We use this expression to describe how to multiply two binomials.
This is VERY similar to the method of DISTRIBUTION.

Example: $(x + 3)(x + 6)$

F _____ : $x \bullet x =$ (multiply the first two terms in the parentheses)
O _____ : $x \bullet 6 =$ (multiply the two outer terms)
I _____ : $3 \bullet x =$ (multiply the two inner terms)
L _____ : $3 \bullet 6 =$ (multiply the two last terms in the parentheses)

After this is complete, simplify, by combining like terms together to make a polynomial:
$x^2 + 6x + 3x + 18 \quad =$

Practice:

1. $(x + 2)(x + 3)$
2. $(x + 5)(3x - 4)$
3. $(x - 4)(x - 2)$
4. $(x - 6)(x + 5)$
5. $(x + y)(x - y)$
6. $(2x - 3y)(4x + 5y)$

MORE WORK WITH MULTIPLYING A POLYNOMIAL BY A POLYNOMIAL

When squaring terms in parentheses you must square the ENTIRE term, which means that you must write it TWICE!!!

Then use FOIL to complete the problem!

$(2x + 3)^2 \quad = \quad (2x + 3)(2x + 3) \quad = \qquad\qquad =$

Practice:

1. $(a + b)^2$
2. $(3x - 2)^2$
3. $(y + 2)^3$

MULTIPLYING A BINOMIAL AND TRINOMIALS

Given: $(c^2 + 2)(c + c^2 - 3)$

Can we use FOIL to simplify this expression? How about PLASTIC?

What should you do?

This is a form of the__________________________________.

- We multiply the first term by each term in the second set of ( ).
- Then multiply the 2nd term by each term in the second set of ( ).
- After you are finished distributing, combine all like terms and write the polynomial in standard form.

More Practice:

1. $(2c + 1)(2c^2 - 3c - 1)$

2. $(x + 2)(x^2 + 3x + 5)$

Challenge Problems:

3. $(x^2 - 4x + 1)(x^2 + 5x - 2)$

4. $a(a + b)(a - b)$

5. $(x^2z - x[yx - x(y - z)]$

DIVIDING POWERS OF THE SAME BASE

$x^5 \div x^2$ can also be written as $\frac{x^5}{x^2}$ This really means….. $\frac{x \bullet x \bullet x \bullet x \bullet x}{x \bullet x}$ =

> In general, when $x \neq 0$ and a and b are positive integers with $a > b$:
>
> $$x^a \div x^b = x^{a-b}$$
>
> When dividing variables with exponents…..
> The base remains the same, and then subtract the exponents.
>
> You MUST have the SAME BASE to divide variables with exponents

Note: In general, when $x \neq 0$ and is a positive integer:

$x^a \div x^a = 1$ $\qquad\qquad$ $x^0 = 1$

Simplify the following expressions:

1. $x^9 \div x^5 =$ ____ $\qquad$ 2. $y^5 \div y =$ ____ $\qquad$ 3. $c^5 \div c^5 =$ ____

4. $10^5 \div 10^3 =$ ____ $\qquad$ 5. $3^a \div 3^{2c} =$ ____ $\qquad$ 6. $x^{5a} \div x^{2a} =$ ____

7. $y^{10b} \div y^{2b} =$ ____ $\qquad$ 8. $a^b \div a^b =$ ____

9. $\frac{5^8}{5^5 \bullet 5} =$ ________________ $\qquad$ 10. $\frac{6 \bullet 6^9}{6^2 \bullet 6^7} =$ ________________

11. $\frac{2^3 \bullet 2^4}{2^2} =$ ________________ $\qquad$ 12. $\frac{(3^3)^3}{3^5 \bullet 3^4} =$ ________________

DIVIDING A MONOMIAL BY A MONOMIAL

Procedure:

1. Multiply the coefficients
2. Multiply powers with same base by ______________ EXPONENTS
3. Multiply the product from step 1 and 2

Examples:

1. $\frac{24a^5}{-3a^2}$ $\qquad$ 2. $\frac{-20x^3y^5z^2}{-5x^2y^3}$

ZERO AND NEGATIVE EXPONENTS

Recall: using the Division Law: $\frac{x^3}{x^5} =$ also, $\frac{x^3}{x^5} = \frac{x \bullet x \bullet x}{x \bullet x \bullet x \bullet x \bullet x} =$

In general:

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

$x^{-2} = \frac{1}{x^2}$

*The negative sign means write the expression as a fraction.
*The exponent remains with the variable!!

Compute:

1. $\frac{x^3}{x^5} =$ ________________
2. $4^{-3} =$ ________________
3. $10^{-1} =$ ________________
4. $2^{-3} =$ ________________
5. $10^{-2} =$ ________________
6. $x^{-7} =$ ________________
7. $2x^{-4} =$ ________________
8. $\frac{1}{2^{-5}} =$ ________________
9. $\left(\frac{2}{3}\right)^2 =$ ________________
10. $\left(\frac{3}{5}\right)^{-3} =$ ________________
11. $3x^{-3} =$ ________________
12. $\left(\frac{2x}{4x}\right)^{-2} =$ ________________
13. $\left(\frac{x^2}{2x^2}\right)^{-2} =$ ________________
14. $\frac{1}{10^{-2}} =$ ________________

RULES FOR ZERO EXPONENTS:

- Any number (or variable) raised to the zero power is ALWAYS = to 1

Reasoning: using the Division Law: $\frac{x^5}{x^5} =$ also, $\frac{x^5}{x^5} = \frac{x \bullet x \bullet x \bullet x \bullet x}{x \bullet x \bullet x \bullet x \bullet x} =$

In general

$x^0 = 1$ (when $\neq 0$)

$x^0 = 1$ $3^0 = 1$ $(2^5)^0 = 1$ $\frac{10^2}{10^2} = \quad = 1$ $chair^0 = 1$

Examples: Zero Exponents

1.	$4^0 =$ ____________	5.	$4x^0 =$ ____________
2.	$(-4)^0 =$ ____________	6.	$121^0 =$ ____________
3.	$-4^0 =$ ____________	7.	$-(x^2)^0 =$ ____________
4.	$(4x)^0 =$ ____________	8.	$3^0 x =$ ____________

Practice: Zero and Negative Exponents

9. $xy^0 =$ ____________

10. $\frac{1}{10^{-2}} =$ ____________

11. $5^0 + 2^{-3} =$ ____________

12. $-3b^0 - (4b)^0 =$ ____________

13. Find the value of $-2x^0 + 3x^{-2}$ when x = 2.

SCIENTIFIC NOTATION

A number in scientific notation is expressed as a product of two factors: