

# Exponent arithmetic

Starting points, what the symbols mean:

$$y^2 = y \cdot y \qquad y^3 = y \cdot y \cdot y \qquad z^{-1} = \frac{1}{z}$$

Fractional exponents are a way to represent roots:

If  $w^2 = s$ , then  $w = s^{1/2}$  That is, a  $1/2$  exponent is another way to write square root.

The nice thing about exponents is that you can do many calculations without using your calculator, and in science we express many quantities as powers of ten.

In multiplication, add exponents when the same number (in the case shown, 10) is raised to a power:

$$(a \times 10^m) \cdot (b \times 10^p) = a \cdot b \times 10^{(m+p)}$$

In division, subtract exponents when the same number (in the case shown, 10) is raised to a power:

$$(c \times 10^r) \div (d \times 10^t) = (c \div d) \times 10^{(r-t)}$$

When raising to a power, multiply. When taking a root, divide as shown below:

$$(f \times 10^v)^n = f^n \times 10^{(v \times n)} \qquad (g \times 10^h)^{1/q} = g^{1/q} \times 10^{(h/q)}$$

## Problems for practice:

I have intentionally set up the following problems so you could solve them without a calculator if you apply the rules above. Please try solving these in your head or use a piece of paper. If you use a calculator, you are defeating the purpose of the exercise.

1.  $(6.022 \times 10^{23}) \cdot (2.0 \times 10^6) =$
2.  $1.50 \times 10^{-7} \cdot (3.00 \times 10^{10}) =$
3.  $(7.5 \times 10^{-3}) \div (2.5 \times 10^6) =$
4.  $(4.39 \times 10^{-6}) \div (1.0 \times 10^{-12}) =$
5.  $0.25^{-1} =$
6.  $9^{1/2} =$
7.  $(2.2 \times 10^5)^2 =$
8.  $(1.00 \times 10^3)^5 =$
9.  $(25 \times 10^6)^{1/2} =$
10.  $(27 \times 10^{12})^{1/3} =$