

Standard Form

Standard form is a way of writing very large or very small numbers by using powers of ten. It is also known as scientific notation.

Numbers in standard form are written in this format:

$$\boxed{\begin{array}{l} a \text{ is a number} \\ 1 \leq a < 10 \end{array}} \rightarrow a \times 10^n \leftarrow \boxed{n \text{ is an integer}}$$




Example

The Sun is approximately 149 600 000 kilometres from Earth.
In standard form, this is written: 1.496×10^8

Converting To and From Standard Form

Ordinary numbers can be written in standard form, and numbers written in standard form can be converted back to ordinary numbers.

Converting to standard form

 **Example** Write 720 000 in standard form.

1 Write down the non-zero digits as a number between 1 and 10

$$7.2 \times 10^5$$

2 Work out the power of ten. We can count places like this:

7.20000

Remember that the decimal point doesn't **actually** move.

Converting from standard form

 **Example** Write 3.4×10^4 as an ordinary number.

This means $3.4 \times 10 \times 10 \times 10 \times 10$

Power of 4 means we multiply by 10 **four** times.

$$3.4 \times 10 \times 10 \times 10 \times 10 = 3.4 \times 10000 = 34000$$

This can also be done by counting places:

Power of 4 means we multiply by 10 **four** times.

"Fill in" the zeroes for correct place value.

Remember that the decimal point doesn't **actually** move.

3.4



34000

Adding and Subtracting in Standard Form

There are two different ways to add or subtract in standard form.



Example Work out $(4 \times 10^3) + (6.7 \times 10^2)$

Convert to ordinary numbers

$$(4 \times 10^3) = 4000$$

Counting places like this is useful for standard form conversions, but remember that the decimal point doesn't **actually** move.

$$(6.7 \times 10^2) = 670$$

You may need to use column addition here.

$$(4 \times 10^3) + (6.7 \times 10^2) = 4000 + 670$$
$$= 4670$$

$$4670 = 4.67 \times 10^3$$

Sometimes you will be asked for your answer in standard form, so you would need to convert your answer.

Adjust to the same power of 10

We adjust one number so that it's written with the same power of 10 as the other one.

Leave this number as it is.

$$(4 \times 10^3) + (6.7 \times 10^2)$$

Adjust this number so it's written using 10^3 instead of 10^2

$$= (4 \times 10^3) + (0.67 \times 10^3)$$
$$= 4.67 \times 10^3$$

Multiplying and Dividing in Standard Form

To multiply or divide in standard form, multiply or divide the integer or decimal parts, then use the laws of indices to simplify the powers of 10.



Example

Work out

$$(4 \times 10^3) \times (2 \times 10^6)$$

1 Multiply the integer parts.

$$4 \times 2 = 8$$

2 Simplify the powers of 10

$$10^3 \times 10^6 = 10^9$$

$$(4 \times 10^3) \times (2 \times 10^6) = 8 \times 10^9$$



Example

Work out

$$(5 \times 10^4) \div (2 \times 10^6)$$

1 Multiply the integer parts.

$$5 \div 2 = 2.5$$

2 Simplify the powers of 10

$$10^4 \div 10^6 = 10^{-2}$$

$$(5 \times 10^4) \div (2 \times 10^6) = 2.5 \times 10^{-2}$$

Check that your final answer is in standard form, if necessary.