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(Affiliated to CBSE up to +2 Level)

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Powers with Negative Exponents

For any non-zero integer x, $x^{-n} = 1/x^n$, where n is a positive integer and x^{-n} is the multiplicative inverse

of x^n.

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

Problem: Evaluate:

(i) 3^{-2}

(ii) $(-4)^{-2}$

(iii) $(1/2)^{-5}$

Solution:

(i) $3^{-2} = 1/3^2 = 1/9$ $[a^{-m} = 1/ a^m]$

(ii) $(-4)^{-2} = 1/4^2 = 1/16$ $[a^{-m} = 1/ a^m]$

(iii) $(1/2)^{-5} = (2/1)^5 = 2^5 = 32$ $[a^{-m} = 1/ a^m]$

Laws of Exponents

Numbers with negative exponents obey the following laws of exponents.

(a) $a^m * a^n = a^{m+n}$

(b) $a^m / a^n = a^{m-n}$

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

(d) $a^m * b^m = (ab)^m$

(e) $a^0 = 1$

(f) $a^m / b^m = (a/b)^m$

(g) $(a/b)^{-m} = (b/a)^m$

Here, a and b are any non-zero integers and m and n are natural numbers.

Problem: Simplify and express the result in power notation with positive exponent:

(i) $(-4)^5 \div (-4)^8$

(ii) $(1/2^3)^2$

(iii) $(-3)^4 * (5/3)^4$

(iv) $(3^{-7} * 3^{-10}) * 3^5$

(v) $2^{-3} * (-7)^3$

Solution:

(i) $(-4)^5 \div (-4)^8 = (-4)^{5-8}$ $[a^m \div a^n = a^{m-n}]$

$= (-4)^{-3}$

$= 1/(-4)^3$ $[a^{-m} = 1/ a^m]$

$= -1/64$

(ii) $(1/2^3)^2 = 1^2/(2^3)^2$ $[(a/b)^m = a^m/b^m]$

$= 1/ 2^{3*2}$ $[(a^m)^n = a^{m*n}]$

$= 1/2^6$

$= 1/64$

(iii) $(-3)^4 * (5/3)^4 = (-3)^4 * (5^4/3^4)$ $[(a/b)^m = a^m/b^m]$

$= (3)^4 * (5^4/3^4)$ $[(-a)^m = a^m$ when m is an even number$]$

$= (3)^{4-4} * 5^4$

$= 5^4$

(iv) $(3^{-7} * 3^{-10}) * 3^5 = 3^{-7-10+5}$ $[a^m * a^n = a^{m+n}]$

$= 3^{-17+5}$

$= 3^{-12}$

$= 1/3^{12}$ $[a^{-m} = 1/ a^m]$

(v) $2^{-3} * (-7)^{-3} = 1/2^3 * 1/(-7)^{-3}$ $[a^{-m} = 1/ a^m]$

$= 1/\{(-7)^3 * 2^3\}$

$= 1/(-7 * 2)^3$ $[a^m * b^m = (a * b)^m]$

$= 1/(-14)^3$

$= -1/(14)^3$ $[(-a)^m = -a^m$ when m is an odd number$]$