

MATD 0370 (ELEMENTARY ALGEBRA) EXERCISE SET 8.2

Scientific Notation

It is often difficult to work with very large or very small numbers. Scientific Notation provides a useful way of writing numbers. The following are examples of numbers written using scientific notation:

$$5.0 \times 10^{12} \text{ miles} = 5,000,000,000,000 \text{ miles}$$

$$3.7 \times 10^{-8} \text{ grams} = 0.000000037 \text{ grams}$$

Lesson 8.2 (page 509) in your textbook (Personal Academic Notebook, or PAN for short) explains how to write numbers in scientific notation. This handout will explain how to multiply and divide numbers written in scientific notation.

Multiplying and Dividing Numbers Written in Scientific Notation

When multiplying or dividing numbers written in scientific notation, we will use the multiplication and division properties of exponents covered in lesson 6.1 and summarized on page 378 in your textbook (PAN). Below are two examples.

- 1) Multiply and write your answer in scientific notation:

$$(2.3 \times 10^7)(3.6 \times 10^{-3})$$

$$= 2.3 \times 10^7 \times 3.6 \times 10^{-3} \quad \text{remove the parentheses}$$

$$= (2.3 \times 3.6) \times (10^7 \times 10^{-3}) \quad \text{rearrange and regroup terms (commutative and associative laws)}$$

$$= 8.28 \times 10^{7+(-3)} \quad \text{add exponents when multiplying like (same) bases}$$

$$= 8.28 \times 10^4$$

- 2) Divide and write your answer in scientific notation:

$$\frac{4.2 \times 10^9}{1.5 \times 10^{-6}}$$

$$= (4.2 \times 10^9) \div (1.5 \times 10^{-6})$$

$$= (4.2 \div 1.5) \times (10^9 \div 10^{-6})$$

$$= 2.8 \times 10^{9-(-6)} \quad \text{subtract exponents when dividing like (same) bases}$$

$$= 2.8 \times 10^{9+6} \quad \text{change subtraction to addition and then use rules of addition}$$

$$= 2.8 \times 10^{15}$$

Note: When a problem is given to us in scientific notation, your answer should also be given in scientific notation. For example:

3) Multiply and write your answer in scientific notation:

$$\begin{aligned} & (7.28 \times 10^7)(3.5 \times 10^{-5}) \\ &= (7.28 \times 3.5) \times (10^7 \times 10^{-5}) \\ &= 25.48 \times 10^2 \end{aligned}$$

Notice that our answer is not yet in scientific notation because 25.48 is not between 1 and 10. To fix this, write 25.48 in scientific notation. To do this, follow the instructions on page 509 of your textbook (PAN) and replace 25.48 with the equivalent expression 2.548×10^1 as follows:

$$\begin{aligned} &= (2.548 \times 10^1) \times 10^2 && \text{rewrite 25.48 in scientific notation} \\ &= 2.548 \times (10^1 \times 10^2) && \text{regroup terms (associative law)} \\ &= 2.548 \times 10^{1+2} && \text{add exponents when multiplying like (same) bases} \\ &= 2.548 \times 10^3 \end{aligned}$$

Here is one more example:

4) Divide and write your answer in scientific notation:

$$\begin{aligned} & \frac{1.6 \times 10^{-7}}{2.56 \times 10^{-10}} \\ &= (1.6 \times 10^{-7}) \div (2.56 \times 10^{-10}) \\ &= (1.6 \div 2.56) \times (10^{-7} \div 10^{-10}) \\ &= 0.625 \times 10^{-7-(-10)} && \text{subtract exponents when dividing like (same) bases} \\ &= 0.625 \times 10^3 \\ &= (0.625 \times 10^{-1}) \times 10^3 && \text{rewrite 0.625 in scientific notation} \\ &= 6.25 \times (10^{-1} \times 10^3) && \text{regroup terms (associative law)} \\ &= 6.25 \times 10^{-1+3} && \text{add exponents when multiplying like (same) bases} \\ &= 6.25 \times 10^2 \end{aligned}$$

In addition to the problems assigned from your Personal Academic Notebook (textbook) for lesson 8.2, work the following problems:

1. Multiply and write your answer in scientific notation:

a. $(1.9 \times 10^{12})(4.7 \times 10^{-8})$

b. $(5.85 \times 10^{-2})(1.40 \times 10^{-5})$

c. $(7.6 \times 10^5)(8.25 \times 10^6)$

d. $(4.3 \times 10^{-9})(5.2 \times 10^4)$

e. $(6.5 \times 10^{-7})(3.8 \times 10^{-3})$

2. Divide and write your answer in scientific notation:

a. $\frac{6.3 \times 10^6}{1.2 \times 10^{-5}}$

b. $\frac{8.4 \times 10^{-3}}{3.2 \times 10^7}$

c. $\frac{2.5 \times 10^{-9}}{4.0 \times 10^{-5}}$

d. $\frac{1.32 \times 10^{-3}}{6.6 \times 10^{18}}$

e. $\frac{4.8 \times 10^7}{6.25 \times 10^4}$

ANSWERS:

1. a. 8.93×10^4

b. 8.19×10^{-7}

c. 6.27×10^{12}

d. 2.236×10^{-4}

e. 2.47×10^{-9}

2. a. 5.25×10^{11}

b. 2.625×10^{-10}

c. 6.25×10^{-5}

d. 2.0×10^{-22}

e. 7.68×10^2