7-10 *Scientific Notation*

Objective: To use scientific notation.

Vocabulary

Scientific notation A positive number in scientific notation is expressed as the product of a number greater than or equal to 1 but less than 10, and an integral power of 10. For example, 2.6×10^3 and 5.02×10^{-4} are written in scientific notation, but 0.4×10^{-5} and 10.3×10^2 are not.

Expanded notation A way of writing numbers using powers of 10 to show place value.

Example 1   Write each number in scientific notation: **a.** 34,610,000   **b.** 0.0000027

Solution   **a.** Move the decimal point left 7 places to get a number between 1 and 10.

$$34{,}610{,}000 = 3.461 \times 10{,}000{,}000 = 3.461 \times 10^7$$

b. Move the decimal point right 6 places to get a number between 1 and 10.

$$0.0000027 = \frac{2.7}{1{,}000{,}000} = \frac{2.7}{10^6} = 2.7 \times 10^{-6}$$

When a number greater than 1 is written in scientific notation, the power of 10 used is positive. When the number is less than 1, the power of 10 used is negative.

Write each number in scientific notation.

1. 27,300   2. 3,060,000   3. 25,010,000
4. 0.00305   5. 0.0000017   6. 0.000000804

Example 2   Write each number in decimal form: **a.** 3.16×10^6 **b.** 6.74×10^{-4}

Solution   **a.** Move the decimal point 6 places.   **b.** Move the decimal point 4 places.
$3.16 \times 10^6 = 3{,}160{,}000$ $6.74 \times 10^{-4} = 0.000674$

Rewrite each number in decimal form.

7. 3.0×10^7 8. 2.27×10^8 9. 4.6×10^{11}
10. 1.8×10^5 11. 5.29×10^{-5} 12. 6.0×10^{-8}

Example 3   Write each number in expanded notation using powers of 10.
a. 7341   **b.** 0.2865   **c.** 48.09

Solution   **a.** $7341 = 7000 + 300 + 40 + 1$
$= 7 \cdot 10^3 + 3 \cdot 10^2 + 4 \cdot 10^1 + 1 \cdot 10^0$

b. $0.2865 = 0.2 + 0.08 + 0.006 + 0.0005$
$= 2 \cdot 10^{-1} + 8 \cdot 10^{-2} + 6 \cdot 10^{-3} + 5 \cdot 10^{-4}$

c. $48.09 = 40 + 8 + 0.0 + 0.09$
$= 4 \cdot 10^1 + 8 \cdot 10^0 + 0 \cdot 10^{-1} + 9 \cdot 10^{-2}$

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Write each number in expanded notation.

13. 1700   **14.** 4812   **15.** 0.143   **16.** 0.1756   **17.** 36.07   **18.** 175.1

19. 10,396   **20.** 0.0061   **21.** 64,000   **22.** 0.00032   **23.** 0.000015   **24.** 85,020,000

Example 4   Simplify. Write your answers in scientific notation.

a. $\dfrac{4.8 \times 10^6}{3.0 \times 10^2}$ **b.** $(1.5 \times 10^2)(8.0 \times 10^4)$ **c.** 0.3×10^5

Solution   **a.** Subtract exponents when you divide.

$$\frac{4.8 \times 10^6}{3.0 \times 10^2} = \frac{4.8}{3.0} \times \frac{10^6}{10^2}$$
$$= 1.6 \times 10^{6-2}$$
$$= 1.6 \times 10^4$$

b. Add exponents when you multiply.

$$(1.5 \times 10^2)(8.0 \times 10^4) = (1.5 \times 8.0)(10^2 \times 10^4)$$
$$= (12)(10^{2+4})$$
$$= (12)(10^6)$$
$$= 12 \times 10^6$$
$$= (1.2 \times 10) \times 10^6$$
$$= 1.2 \times 10^7$$

c. $0.3 \times 10^5 = (3 \times 10^{-1}) \times 10^5$
$$= 3 \times 10^4$$

Simplify. Write your answers in scientific notation.

25. $\dfrac{6.0 \times 10^5}{1.5 \times 10^2}$ **26.** $(4.0 \times 10^{-6})(1.6 \times 10^8)$ **27.** $(6 \times 10^6)(7 \times 10^{-2})$

28. $(1.25 \times 10^4)(12 \times 10^3)$ **29.** $\dfrac{2 \times 10^4}{(4 \times 10^{-2})(5 \times 10)}$ **30.** $(4 \times 10^4)(7 \times 10^{-2})$

Mixed Review Exercises

Simplify. Give your answers using positive exponents.

1. $-[x + (-9)] + 3y + 4$ **2.** $(x^{-3}y^4)^2$ **3.** $(11 - 23) - (5 - 15)$

4. $25:15$ **5.** $[3 + (-5)] + 6$ **6.** $2t + [(-4) + (-1) + 7]$

7. $\left(\dfrac{c^{-2}}{2}\right)^2$ **8.** $-\dfrac{3}{4} + 4 + \left(-\dfrac{1}{4}\right)$ **9.** $\dfrac{20b^2c^3}{16bc^2}$