12.Exponents and powers
Module-2/3
Presented
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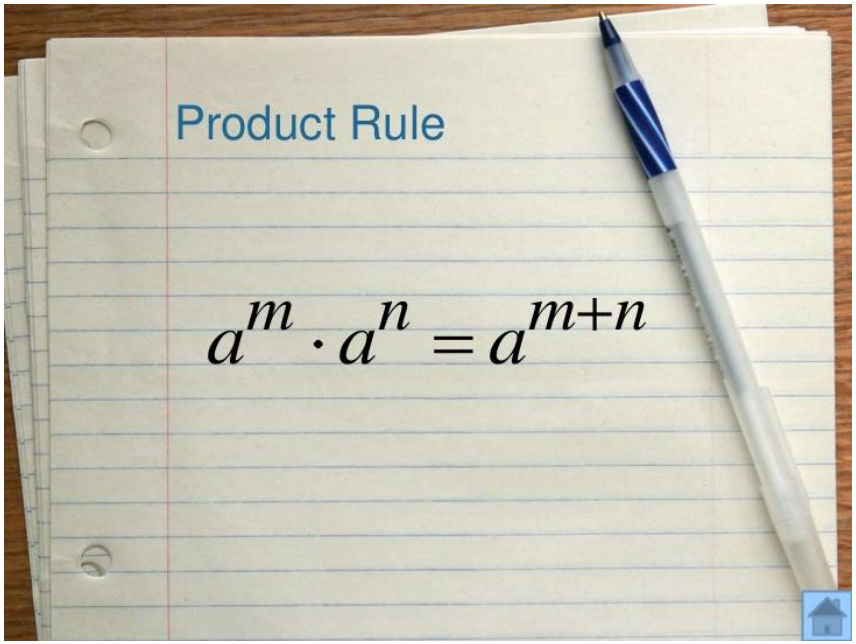
Product of powers law



- The product law can be applied when the exponentials have same base, the powers will be added with same base

VALIDATION FOR NEGATIVE POWERS

Let us verify the first law for negative exponents

1. For any non-zero integer a,

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

where m,n are intgers $3^{-4} = \frac{1}{3^4}$, $3^{-5} = \frac{1}{3^5}$

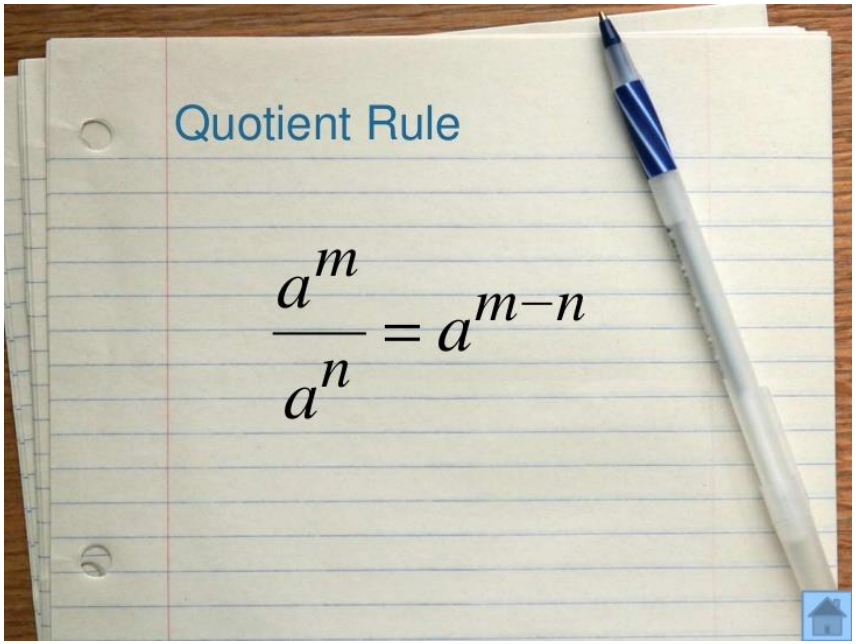
$* 3^{-4} \times 3^{-5} = \frac{1}{3^4} \times \frac{1}{3^5} = \frac{1}{3^4 x 3^5} = \frac{1}{3^9} = 3^{-9}$

Therefore the law holds for negative powers also

let us verify for other example $(-5)^{-4} = \frac{1}{(-5)^4}$, $(-5)^{-6} = \frac{1}{(-5)^6}$

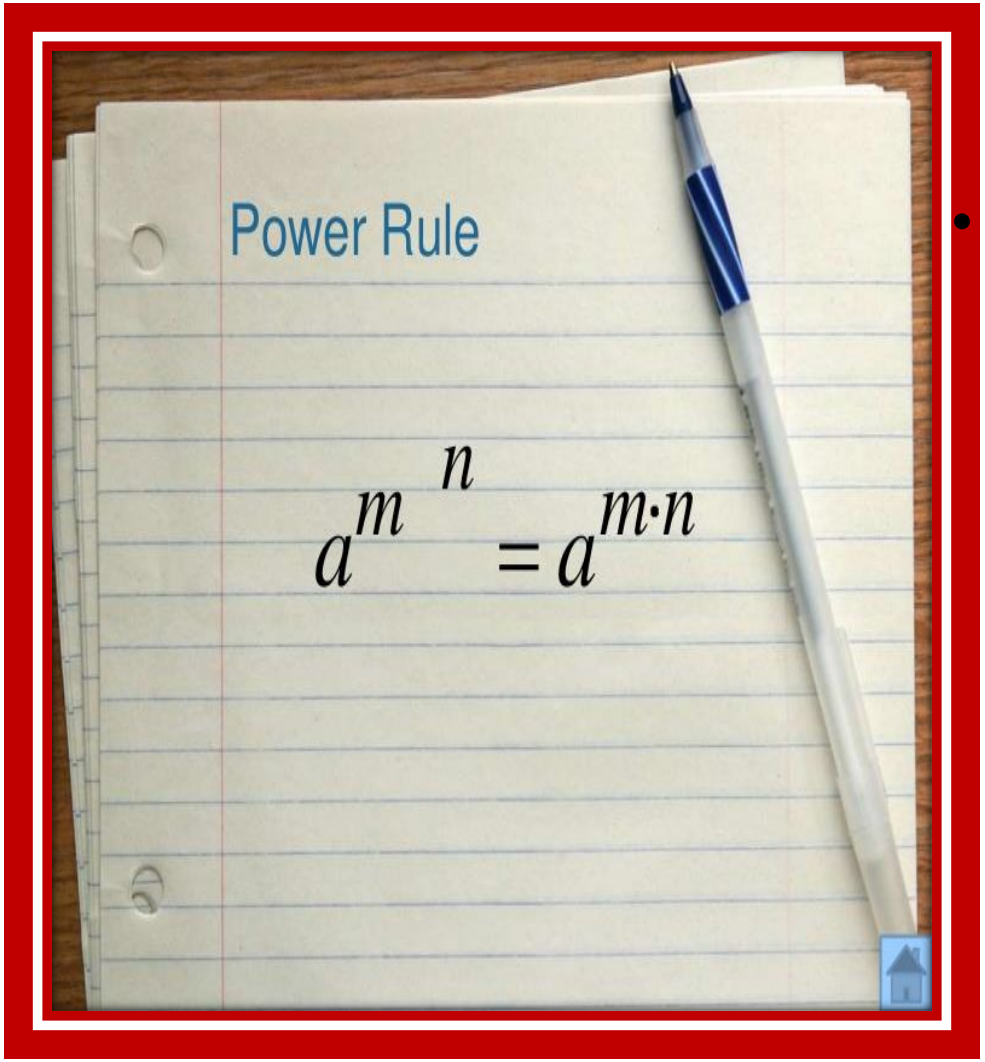
$* (-5)^{-4} \times (-5)^{-6} = \frac{1}{(-5)^4} \times \frac{1}{(-5)^6} = \frac{1}{(-5)^4 x (-5)^6} = \frac{1}{(-5)^{10}} = (-5)^{-10}$

QUOTIENT POWER LAW



- Exponential form of a number is divided by other exponential form of number with same base, then quotient is difference of powers with same base

POWER OF POWER LAW



- the exponential form of exponent, then the result is product of powers with same base

POWER OF POWER

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

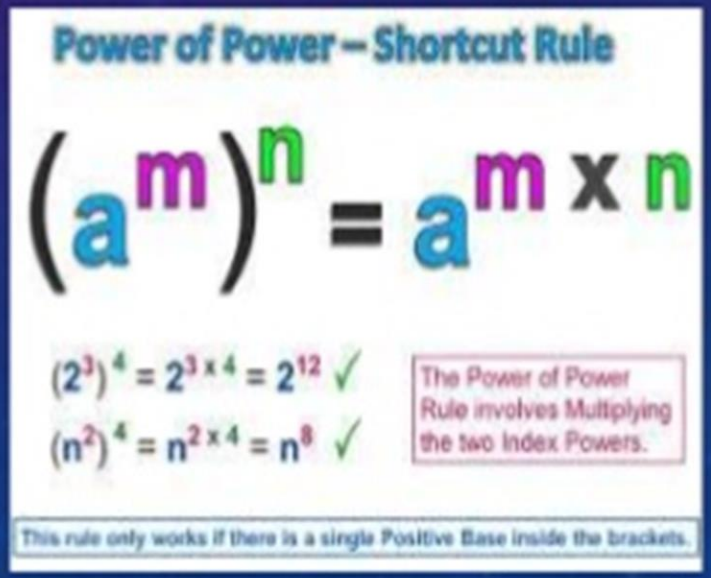
(when taking a monomial to a power, multiply the powers including the coefficient)

EXAMPLES

1) $(a^4 b^3)^2 = a^8 b^6$

2) $(3m^2 n^5)^4 = 3^4 m^8 n^{20} = 81m^8 n^{20}$

3) $(-2xy^7 z^2)^5 = (-2)^5 x^5 y^{35} z^{10} = -32x^5 y^{35} z^{10}$



POWERS WITH DIFFERENT BASE

Lesson 1: Laws of Exponents

Powers with different bases

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

Lesson 1: Laws of Exponents

Powers with different bases

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

Dividing different bases can't be simplified unless the exponents are equal.

negative POWERS

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

"Negative Exponents"

Properties of Exponents

Lesson 1: Laws of Exponents

Negative exponents

$$a^{-n} = \left(\frac{1}{a}\right)^{n}$$

A nonzero base raised to a negative exponent is equal to the reciprocal of the base raised to the positive exponent.

$$\frac{(27)^{-1} \times 5^3}{3^{-4}}$$

(*ii*) $(5^{-1} \times 3^{-1}) \times 8^{-1}$

$$\left\{\left(\frac{1}{3}\right)^{-1} - \left(\frac{1}{5}\right)^{-1}\right\}^{-1}$$

$(4^{-1} \times 3^{-1})^{-1} \div 5^{-1}$

$$\left\{\left(\frac{1}{3}\right)^{-2} - \left(\frac{1}{2}\right)^{-3}\right\} \div \left(\frac{1}{4}\right)^{-2}$$

Solutions of above problems

1. $(27)^{-1}$ can be converted exponential form is 3^{-3}

$$\frac{3^{-3}}{3^{-4}} \times 5^3 = \frac{3^{-3}}{3^{-4}} \times 5^3 = 3^{-3+4} \times 5^3 = 3^1 \times 5^3 = 3 \times 5^3$$

2) $(5^{-1} \times 3^{-1}) \times 8^{-1}$

$$(\frac{1}{5} \times \frac{1}{3}) \times \frac{1}{8} = \frac{1}{15} \times \frac{1}{8} = \frac{1}{120}$$

3) $(\frac{1}{3})^{-1} = 3 \qquad (\frac{1}{5})^{-1} = 5$

$$(3-5)^{-1} = (-2)^{-1} = \frac{1}{-2}$$

4) $(4^{-1} \times 3^{-1})^{-1} \div 5^{-1}$

$$((4 \times 3)^{-1})^{-1} = 12$$

$$12 \div \frac{1}{5} = 12 \times 5 = 60$$

5) $(\frac{1}{3})^{-2} - (\frac{1}{2})^{-3} \div (\frac{1}{4})^{-2} = (3^2 - 2^3) \div 4^2$

$$(9-8) \div 16 = 1 \div 4^2 = \frac{1}{16}$$

$a^n = 1$ for $n = 0$

$a^n = 1$ for $n = 0$, This will work for any a except a = 1 or a = -1

for a=1 ,$1^2 = 1^3 = 1^4 = 1^5$ ..... = 1

for a = -1, $(-1)^2 = (-1)^4 = (-1)^6 = (-1)^8 = (-1)^{10}$ = ... $(-1)^p = 1$

Where p is even number

$$\left(\frac{27}{125}\right)^{-\frac{2}{3}} \div \left(\frac{27}{125}\right)^{-\frac{4}{3}}$$

$$\left(\frac{125}{27}\right)^{\frac{2}{3}} \div \left(\frac{125}{27}\right)^{\frac{4}{3}}$$

$$\left(\frac{5^3}{3^3}\right)^{\frac{2}{3}} \div \left(\frac{5^3}{3^3}\right)^{\frac{4}{3}}$$

$$\left(\frac{5}{3}\right)^{3\times\frac{2}{3}} \div \left(\frac{5}{3}\right)^{3\times\frac{4}{3}}$$

$$\left(\frac{5}{3}\right)^{2} \div \left(\frac{5}{3}\right)^{4} = \left(\frac{5}{3}\right)^{2-4}$$

$$= \left(\frac{5}{3}\right)^{-2} = \left(\frac{3}{5}\right)^{2} = \frac{9}{25}$$

“Thank You”