

Quantities expressed in scientific notation do not need to have the same exponents before they are multiplied or divided. Multiply the values of M , then add the exponents. The units are multiplied.

Example Problem

Multiplication Using Scientific Notation

- a. $(3 \times 10^6 \text{ m})(2 \times 10^3 \text{ m}) = 6 \times 10^{6+3} \text{ m}^2 = 6 \times 10^9 \text{ m}^2$
 b. $(2 \times 10^{-5} \text{ m})(4 \times 10^9 \text{ m}) = 8 \times 10^{9-5} \text{ m}^2 = 8 \times 10^4 \text{ m}^2$
 c. $(4 \times 10^3 \text{ kg})(5 \times 10^{11} \text{ m}) = 20 \times 10^{3+11} \text{ kg} \cdot \text{m}$
 $= 2 \times 10^{15} \text{ kg} \cdot \text{m}$

Quantities expressed in scientific notation with different exponents also can be divided. Divide the values of M , then subtract the exponent of the divisor from the exponent of the dividend.

Example Problem

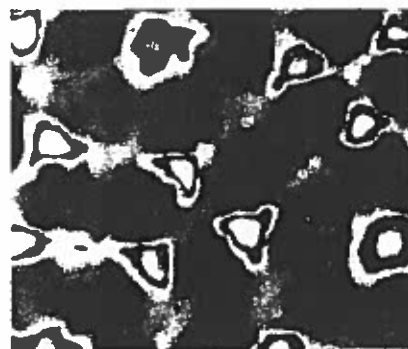
Division Using Scientific Notation

- a. $\frac{8 \times 10^6 \text{ m}}{2 \times 10^3 \text{ s}} = 4 \times 10^{(6-3)} \text{ m/s} = 4 \times 10^3 \text{ m/s}$
 b. $\frac{8 \times 10^6 \text{ kg}}{2 \times 10^{-2} \text{ m}^3} = 4 \times 10^{6-(-2)} \text{ kg/m}^3 = 4 \times 10^8 \text{ kg/m}^3$

Practice Problems

Find the value of each of the following quantities.

9. a. $(2 \times 10^4 \text{ m})(4 \times 10^8 \text{ m})$ c. $(6 \times 10^{-4} \text{ m})(5 \times 10^{-8} \text{ m})$
 b. $(3 \times 10^4 \text{ m})(2 \times 10^6 \text{ m})$ d. $(2.5 \times 10^{-7} \text{ m})(2.5 \times 10^{16} \text{ m})$
10. a. $\frac{6 \times 10^8 \text{ kg}}{2 \times 10^4 \text{ m}^3}$ c. $\frac{6 \times 10^{-8} \text{ m}}{2 \times 10^4 \text{ s}}$
 b. $\frac{6 \times 10^8 \text{ kg}}{2 \times 10^{-4} \text{ m}^3}$ d. $\frac{6 \times 10^{-8} \text{ m}}{2 \times 10^{-4} \text{ s}}$
- ▶ 11. a. $\frac{(3 \times 10^4 \text{ kg})(4 \times 10^4 \text{ m})}{6 \times 10^4 \text{ s}}$ b. $\frac{(2.5 \times 10^6 \text{ kg})(6 \times 10^4 \text{ m})}{5 \times 10^{-2} \text{ s}^2}$



a



b

FIGURE 2-5. For extremely small measurements, such as the distance between atoms (a), and for very large measurements, such as the distance to the Andromeda galaxy (b), it is convenient to use scientific notation. Showing all the digits in numbers like these makes calculations difficult.

CONCEPT REVIEW

- Some calculators display large numbers as 1.574 E8. Express in normal scientific notation.
- Your height might be given either in terms of a small unit, like a millimeter, or a larger unit, like a meter. In which case would your height be a larger number?
- Describe in detail how you would measure the time in seconds needed to go from home to school.
- Critical Thinking:** What additional steps would you need to time your trip, using one clock at home and one at school?