

Lesson 7.4 Notes (Scientific Notation)

Objectives:

- Express numbers in scientific notation.
- Find products and quotients of numbers expressed in scientific notation.

Scientific Notation – numbers in the form $a \times 10^n$ (where $1 \leq a < 10$ and n is an integer)

KeyConcept Standard Form to Scientific Notation

Step 1 Move the decimal point until it is to the right of the first nonzero digit. The result is a real number a .

Step 2 Note the number of places n and the direction that you moved the decimal point.

Step 3 If the decimal point is moved left, write the number as $a \times 10^n$.
If the decimal point is moved right, write the number as $a \times 10^{-n}$.

Step 4 Remove the unnecessary zeros.

Examples: Express each number in scientific notation.

1. 201,000,000 2.01×10^8 2. 0.000051 5.1×10^{-5}

3. 68,700,000,000 6.87×10^{10} 4. 0.00000725 7.25×10^{-6}

KeyConcept Scientific Notation to Standard Form

Step 1 In $a \times 10^n$ note whether $n > 0$ or $n < 0$.

Step 2 If $n > 0$, move the decimal point n places right.
If $n < 0$, move the decimal point $-n$ places left.

Step 3 Insert zeros, decimal point, and commas as needed for place value.

Examples: Express each number in standard form.

5. 4.91×10^4 $49,100$ 6. 3.2×10^{-5} $.000032$

7. 2.001×10^{-6} $.000002001$ 8. 1.00024×10^{10} $10,002,400,000$

Products and Quotients in Scientific Notation – You can use scientific notation to simplify multiplying and dividing very large and very small numbers.

Examples: Evaluate each product. Express the results in scientific notation and standard form.

9. $(3.4 \times 10^3)(5 \times 10^4)$

$$\begin{aligned} & (3.4 \times 5)(10^3 \times 10^4) \\ & 17 \times 10^7 \\ & (1.7 \times 10^1) \times 10^7 \\ & \boxed{1.7 \times 10^8} \end{aligned}$$

10. $(2.8 \times 10^{-4})(1.9 \times 10^7)$

$$\begin{aligned} & (2.8 \times 1.9)(10^{-4} \times 10^7) \\ & \boxed{5.32 \times 10^3} \end{aligned}$$

11. $(6.7 \times 10^{-7})(3 \times 10^3)$

$$\begin{aligned} & (6.7 \times 3)(10^{-7} \times 10^3) \\ & 20.1 \times 10^{-4} \\ & (2.01 \times 10^1) \times 10^{-4} \\ & \boxed{2.01 \times 10^{-3}} \end{aligned}$$

12. $(1.2 \times 10^{-4})^2$

$$\begin{aligned} & (1.2 \times 1.2)(10^{-4} \times 10^{-4}) \\ & \boxed{1.44 \times 10^{-8}} \end{aligned}$$

Examples: Evaluate each quotient. Express the results in scientific notation and standard form.

13. $\frac{4.9 \times 10^{-3}}{2.5 \times 10^{-4}}$

$$\begin{aligned} & \left(\frac{4.9}{2.5}\right)\left(\frac{10^{-3}}{10^{-4}}\right) \\ & 1.96 \times 10^1 \end{aligned}$$

14. $\frac{5.8 \times 10^4}{5 \times 10^{-2}}$

$$\begin{aligned} & \left(\frac{5.8}{5}\right)\left(\frac{10^4}{10^{-2}}\right) \\ & \boxed{1.16 \times 10^6} \end{aligned}$$

15. $\frac{1.6 \times 10^5}{4 \times 10^{-4}}$

$$\begin{aligned} & \left(\frac{1.6}{4}\right)\left(\frac{10^5}{10^{-4}}\right) \\ & 0.4 \times 10^9 \\ & (4 \times 10^1) \times 10^7 \\ & \boxed{4.0 \times 10^8} \end{aligned}$$

16. $\frac{8.6 \times 10^6}{1.6 \times 10^{-3}}$

$$\begin{aligned} & \left(\frac{8.6}{1.6}\right)\left(\frac{10^6}{10^{-3}}\right) \\ & \boxed{5.375 \times 10^9} \end{aligned}$$