

# Exponents and roots

Study guide · Math tricks

## Exponents and roots

| Rule                                                                                       | Example                               |
|--------------------------------------------------------------------------------------------|---------------------------------------|
| Multiply the same base: add the exponents. $a^m \cdot a^n = a^{m+n}$                       | $x^3 \cdot x^4 = x^7$                 |
| Divide the same base: subtract them. $a^m \div a^n = a^{m-n}$                              | $y^8 \div y^3 = y^5$                  |
| A power of a power: multiply them. $(a^m)^n = a^{mn}$                                      | $(2^3)^2 = 2^6 = 64$                  |
| Anything (except 0) to the 0 is 1.                                                         | $7^0 = 1$                             |
| A negative exponent flips it under 1. $a^{-n} = \frac{1}{a^n}$                             | $5^{-2} = \frac{1}{25}$               |
| A fraction exponent is a root. $a^{1/n}$ is the nth root; $a^{m/n}$ is that root to the m. | $8^{2/3} = (\sqrt[3]{8})^2 = 2^2 = 4$ |
| A negative base: an even power is positive, an odd power negative. Watch the parentheses.  | $(-3)^2 = 9$ , but $-3^2 = -9$        |

### Simplifying a square root

Pull out the biggest perfect square that divides it:  $\sqrt{72} = \sqrt{36 \times 2} = 6\sqrt{2}$ . Roots multiply and divide freely,  $\sqrt{a} \cdot \sqrt{b} = \sqrt{ab}$ , but they do not add:  $\sqrt{9} + \sqrt{16} = 7$ , while  $\sqrt{25} = 5$ .

### Estimating a root

Find the squares on either side:  $\sqrt{50}$  is between  $\sqrt{49} = 7$  and  $\sqrt{64} = 8$ , and much closer to 7 (it is about 7.07).

### Scientific notation

Move the decimal point until one digit is left in front, and count the moves:  $45,000 = 4.5 \times 10^4$ , and  $0.0032 = 3.2 \times 10^{-3}$ . To multiply, multiply the fronts and add the exponents.