Super Big Standard Form

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Starter worksheet

Standard form is a way of writing really big and really small numbers to make them easier to use. From astronomers comparing distances between galaxies to microbiologists measuring viruses, standard form is used all over the world. Scientists, in particular, find it very helpful.

Remember that standard form looks like this:

5.2×10^6

A power of 10

Number between 1 and 10

So, 5.2×10^6 means $5.2 \times 1\,000\,000 = 5\,200\,000$.

Pluto is approximately 3 600 000 000 miles away from the Sun. In standard form,

$$3\,600\,000\,000 = 3.6 \times 1\,000\,000\,000 = \mathbf{3.6} \times \mathbf{10^9}$$

The power is **9** because $1\,000\,000\,000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$, which is 10 multiplied by itself **9** times.

Activity:

Don't think about this for long - just take a few seconds to guess:
how old are you … in seconds?

Compare your answer with the person sitting next to you.

(With a partner?) **Try and work out the real answer**. (You'll need a calculator)

Bear in mind…
there are 60 seconds in a minute, 60 minutes in an hour, 24 hours in a day and 365.25 days in year.

Your answer should be pretty big. You could tell your friends your exact age, down to the last second, but your answer will only be accurate for one second. Instead, it is more helpful to round your answer to **3 significant figures**.

Your answer will still be a bit of a mouthful so it is even more helpful to write it in standard form. **Have a go at expressing your answer in standard form.**

Now tell your friends how old you are!

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Core worksheet

Sometimes you might want to expand standard form and return a number to its ordinary form.

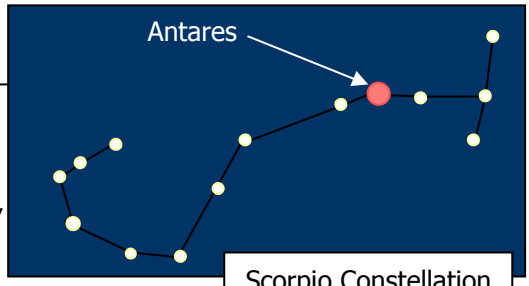
For example, the average distance of Saturn from the sun is 1.43×10^9 km.

1.43 x 10^9 = 1.43 x 1 000 000 000 = **1 430 000 000** km

Can you undo all the standard form in this article?

Rewrite the article with all the numbers in bold type written out in full.

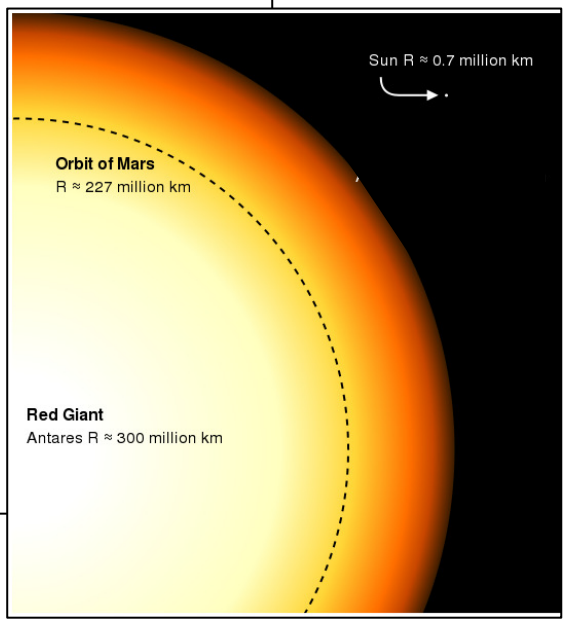
The brightest star in the Scorpio constellation is a red supergiant star called Antares. Even though Antares and our solar system are both in the Milky Way galaxy, Antares is **4.94×10^{15}** km away from the Earth. Astronomers estimate that Antares is just one of roughly **2.5×10^{11}** stars in the Milky Way.



Scorpio Constellation

The radius of Antares is **3.0×10^8** km – that's wider than the orbit of Mars and roughly 430 times larger the Sun's radius. Have a look at the scaled picture to see how they compare. At this scale, the Earth is too small to see because its radius is 109 times smaller than the sun's radius. **1.3×10^6** Earths would occupy the same volume as the Sun!

In about **5×10^9** years the Sun will become a red giant star and its radius will be at least **1.4×10^8** km. That's 200 times the length it is now and big enough to swallow up the inner planets – Mercury, Venus, Earth and Mars.



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Core worksheet

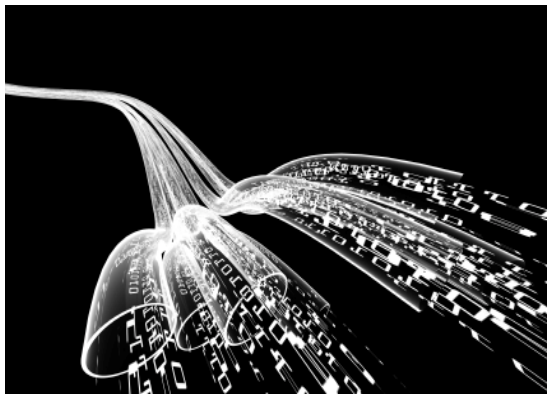
Calculations using standard form

What is $(1.5 \times 10^6) \times (4 \times 10^8)$?

Multiply the first part of each number together: **1.5×4**.

Then multiply the second part of each number together: **$10^6 \times 10^8$**. This is 10 multiplied by itself 6 and then 8 times, 14 times altogether, so **$10^6 \times 10^8 = 10^{14}$**.

So the answer is **$1.5 \times 4 \times 10^6 \times 10^8 = 6 \times 10^{6+8}$**
$= 6 \times 10^{14}$



1. What is $(5 \times 10^7) \times (4.2 \times 10^3)$? Express your answer in standard form.

The Milky Way is the galaxy of stars that we live in. It is approximately 6.76×10^{11} times longer than the diameter of the sun. The sun's diameter is 1.4×10^6 km.

Because distances in space are so much greater than distances on earth, astronomers have created special units to use in their measurements. One of these units is called a **light year**, which is the distance that light travels in a year. For measuring really massive distances, astronomers use another unit, called a **megaparsec**.

One light year is 9.46×10^{15}m and there are 3.26×10^6 light years in one megaparsec.

Read the text box and answer these questions:

2. What is the length of the Milky Way? Express your answer in standard form.

3. How many metres are there in a megaparsec? Express your answer in standard form.

We can divide two numbers in standard form by applying division to the first parts and to the second parts separately, then multiplying the results

$(9 \times 10^{10}) \div (5 \times 10^7) = (9 \div 5) \times (10^{10} \div 10^7) = 1.8 \times 10^3$

Try writing these numbers out in full to see why this works.

4. What is $(2.1 \times 10^{15}) \div (8.4 \times 10^8)$? Express your answer in standard form.

5. The brightest star in the night sky is Sirius and it is 8.14×10^{16} m from the earth. How many light years away is Sirius?

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Advanced worksheet

Addition and subtraction

What is **$(2.5 \times 10^4) + (7 \times 10^6)$** ?

You could do this by turning both back into normal numbers, adding them and then putting the answer in standard form. Or you could try **factorising** the numbers as shown below.

$(2.5 \times 10^4) + (7 \times 10^6) = (2.5 \times 10^4) + (7 \times 10^2 \times 10^4)$

$= (2.5 + [7 \times 10^2])$ **$\times 10^4$**

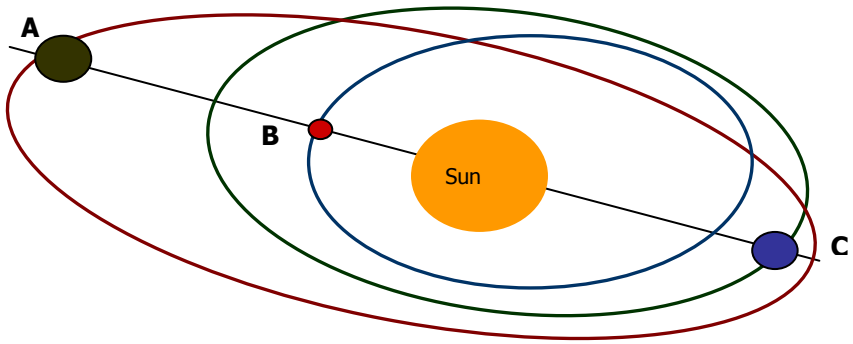
$= (2.5 + 700)$ **$\times 10^4$**

$= 702.5 \times 10^4$

You can use the same method for subtraction.

1. (a) Write 702.5×10^4 in standard form.
(b) What is $(8.1 \times 10^9) - (5.6 \times 10^5)$?
(c) What is $(6.8 \times 10^{11}) - (4 \times 10^{10})$?

For a short period of time, 3 planets and the sun they orbit all lie on the same straight line:



The distance from the centre of planet B to centre of the sun is 5.76×10^6km
The distance from the centre of planet B to the centre of planet C is 2.33×10^8km
The distance from the centre of planet A to the centre of planet C is 3.107×10^9km

2. Use this information to find:

The distance of planet A from the sun.
The distance of planet C from the sun.
The distance between planet A and planet B.