

# Properties of Exponents

## What are Exponents?

Consider the expression  $a^n$ .  $a$  is called the *base*, and it can be any real number.  $n$  is called the *exponent*. When  $n$  is an integer greater than one,

$$a^n = \underbrace{a \cdot a \cdot \dots \cdot a}_{n \text{ factors}}$$

In other words,  $a^n$  is the product of  $n$  factors, each of which is  $a$ .

## Useful Facts

The following are useful in manipulating expressions involving exponents:

For any real number  $a$ ,  $a^1 = a$

For any nonzero real number  $a$  and  $b$  and any rational numbers  $m$  and  $n$ ,  $p$  and  $q$  any integers  $q \neq 0$

$$a^0 = 1$$

$$a^m \cdot a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{m \cdot n}$$

$$(a \cdot b)^n = a^n \cdot b^n$$

$$\frac{a^{-n}}{b^{-n}} = \frac{a^n}{b^n}$$

$$a^{-n} = \frac{1}{a^n} = \frac{1}{a}^n$$

$$a^{\frac{p}{q}} = \sqrt[q]{a^p} = (\sqrt[q]{a})^p$$

When simplifying expressions with exponents, order of operation still holds. Simplify inside the brackets first.

If you have to simplify an expression with exponents and radicals, it is often easier to convert radicals to exponential form, simplify and look at the question instructions to determine what form your answer should be in (radicals and exponents, just exponents, positive exponents only).