

## Laws of Exponents

For any real number  $a$  and natural number  $n$ , we can write  $a$  taken as a factor  $n$  times as  $a^n$ .

1.  $a^n = a \times a \times a \times \dots \times a$  ( $n$  times) ( $a \in \mathbb{R}, n \in \mathbb{N}$ )
2.  $a^0 = 1$  ( $a \neq 0$  because  $0^0$  is undefined)
3.  $a^{-n} = \frac{1}{a^n}$  ( $a \neq 0$  because  $\frac{1}{0}$  is undefined)

### Examples:

$$3 \times 3 = 3^2$$

$$5 \times 5 \times 5 \times 5 = 5^4$$

$$p \times p \times p = p^3$$

$$(3^x)^0 = 1$$

$$2^{-4} = \frac{1}{2^4} = \frac{1}{16}$$

$$\frac{1}{5^{-x}} = 5^x$$

$$4. a^m \times a^n = a^{m+n}$$

$$5. \frac{a^m}{a^n} = a^{m-n}$$

$$6. (ab)^n = a^n b^n$$

$$7. \left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$8. (a^m)^n = a^{mn}$$

where  $a > 0$ ,  $b > 0$  and  $m, n \in \mathbb{Z}$ .