

Another example:  $7.45 \times 10^{-8} = 0.0000000745$  → the “-8” tells you that there are 8 decimal places between the right side of the 7 and the end of the number.

In both very large and very small numbers, the exponent tells you how many decimal points are between the right side of the first digit and the end of the number. If the exponent is positive, the decimal places are to the right of the number. If the exponent is negative, the decimal places are to the left of the number.

### **Critical Thinking Questions**

8. Two of the following six numbers are written incorrectly. Circle the two that are incorrect.

a)  $3.57 \times 10^{-8}$       b)  $4.23 \times 10^{-2}$       c)  $75.3 \times 10^2$       d)  $2.92 \times 10^9$       e)  $0.000354 \times 10^4$       f)  $9.1 \times 10^4$

What do you think is wrong about the two numbers you circled?

9. Write the following numbers in scientific notation:

a) 25,310,000,000,000,000 = \_\_\_\_\_      b) 0.000000003018 = \_\_\_\_\_

10. Write the following scientific numbers in regular notation:

a)  $8.41 \times 10^{-7} =$  \_\_\_\_\_      b)  $3.215 \times 10^8 =$  \_\_\_\_\_

### **Information: Multiplying and Dividing Using Scientific Notation**

When you multiply two numbers in scientific notation, you must add their exponents. Here are two examples. Make sure you understand each step:

$$(4.5 \times 10^{12}) \times (3.2 \times 10^{36}) = (4.5)(3.2) \times 10^{12+36} = 14.4 \times 10^{48} \rightarrow 1.44 \times 10^{49}$$

$$(5.9 \times 10^9) \times (6.3 \times 10^{-5}) = (5.9)(6.3) \times 10^{9+(-5)} = 37.17 \times 10^4 \rightarrow 3.717 \times 10^5$$

When you divide two numbers, you must subtract denominator's exponent from the numerator's exponent. Here are two examples. Make sure you understand each step:

$$\frac{2.8 \times 10^{14}}{3.2 \times 10^7} = \frac{2.8}{3.2} \times 10^{14-7} = 0.875 \times 10^7 = 8.75 \times 10^6$$

$$\frac{5.7 \times 10^{19}}{3.1 \times 10^{-9}} = \frac{5.7}{3.1} \times 10^{19-(-9)} = 1.84 \times 10^{19+9} = 1.84 \times 10^{28}$$

## **Critical Thinking Questions**

11. Solve the following problems.

a)  $(4.6 \times 10^{34})(7.9 \times 10^{-21}) =$

b)  $(1.24 \times 10^{12})(3.31 \times 10^{20}) =$

12. Solve the following problems.

a)  $\frac{8.4 \times 10^{-5}}{4.1 \times 10^{17}} =$

b)  $\frac{5.4 \times 10^{32}}{7.3 \times 10^{14}} =$

## **Information: Adding and Subtracting Using Scientific Notation**

Whenever you add or subtract two numbers in scientific notation, you must make sure that they have the same exponents. Your answer will then have the same exponent as the numbers you add or subtract. Here are some examples. Make sure you understand each step:

$$4.2 \times 10^6 + 3.1 \times 10^5 \rightarrow \text{make exponents the same, either a 5 or 6} \rightarrow 42 \times 10^5 + 3.1 \times 10^5 = 45.1 \times 10^5 = 4.51 \times 10^6$$

$$7.3 \times 10^{-7} - 2.0 \times 10^{-8} \rightarrow \text{make exponents the same, either -7 or -8} \rightarrow 73 \times 10^{-8} - 2.0 \times 10^{-8} = 71 \times 10^{-8} = 7.1 \times 10^{-7}$$

## **Critical Thinking Questions**

13. Solve the following problems.

a)  $4.25 \times 10^{13} + 2.10 \times 10^{14} =$

b)  $6.4 \times 10^{-18} - 3 \times 10^{-19} =$

c)  $3.1 \times 10^{-34} + 2.2 \times 10^{-33} =$