VIDYA BHAWAN, BALIKA VIDYAPITH
Shakti Utthan Ashram, Lakhisarai-811311(Bihar)
(Affiliated to CBSE up to +2 Level)

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Exponents and Powers

Exponent: If p is a rational number and have a non-zero value, m is a natural number, then, p × p × p × p ×…..× p(m times) is written as p^m, where p is the base number and m is the exponent value and p^m is the power and 'p^m' is said as 'p – raised to the power m'. This is the general representation of exponents and powers.

Example: 9 × 9 × 9 × 9 × 9 × 9 × 9 = 9^7, where 9 is the base number and 7 is the exponent.

The numbers with negative exponents also obey the following laws:

Rules for Integral Exponents

1. $a^{-n} = \frac{1}{n}$ *Defination of negative exponant*
2. $\frac{1}{a} = a^{-1}$ *and* $\frac{1}{a^{-n}} = a^n$ Negative exponent rule
3. $a^0 = 1$ Definition of Zero exponent
4. $a^m \times a^n = a^{m+n}$ Product Rule
5. $a^m \div a^n = a^{m-n}$ Quotient Rule
6. $(a^m)^n = a^{mn}$ Power of power Rule
7. $(a \times b)^m = a^m x\ b^m$ Power of Product Rule
8. $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ Power of Quotient Rule

(a) $x^m \times x^n = x^{m+n}$

(b) $x^m \div x^n = x^{m-n}$

(c) $x^m \times b^m = (xb)^m$

(d) $x^0 = 1$

(e) $\frac{x^m}{y^m} = \left(\frac{x}{y}\right)^m$

(f) $\left(\frac{x}{y}\right)^n = \left(\frac{y}{x}\right)^{-n}$

(g) $\frac{1}{x} = x^{-1}$

(h) $x^p \times x^q \times x^r \times x^s = x^{p+q+r+s}$

(i) $[(x^m)^n = x^{mn}]$

(i) $a^m \times a^n = a^{m+n}$

(ii) $\frac{a^m}{a^n} = a^{m-n}$

(iii) $(a^m)^n = a^{mn}$

(iv) $a^m \times b^m = (ab)^m$

(v) $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$

(vi) $a^0 = 1$

(vii) $\left(\frac{a^{-m}}{b^{-n}}\right) = \frac{b^n}{a^m}$

(viii) $\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^m$

Laws of Exponents

If a, b are non-zero integers and m, n are any integers, then

Remember

- $a^n = 1 \Rightarrow n = 0$
- $1^n = 1$ where n is any integer.
- $(-1)^n = 1$ where n is any even integer.
- $(-1)^n = -1$ where n is any odd integer.
- **Powers With Negative Exponents**

  If a is any non-zero integer and m is a positive integer, then

  $a^{-m}=1/a^m$

  Note: a^{-m} is called the multiplicative inverse of am as $a^{-m} \times a^m = 1$.

  It is obvious that am and a-m are multiplicative inverses of each other.