

Standard form

Numbers in standard form have two parts.

$$7.3 \times 10^{-6}$$

This part is a number greater than or equal to 1 and less than 10.

This part is a power of 10.

You can use standard form to write very large or very small numbers.

$$920\,000 = 9.2 \times 10^5$$

Numbers greater than 10 have a positive power of 10.

$$0.007\,03 = 7.03 \times 10^{-3}$$

Numbers less than 1 have a negative power of 10.

Counting decimal places

You can count decimal places to convert between numbers in standard form and ordinary numbers.

$$7\,900 = 7.9 \times 10^3$$

7900 > 10
So the power is positive

$$0.000\,35 = 3.5 \times 10^{-4}$$

0.00035 < 1
So the power is negative

Be careful!

Don't just count zeros to work out the power.

Worked example

Target grade 5

Work out the value of $(8.3 \times 10^6) - (4.1 \times 10^5)$
Give your answer in standard form. (2 marks)

$$\begin{array}{r} 8\,300\,000 \\ - 410\,000 \\ \hline \end{array}$$

$$7\,890\,000 = 7.89 \times 10^6$$

Examiners' report

You need to be able to work with numbers in standard form on your **non-calculator paper**. To add or subtract, write the numbers as ordinary numbers first, then write your final answer in standard form.

Real students have struggled with questions like this in recent exams – **be prepared!**



Non-calculator multiplying

1

Rearrange so powers of 10 are together

Multiply the number parts

$$\begin{aligned} (3 \times 10^3) \times (5 \times 10^6) \\ = (3 \times 5) \times (10^3 \times 10^6) \\ = 15 \times 10^9 \end{aligned}$$

Add the powers

$$a^m \times a^n = a^{m+n}$$

Rewrite your answer in standard form if necessary

$$\begin{aligned} &= 1.5 \times 10^1 \times 10^9 \\ &= 1.5 \times 10^{10} \end{aligned}$$

Non-calculator dividing

2

Rearrange so powers of 10 are together

Divide the number parts

$$\begin{aligned} (1.2 \times 10^8) \div (2 \times 10^4) \\ = (1.2 \div 2) \times (10^8 \div 10^4) \\ = 0.6 \times 10^4 \end{aligned}$$

Subtract the powers

$$a^m \div a^n = a^{m-n}$$

Rewrite your answer in standard form if necessary

$$\begin{aligned} &= 6 \times 10^{-1} \times 10^4 \\ &= 6 \times 10^3 \end{aligned}$$

Using a calculator

You can enter numbers in standard form using the $\times 10^x$ key.

To enter 3.7×10^{-6} press

$$3 \cdot 7 \times 10^x (-) 6$$

If you are using a calculator with numbers in standard form it is a good idea to put brackets around each number.

Now try this

Target grade 5

The mass of one *E.coli* bacterium is 6×10^{-16} grams. Find the total mass of 3×10^6 bacteria. (2 marks)

Have a go at this question **without a calculator** first. Then use your calculator to check your answer.