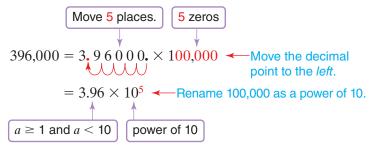
Scientific Notation

Objective To write numbers in standard notation as numbers in scientific notation, and vice versa • To perform operations in scientific notation

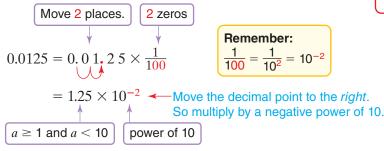
A mature male elephant can weigh as much as 24,750 pounds, which is 396,000 ounces. The weight of a feather is about 0.0125 ounces. You can write these numbers in scientific notation.

- Very large or very small numbers can be rewritten in scientific notation so that they are in the form of $a \times 10^n$, where $a \ge 1$ and a < 10, and n is an integer.
 - To write a *number greater than 1* in scientific notation, move the decimal point to the left.



In scientific notation, $396,000 = 3.96 \times 10^5$.

• To write a *decimal between 0 and 1* in scientific notation, move the decimal point to the right.



In scientific notation, $0.0125 = 1.25 \times 10^{-2}$.

To write a number expressed in scientific notation as a number in standard form, multiply the factors.

Key Concept

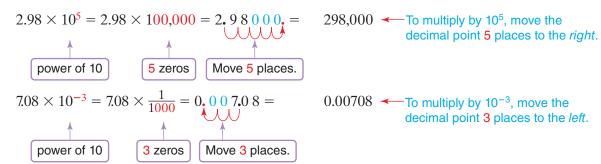
Writing a Number in Scientific Notation

To write a number in scientific notation, express it as a product of two factors.

- **1.** Express one factor as a number greater than or equal to 1 but less than 10. Move the decimal point to the *left* or *right*.
- 2. Express the other factor as a power of 10. Count the number of places the decimal point was moved to the left or right, and use this number as the *exponent* of the power of 10.

Scientific Notation

Standard Form



Simplify:
$$9.7 \times 10^5 + 7.3 \times 10^5 - 2 \times 10^5$$

$$9.7 \times 10^5 + 7.3 \times 10^5 - 2 \times 10^5$$
 \leftarrow All the terms have the same power of 10.

$$(9.7 + 7.3 - 2) \times 10^5$$
 Group the decimal factors; keep the common power of 10.

$$15 \times 10^5$$
 Simplify the decimal factors.

$$1.5 \times 10^6$$
 —Multiply the powers of 10 by adding their exponents.

So
$$9.7 \times 10^5 + 7.3 \times 10^5 - 2 \times 10^5 = 1.5 \times 10^6$$
.

- To multiply or divide numbers in scientific notation, multiply or divide the decimal factors, then multiply or divide the powers of 10. Simplify and write the product in scientific notation.
 - Multiply: $(6.1 \times 10^7)(2.3 \times 10^4)$

$$14.03 \times 10^{11}$$
 —Multiply the decimal factors. Then multiply the powers of 10 by adding their exponents.

$$1.403 \times 10^{12}$$
 —Multiply the powers of 10 by adding their exponents.

So
$$(6.1 \times 10^7)(2.3 \times 10^4) = 1.403 \times 10^{12}$$
.

• Divide:
$$\frac{4.731 \times 10^8}{5.7 \times 10^3}$$

$$\frac{4.731}{5.7} \times \frac{10^8}{10^3}$$
 Group like factors.

$$0.83 \times 10^5$$
 — Divide the decimal factors. Then divide the powers of 10 by subtracting their exponents.

So
$$(4.731 \times 10^8) \div (5.7 \times 10^3) = 8.3 \times 10^4$$
.

These

Write in scientific notation.

Write in standard form.

3.
$$1.34 \times 10^{-9}$$

4.
$$7.123 \times 10^8$$

Perform the indicated operations. Express answers in scientific notation.

5.
$$6.9 \times 10^{-6} + 5 \times 10^{-6}$$

6.
$$9.2 \times 10^8 + 6.4 \times 10^8 - 2 \times 10^8$$
 7. $(3.65 \times 10^{12})(4.7 \times 10^5)$

7.
$$(3.65 \times 10^{12})(4.7 \times 10^5)$$

8.
$$(6.174 \times 10^{11}) \div (6.3 \times 10^{6})$$

9.
$$(9 \times 10^7)(4.1 \times 10^4) \div (3 \times 10^5)$$

8.
$$(6.174 \times 10^{11}) \div (6.3 \times 10^{6})$$
 9. $(9 \times 10^{7})(4.1 \times 10^{4}) \div (3 \times 10^{5})$ **10.** $6 \times 10^{13} + (4 \times 10^{8})(1.1 \times 10^{5})$

11. Discuss and Write Explain how to add 4.77×10^9 and 7.35×10^8 even though the given powers of 10 are not the same.