PREPARATORY MATH SKILLS LAB

Lab PMS 9

MATH ACTIVITY

Writing Decimal Numbers as Power-of-ten Numbers and Writing Power-of-ten Numbers as Decimal Numbers

MATH SKILLS LAB OBJECTIVES

When you complete this activity, you should be able to do the following:

1. ***Express a decimal number in power-of-ten notation.***
2. ***Express a number in power-of-ten notation as a decimal.***

MATERIALS

For this activity, you'll need a pencil and paper.

In Unit 2, "*Work*," you learned that one coulomb of charge represents:

6,250,000,000,000,000,000 electrons.

The amount of charge carried by a single electron is:

0.0000000000000000001602 coulombs.

Frequently, technical work involves very large or very small numbers. These numbers require much space and effort to write in decimal notation (as above).

To make large numbers more compact, they're written in a form known as "power-of-ten" notation. This method allows numbers such as one coulomb of charge to be reduced to 6.25×10^{18} electrons. The charge carried by an electron reduces to 1.602×10^{-19} coulombs. In other words,

$$6{,}250{,}000{,}000{,}000{,}000{,}000 = 6.25 \times 10^{18}$$

and

$$0.0000000000000000001602 = 1.602 \times 10^{-19}$$

The following table lists examples of decimal numbers written in power-of-ten notation. The examples include numbers larger than one (from 10 to 1,000,000) and numbers smaller than one (from 1/10 to 1/1,000,000).

TABLE 1: DECIMAL NUMBER AND POWER-OF-TEN EQUIVALENTS

Decimal Number	Power of Ten	Explanation
1,000,000	1×10^6 or 10^6	$10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6$
100,000	1×10^5 or 10^5	$10 \times 10 \times 10 \times 10 \times 10 = 10^5$
10,000	1×10^4 or 10^4	$10 \times 10 \times 10 \times 10 = 10^4$
1,000	1×10^3 or 10^3	$10 \times 10 \times 10 = 10^3$
100	1×10^2 or 10^2	$10 \times 10 = 10^2$
10	1×10^1 or 10^1	$10^1 = 10$ (usually written without exponent)
1	1×10^0 or 10^0	$10^0 = 1$ (by definition, any number to zero power equals 1)
0.1	1×10^{-1} or 10^{-1}	$\frac{1}{10} = 10^{-1}$
0.01	1×10^{-2} or 10^{-2}	$\frac{1}{10 \times 10} = \frac{1}{100} = 10^{-2}$
0.001	1×10^{-3} or 10^{-3}	$\frac{1}{10 \times 10 \times 10} = \frac{1}{1{,}000} = 10^{-3}$
0.0001	1×10^{-4} or 10^{-4}	$\frac{1}{10 \times 10 \times 10 \times 10} = \frac{1}{10{,}000} = 10^{-4}$
0.00001	1×10^{-5} or 10^{-5}	$\frac{1}{10 \times 10 \times 10 \times 10 \times 10} = \frac{1}{100{,}000} = 10^{-5}$
0.000001	1×10^{-6} or 10^{-6}	$\frac{1}{10 \times 10 \times 10 \times 10 \times 10 \times 10} = \frac{1}{1{,}000{,}000} = 10^{-6}$

Every decimal number can be expressed in power-of-ten notation. To do this, factor the number into two separate parts. For example, 80 can be separated into a product of the factors 8.0 and 10. In other words, $80 = 8.0 \times 10$. The first leading factor contains the significant digits in the number. The second factor (after the multiplication sign represented by the "x") is a 10 with an exponent. (Here, the exponent is 1—usually left off, since $10^1 = 10$.) The exponent is the "power of ten," or how many times 10 is used as a factor in the multiplication process.

Study Figure 1. It is a graphic description of the explanation given in the preceding paragraph.

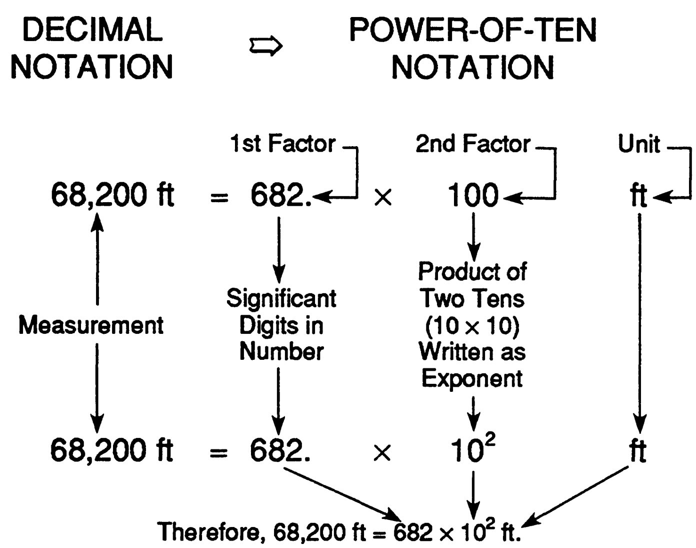

Fig. 1 Expressing a number in power-of-ten notation.

Note: In Figure 1, we have written 68,200 as 682×10^2. We also could have written 68,200 as 6.82×10^4 or 68.2×10^3. All are equally correct! Many times, depending on other numbers you may be working with, you'll choose one form over the other.

Study Table 2, using Table 1 to verify the answers.

TABLE 2: CONVERSION OF DECIMAL NUMBERS (COLUMN A) TO POWER-OF-TEN NUMBERS (COLUMN B)

Column A		Column B
375,000	=	375×10^3
81,000	=	81×10^3
623,000,000	=	623×10^6
0.0715	=	715×10^{-4}
0.000000133	=	133×10^{-9}

To emphasize the point we made earlier, note that ALL of the following power-of-ten notations express the ***same*** number—81,000.

$$81{,}000 = 8.1 \times 10^4$$
$$81{,}000 = 81 \times 10^3$$
$$81{,}000 = 810 \times 10^2$$
$$81{,}000 = 8100 \times 10^1$$
$$81{,}000 = 0.81 \times 10^5$$

Remember that power-of-ten numbers can be written in more than one way.

Converting power-of-ten numbers to decimal numbers is a "reverse" process. Look at the second column of Table 1. Choose any power-of-ten number. Convert it to a decimal number (Column 1 of Table 1).

For example, the number 1×10^4 equals 10,000 in decimal form. This means that the decimal point is placed *four places to the right* of 1. So, $1 \times 10^4 = 10000. = 10{,}000$. If the number is 1×10^{-4}, then the decimal is placed *four places to the left* of 1. So, $1 \times 10^{-4} = 0.0001$, or one ten-thousandth.

Here are two more examples.

$$32.6 \times 10^4 = 32.6 \times 10{,}000 \qquad (10^4 = 10{,}000)$$
$$= 326{,}000. \qquad \text{(Decimal point moved 4 places to the right.)}$$

So, $32.6 \times 10^4 = 326{,}000$.

$$43.1 \times 10^{-2} = 43.1 \times 0.01 \qquad (10^{-2} = 1 \times 10^{-2} = 0.01)$$
$$= 0.431 \qquad \text{(Decimal point moved 2 places to the left.)}$$

So, $43.1 \times 10^{-2} = 0.431$.

PRACTICE EXERCISES

Problem 1: Convert the decimal numbers in Column A to "power-of-ten" numbers in Column B. *More than one form will be correct.* Write 2 or 3 correct forms. For example, 125,000 can be written as 125×10^3, 12.5×10^4 or 1.25×10^5.

Column A	Column B		
125,000	________	________	________
32,100	________	________	________
1,521	________	________	________
1,921,000	________	________	________
0.0000192	________	________	________
0.11050	________	________	________
0.567	________	________	________
22	________	________	________

Problem 2: Convert the power-of-ten numbers in Column A to decimal numbers. In this conversion, there is only *one* correct form for the decimal number. Place the answers in Column B.

Column A	Column B
326×10^{3}	________
41.98×10^{4}	________
2.12×10^{-4}	________
6.1×10^{5}	________
3.06×10^{2}	________
1.2×10^{-3}	________
0.81×10^{5}	________