

Section 2.3 Standard Form

Standard form is another way of representing numbers and is generally used to simplify calculations with very large or very small numbers. It is commonly referred to as scientific notation.

You should be able to convert numbers into standard form or “non” standard form, called decimal form. You should also be able to perform calculations with numbers in standard form.

Numbers in standard form are written in the form $a \times 10^k$ where $1 \leq |a| < 10$ and k is a positive or negative integer (not a decimal). a can be positive or negative and can include a decimal but the absolute value of a must be smaller than 10.

Remember, a negative exponent in standard form means to move the decimal place that many places to the left (it is a SMALL decimal). A positive exponent means to move the decimal place that many places to the right (it is a BIG number).

If you're given a number in standard form, you can enter that in the calculator without converting it. For example... 4.53×10^{-4} can be entered in the calculator as $4.53*10^{-4}$.

If your calculator gives you a number in scientific notation it uses an E instead of a 10. So 4.53×10^{-4} would be given as 4.53E-4.

Example: Which of the following is NOT in standard form:

- (a) 1.2×10^{-2} (OK) (b) 14.3×10^{-4} (NOT OK) (c) 3.21×10^3 (OK)

Example: Convert the following numbers into the form $a \times 10^k$ where $1 \leq |a| < 10$ and $k \in \mathbb{Z}$ (this means k is an integer):

(a) 5230000

(b) 0.0000698

In this case our a value will be 5.23
I need to move 6 places to get there.

In this case our a value will be 6.98
I need to move 5 places to get there.

5.23×10^6

6.98×10^{-5}

Example: Convert the following numbers into decimal form.

(a) 2.5×10^{-4}

(b) 3.14×10^7

In this case I need to move 4 decimal places
to the left to make it smaller.

In this case I need to move 7 decimal places
to the right to make it bigger.

0.00025

31,400,000

Operations in Standard Form

Adding or Subtracting:

The numbers must both be in the form $a \times 10^k$ but they must both have the same k value. To make this happen you may need to alter the a value which may cause it to be smaller than 1 or greater than 10. Once they have the same k value you can add or subtract the a values. Be sure to give your final answer where $1 \leq |a| < 10$

Example:

$$(2.456 \times 10^5) + (6.0034 \times 10^8)$$

Let's make the smaller number have the same k value as the larger. I need to increase it by 3 so move the decimal 3 places.

$$(0.002456 \times 10^8) + (6.0034 \times 10^8) = ((0.002456 + 6.0034) \times 10^8) = 6.005856 \times 10^8$$

Multiply or Divide:

Move things around so you multiply/divide the a values and the 10^k values. Be sure to give your final answer where $1 \leq |a| < 10$

Example:

$$(2.6 \times 10^5)(9.2 \times 10^{-13})$$

$$\begin{aligned}(2.6)(9.2)(10^5)(10^{-13}) &= (2.6)(9.2)(10^{5+(-13)}) = (23.92) \times 10^{-8} = (2.392 \times 10^1) \times 10^{-8} \\ &= 2.392 \times 10^{-7}\end{aligned}$$

Example:

A sheet of paper is 1.2×10^{-1} mm thick. Find how many sheets are needed to make a pile of paper that is 20 mm high.

Divide...

$$\frac{20}{1.2 \times 10^{-1}} = \frac{2.0 \times 10^1}{1.2 \times 10^{-1}} = \frac{2}{1.2} \times 10^{1-(-1)} = 1.67 \times 10^2 = 167 \text{ sheets}$$

Note: You may be allowed to use a calculator to check your work but you will need to show proof that you know how to do it by hand. Like shown above.