

Elementary Algebra

Skill-BUILDER # E – 1

Applying the Product Rule for Exponents

The following rule applies when multiplying exponential expressions with the same base.

For any nonzero real number a and positive integers m and n ,

$$a^m \cdot a^n = a^{m+n}.$$

The rule says that to multiply exponential expressions with the same base a , keep the base a and add the exponents.

Examples

1. Simplify: $2 \cdot 2^3$

Solution: The common base is 2 and the exponents are 1 and 3 for the first and second factors, respectively, so the product will have 2 for its base and the exponent will be $1+3=4$. Thus,

$$2 \cdot 2^3 = 2^{1+3} = 2^4 = 16.$$

2. Simplify: $x^2 \cdot x^4 \cdot x$

Solution: The common base is x and the exponents are 2, 4, and 1 for the first, second, and third factors, respectively, so the product will have x for its base and the exponent $2+4+1=7$. Thus,

$$x^2 \cdot x^4 \cdot x = x^{2+4+1} = x^7.$$

3. Simplify: $(a^5b)(a^2b^4)$

Solution: We essentially have four factors with two bases a and b . We apply the associative and commutative properties for multiplication to group the factors that have the same base before applying the product rule. Thus,

$$(a^5b)(a^2b^4) = (a^5a^2)(bb^4) = a^{5+2}b^{1+4} = a^7b^5.$$

4. Simplify: $2x(3x^4y^3z)(-4x^2yz^3)$

Solution: We again need to apply the associative and commutative properties of multiplication to group factors with the same base together and to group the numerical coefficients together. Then apply the product rule. Thus,

$$2x(3x^4y^3z)(-4x^2yz^3) = (2 \cdot 3 \cdot (-4))(x \cdot x^4 \cdot x^2)(y^3 \cdot y)(z \cdot z^3) = -24x^7y^4z^4.$$

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Simplify the following using the product rule for exponents. Apply the commutative and associative properties first when necessary.

1. $3^2 \cdot 3^3$

2. $2^2 \cdot 3 \cdot 2 \cdot 3^2$

3. $a^5 \cdot a^2 \cdot a^3$

4. $x(x^2)(-4x^3)(-2x^6)$

5. $(a^2b^4)(a^3b^5)$

6. $(2np^2)(-n^3p)(3n^2)(5p^4)$

7. $(a^3bc^6)(2^3ab^4c)(2a^3bc)$

8. $-2y^4(y^5z^3)(-3z^4t^7)(-t^8w^6)w^9$

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Answer Key:

1. 3^5 or 243

2. $2^3 \cdot 3^3$ or 216

3. a^{10}

4. $8x^{12}$

5. a^5b^9

6. $-30n^6p^7$

7. $16a^7b^6c^8$

8. $-6y^9z^7t^{15}w^{15}$

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