Math 9 – Unit 2: Algebra One

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Lesson #4: More Distributive Property and Powers of Monomials

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Learning Goal: We are learning to expand and simplify more complicated expressions.

Let's start off by continuing our lesson on the Distributive Property. Take a look at the following questions:

Expand AND simplify (put your answers in descending order):

a) $3x(4x^2-7x+2)+4x^2(2x-3)$

$= 12x^3 - 21x^2 + 6x + 8x^3 - 12x^2$

$= 20x^3 - 33x^2 + 6x$

b) $-4y^2(3y^2-5)-5y^3(6+y)$

$= -12y^4 + 20y^2 - 30y^3 - 5y^4$

$= -17y^4 - 30y^3 + 20y^2$

c) $3mn(2m-7n)-5m^2(4n+8)+6n^2(3m-n)$

$= 6m^2n - 21mn^2 - 20m^2n - 40n^2 + 18mn^2 - 6n^3$

$= -14m^2n - 3mn^2 - 40n^2 - 6n^3$

Now we are going to go back to discussing monomials. How do we simplify $(3x^2y^5)^3$? This is called a monomial raised to a power. How does the outside exponent affect the question? First, how does it work with just a number?

Simplify $(4^3)^2$ $= (4^3) \times (4^3)$

$= (4\times4\times4) \times (4\times4\times4) = 4^{6}$

The initial exponents were *3* and *2*, with the final exponent a 6. So, 3 x 2 = 6! This leads to our second exponent law. When raising a power to a power, multiply the exponents. Try it out!

a) $(x^4)^5$ $= x^{20}$

b) $(y^2)^8$ $= y^{16}$

c) $(m^3n^6)^4$ $= m^{12}n^{24}$

That's all well and good (hopefully), but how do you handle a question with a coefficient?

Consider the expression from before, $(3x^2y^5)^3$. Expand it without using the laws.

$= (3x^2y^5)\times(3x^2y^5)\times(3x^2y^5)$

$= 3^3x^6y^{15} = 27x^6y^{15}$

The coefficient was just raised to the power of 3! Awesome. Try out some more, this time following the laws.

a) $(2x^4y^2)^5$

$= (2)^5(x^4)^5(y^2)^5$

$= 32x^{20}y^{10}$

b) $(-3m^7n^2)^2$

$= 9m^{14}n^2$

c) $(5a^2b^3c^4d^5)^6$

multiply all exponents by 5^6

$= 15625a^{12}b^{18}c^{24}d^{30}$

First, deal with the outside exponents

d) $\left(3x^2y^5\right)^2\left(2xy^3\right)$

$= (9x^4y^{10})(2x^1y^3)$

$= 18x^5y^{13}$

e) $\left(-4m^3n^2\right)^3\left(3m^4n^3\right)^2$

→ coefficient to the power of the exponent
→ multiply exponents

$=(-64m^9n^6)(9m^8n^6)$

→ add exponents
→ multiply exponents

$=-576m^{17}n^{12}$

f) $\left(5x^2y^4z^6\right)^0$ *Whoah!! Exponent of zero? How does that work?*

There are multiple explanations. We will look at a pattern, starting with 4^1 then moving up the ladder.

$4^4 = 256$ ×4
$4^3 = 64$ ×4
$4^2 = 16$ ×4
$4^1 = 4$ ÷4
$4^0 = 1$ ÷4
$4^{-1} = \frac{1}{4}$ ÷4

As you move up the ladder, you keep multiplying by 4. If you were to go down the ladder, you would _divide_ by 4. Follow the pattern to determine what four to the power of zero is.

This leads to another exponent law: Anything to the power of zero is equal to _____.

$4^{-2} = \frac{1}{16} = \frac{1}{4^2}$

$4^{-4} = \frac{1}{4^4} = \frac{1}{256}$ (reciprocal)

$\left(5x^2y^4z^6\right)^0 =$

$= 5^0(x^2)^0(y^4)^0(z^6)^0$

$= 1x^0y^0z^0$

$= 1$

$(3x^0y^2)^3 = 27y^6$

Success Criteria:

- I can use the distributive property to multiply a polynomial with a monomial
- I can use the distributive property to combine multiple variables into a single term
- I can simplify a monomial raised to a power by multiplying the exponents of each variable
- I can recognize that when a coefficient is raised to a power, it is NOT NOT NOT multiplied
- I can understand that raising to the power of zero equals one.