

Elementary Algebra

Skill-Builder # E – 8

Applying Combined Exponent Rules

We have the following exponent rules for any nonzero real numbers a and b , and positive integers m and n ,

Product Rule:	$a^m \cdot a^n = a^{m+n}$
Power Rule:	$(a^m)^n = a^{mn}$
Distributivity of Exponentiation over Multiplication:	$(ab)^n = a^n b^n$
Quotient Rule:	$\frac{a^m}{a^n} = a^{m-n}$
Zero Exponent Rule:	$a^0 = 1$
Negative Exponent Rule:	$a^{-n} = \left(\frac{1}{a}\right)^n = \frac{1}{a^n}$
Distributivity of Exponentiation over Division:	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Examples

1. Simplify: $\left(\frac{2a^{-1}b}{5a^2b^0c^{-1}}\right)^2$

Solution: We could simplify the expression inside the quantity first or we can distribute the exponent 2 first using the two distributive properties. Let us do the latter to get

$$\left(\frac{2a^{-1}b}{5a^2b^0c^{-1}}\right)^2 = \frac{2^2 a^{-2} b^2}{5^2 a^4 b^0 c^{-2}}.$$

Next, we can use the zero and negative exponent rules as well as evaluate 2^2 and 5^2 to get $\frac{4b^2c^2}{25a^4a^2}$.

Then, we can apply the product rule to get the final answer of $\frac{4b^2c^2}{25a^6}$.

2. Simplify: $\frac{3x^3(-2x^{-1}y^4)^{-3}}{(-3x^2y^{-4})^2}$

Solution: We first apply the distributivity of exponentiation over multiplication to get

$$\frac{3x^3(-2x^{-1}y^4)^{-3}}{(-3x^2y^{-4})^2} = \frac{3x^3(-2)^{-3}x^3y^{-12}}{(-3)^2x^4y^{-8}}.$$

Then apply the negative exponent rule to get $\frac{3x^3x^3y^8}{(-3)^2(-2)^3x^4y^{12}}$. Now apply the product and quotient

rules and evaluate the numeric expressions to get $\frac{3x^6y^{-4}}{-72x^4}$ and further simplify to get $-\frac{x^2}{24y^4}$.

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Simplify the following using the exponent rules.

1. $\frac{4^0 x^{-3} y^5}{4xy^{-1}}$

2. $(3^{-1} a^0 b^5 c^{-3})^{-4}$

3. $\left(\frac{2x^3 y^{-2}}{3^0 x^{-3} y^{-1}}\right)^{-3}$

4. $\frac{(5y)^{-1} (-3y^{-2})^{-1}}{5y^0 (3y)^{-2}}$

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Answer Key:

1. $\frac{y^6}{4x^4}$

2. $\frac{81c^{12}}{b^{20}}$

3. $\frac{y^3}{8x^{18}}$

4. $-\frac{3y^3}{25}$

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