 4×10^{-4}. Because 3.2 $<$ 4, you know that 3.2×10^{-4} is less than 4×10^{-4}.

So, 2.8×10^{-5} < 3.2×10^{-4} < 4×10^{-4}.

Step 3 **Write** the original numbers in order from least to greatest.

2.8×10^{-5}; 3.2×10^{-4}; 0.0004

✔ ***Checkpoint*** **Complete the following exercise.**

2. Order 225,000, 1,740,000, and 1.75×10^5 from least to greatest.

1.75×10^5; 225,000; 1,740,000

Your Notes

Example 4 ***Compute with numbers in scientific notation***

Evaluate the expression. Write your answer in scientific notation.

a. $(5.6 \times 10^{-4})(1.4 \times 10^{-5})$

$= (5.6 \cdot 1.4) \times (10^{-4} \cdot 10^{-5})$ — **Commutative property and associative property**

$=$ 7.84 $\times$ 10^{-9} — **Product of powers property**

b. $(3.2 \times 10^{2})^{3}$

$=$ 3.2^{3} $\times$ $(10^{2})^{3}$ — **Power of a product property**

$=$ 32.768 $\times$ 10^{6} — **Power of a power property**

$=$ (3.2768×10^{1}) $\times$ 10^{6} — **Write** 32.768 **in scientific notation.**

$=$ 3.2768 $\times$ ($10^{1} \times 10^{6}$) — **Associative property**

$=$ 3.2768×10^{7} — **Product of powers property**

c. $\dfrac{3.5 \times 10^{-3}}{1.75 \times 10^{-5}}$

$= \dfrac{3.5}{1.75} \times \dfrac{10^{-3}}{10^{-5}}$ — **Product rule for fractions**

$=$ 2 $\times$ 10^{2} — **Quotient of powers property**

✔ ***Checkpoint*** **Simplify the expression.**

3. $(2.01 \times 10^{-7})^{2}$	**4.** $\dfrac{4.8 \times 10^{-4}}{6 \times 10^{-4}}$
4.0401×10^{-14}	8×10^{-1}

Homework