

# Standard Form

## SUMMARY:

- Standard form is a way to write very large or very small numbers, eliminating the need to write multiple zeros.
- Each number is expressed as a value between 1 and 10 multiplied by a power of ten.
- It makes calculations with these numbers much easier.

## EXPLANATION:

Converting to standard form:

To convert a number into standard form you need to split it into a number between 1 and 10 and a power of ten. To do this you need to first understand what the powers of ten are.

$$10^0 = 1$$

$$10^1 = 10$$

$$10^2 = 100$$

$$10^3 = 1000$$

Etc...

This is multiplied by the number between 1 and 10 in order to create a number in standard form.

For example: Write 34000 in standard form:

$$34000 = 3.4 \times 10000$$

$$10000 = 10^4$$

Therefore the answer is  $3.4 \times 10^4$

When the number is very small (less than 1), negative powers of ten are used:

$$10^{-1} = 0.1$$

$$10^{-2} = 0.01$$

$$10^{-3} = 0.001$$

Etc...

Example: write 0.0022 in standard form

$$0.0022 = 2.2 \times 0.001$$

$$0.001 = 10^{-3}$$

Therefore, the answer is  $2.2 \times 10^{-3}$

Sometimes numbers may look like they are written in standard form but actually do not follow the rule. An example would be a number such as  $27 \times 10^3$ . Although this number is in two parts, with one being the power of ten, the other part is greater than 10. This means it is not in standard form. Similarly,  $0.38 \times 10^4$  is not in standard form as 0.38 is less than 1.

Converting from standard form:

To take a number out of standard form we need to multiply by the power of ten. For example:

$$3.5 \times 10^5 = 3.5 \times 100000 = 350000$$

$$6.3 \times 10^{-3} = 6.3 \times 0.001 = 0.0063$$

Ordering values in standard form:

To order numbers written in standard form, you must first order them in powers of ten as this tells you the size of the number. If two numbers have the same power of ten, you then compare the number at the front.

Adding and subtracting:

When adding or subtracting, it is easiest to convert the numbers out of standard form to complete the calculation and then convert the answer back into standard form. For example:

$$\begin{aligned}(6.3 \times 10^4) + (2.3 \times 10^3) &= 63000 + 2300 \\ &= 65300\end{aligned}$$

## Multiplying and dividing:

When multiplying and dividing, you can use the laws of indices, first complete the calculation for the powers of ten then multiply or divide the numbers in front. Using standard form allows you to multiply or divide large numbers without a calculator, for example:

$$35000 \times 4300$$

$$35000 = 3.5 \times 10^4$$

$$43000 = 4.3 \times 10^4$$

$$35000 \times 4300 = (3.5 \times 10^4) \times (4.3 \times 10^4)$$

$$= 3.5 \times 4.3 \times 10^8$$

$$= 15.05 \times 10^8$$