Small numbers

Everything in our world is constructed from very small atoms, which are too small to be seen. For example on each full stop we can put 100 miliard of atoms! Some things in our world stay the same for millions of years and others change in a millionth of a second!

The size of atoms using negative powers

Mathematicians have found a clever way to write very very small numbers using negative powers of ten. 1 nanosecond = 1 miliard part of a second = 0, 000 000 001 s = $\frac{1}{1\,000\,000\,000}$ s = $\frac{1}{10^9}$ s .

The number $\frac{1}{10^9}$ we write as 10^{-9}.

An astronomer has a reflex time of 0,25 s. We can write this in another way:

$0{,}25 = \frac{1}{4} = \frac{1}{4^1} = 4^{-1}$, or $0{,}25 = \frac{1}{4} = \frac{1}{2^2} = 2^{-2}$.

This explains what we mean by a base number to a negative power n where n is a natural number:

$$a^{-n} = \frac{1}{a^n}, \quad a \neq 0$$

$$a^{-1} = \frac{1}{a}, \quad a \neq 0$$

1. Do the same for 0,0001km, 0,000001kg, 0,125mm.
2. Calculate and write the result as a fraction:

   4^{-1}, 4^{-2}, $(-4)^{-1}$, $(-4)^{-2}$, $(1/4)^{-1}$, $(-1/4)^{-2}$, $\left(\frac{2}{3}\right)^{-1}$, $\left(\frac{2}{7}\right)^{-2}$, $(0{,}1)^{-3}$, $(-0{,}01)^{-2}$.

3. Which of the following are correct?

   a) $\frac{1}{10000} = 10^{-4}$,
   c) $\frac{1}{100^2} = 100^{-2}$
   e) $\frac{1}{10^{-4}} = 10^4$.
   b) $\frac{1}{100^2} = 10^{-4}$
   d) $\frac{1}{10^{-3}} = 10^{-3}$

4. Write the following as decimal numbers:

   a) $2500 \cdot 10^{-2}$
   b) $2{,}5 \cdot 10^{-3}$
   c) $\frac{2}{5} \cdot 10^{-5}$
   d) $1{,}01 \cdot 10^{-1} + 1{,}1 \cdot 10^{-2}$
   e) $3{,}5 \cdot 10^{-4} \cdot 10^3$
   f) $5 \cdot 10^{-3} : 10^2$

5. The total mass of all the asteroids in the solar system is not bigger than 1/1000 the mass of the earth. Write this fraction as a power and calculate the total mass of all the asteroids if the mass of the earth is $6 \cdot 10^{21}$ ton.