Standard form (8 & 9)

Contents

1 Writing numbers in standard form

Very large numbers and very small numbers can be written in a more concise way using standard form. Numbers in standard form are in the form:

$$a \times 10^n$$

where

- a is a number between 1 and 10,
- n is an integer (i.e. a positive or negative whole number, or zero)

Follow these examples. Let's start with large numbers:

$$36,000 = 3.6 \times 10^4$$
$$567,000 = 5.67 \times 10^5$$
$$9 \text{ million} = 9000000 = 9 \times 10^6$$

In reverse,

$$7 \times 10^5 = 700000$$
$$5 \times 10^0 = 5 \qquad \textit{(remember anything to the power 0 is 1)}$$
$$6.2 \times 10^1 = 62$$

When the numbers are small, we use negative powers. For example:

$$0.0003 = 3 \times 10^{-4}$$

If we remember our work on indices, 10^{-4} means $\frac{1}{10,000}$ and finding $\frac{1}{10,000}$ of 3 is the same as $3 \div 10,000$.
Follow these examples:

$$0.00067 = 6.7 \times 10^{-4}$$
$$0.004 = 4 \times 10^{-3}$$
$$0.0000000781 = 7.81 \times 10^{-8}$$

In reverse,

$$6.2 \times 10^{-5} = 0.000062$$
$$3 \times 10^{-9} = 0.000000003$$

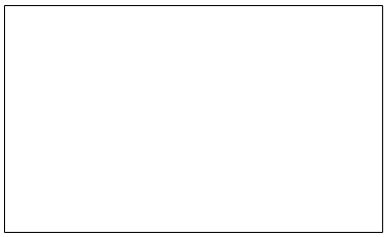
2 Standard form on the calculator

Writing a number in standard form before entering it into the calculator can save you typing in such a large or small number (and sometimes these do not fit on the screen anyway). You will have to work out how to deal with standard form on your own calculator, but here are the most common buttons:

Older calculators. For 3×10^6 enter $3\boxed{\text{EXP}}6$, displayed as $\boxed{3^6}$.
Be careful not to interpret 3^6 as 3 multiplied by itself 6 times, but rather as 3 multiplied by 10 6 times.

Newer calculators. For 3×10^6 enter $3\boxed{\times 10^x}6$, displayed as $\boxed{3 \times 10^6}$.

Example. To find the area of this rectangle:



35,000,000

290,000,000

$$\begin{aligned}
\text{Area} &= 290,000,000 \times 35,000,000 \\
&= (2.9 \times 10^8) \times (3.5 \times 10^7) \\
&= 2.9\boxed{\text{EXP}}8 \times 3.5\boxed{\text{EXP}}7 \\
&= 1.015 \times 1016 \\
&= 1015000000000000
\end{aligned}$$

3 Calculations with numbers in standard form

We can calculate with numbers in standard form but there are some short cuts we can employ using the rules of indices.

Multiplying. Consider $30,000 \times 600,000$. We know this is $6,000,000,000$.
In standard form we get $(3 \times 10^4) \times (2 \times 10^5) = 6 \times 10^9$
That is, we can simply multiply the 3 and the 2 and add the indices.

Dividing. Consider $60,000 \div 200$. We know this is 300.
In standard form we get $(6 \times 10^4) \div (2 \times 10^2) = 3 \times 10^2$
That is, we can simply divide 6 by 2 and subtract the indices.

Squaring. Consider: $(3,000)^2$. We know this is $3,000 \times 3,000 = 9,000,000$.
In standard form we get $(3 \times 10^3)^2 = 3 \times 10^6$.
That is, we can simply square the 3 and multiply the powers.

Adding and subtracting. So, with multiplication, division and brackets we can use our rules of indices. Since there is no rule of indices for addition and subtraction, we have to write the numbers out in full.

$$\begin{aligned} 5 \times 10^4 + 3 \times 10^2 &= 50,000 + 300 \\ &= 50,300 \end{aligned}$$

Here are some examples to study:

$$\begin{aligned} (3 \times 10^6) \times (6 \times 10^5) &= 18 \times 10^{11} \\ &= 1.8 \times 10^{12} \end{aligned}$$ *(adjust between 1 and 10)*

$$\begin{aligned} \left(5 \times 10^6\right)^3 &= 125 \times 10^{18} \\ &= 1.25 \times 10^{20} \end{aligned}$$

$$\begin{aligned} (4 \times 10^5) - (3 \times 10^4) &= 400,000 - 30,000 \\ &= 370,000 \\ &= 3.7 \times 10^5 \end{aligned}$$