Polynomials

Vocabulary

- **Monomials - a number, a variable, or a product of a number and one or more variables.**
- $4x$, $20x^2yw^3$, -3, a^2b^3, and $3yz$ are all monomials.
- ***Binomial*:** A polynomial containing two terms.
- ***Example : 3x+5,*** $4x + 6x^2$,
- ***Trinomial:*** A polynomial containing three terms.
- Example : $3a^2 - 5a + 4$
- **Polynomials – one or more monomials added or subtracted**
  - $4x + 6x^2$, $20xy - 4$, and $3a^2 - 5a + 4$ are all polynomials.

Important Note!!

An expression is not a polynomial if there is a variable in the denominator.

State whether each expression is a polynomial. If it is, identify it.

1) $7y - 3x + 4$

trinomial

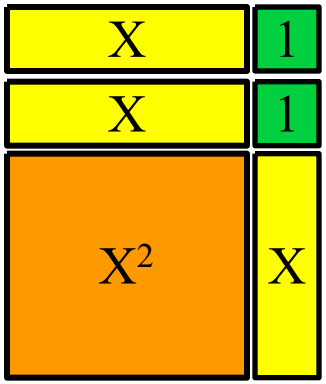
2) $10x^3yz^2$

monomial

3) $\frac{5}{2y^2} + 7y$

not a polynomial

Which polynomial is represented by



1. $x^2 + x + 1$
2. $x^2 + x + 2$
3. $x^2 + 2x + 2$
4. ✓ $x^2 + 3x + 2$
5. I've got no idea!

The **degree** of a monomial is the sum of the exponents of the variables.

Find the degree of each monomial.

1) $5x^2$

2

2) $4a^4b^3c$

8

3) -3

1

To find the degree of a polynomial, find the largest degree of the terms.

1) $8x^2 - 2x + 7$

Degrees: 2 1 1

Which is biggest? **2 is the degree!**

2) $y^7 + 6y^4 + 3x^4m^4$

Degrees: 7 4 8

8 is the degree!

Find the degree of $x^5 - x^3y^2 + 4$

1. 0
2. 2
3. 3
4. ✓ 5
5. 10

A polynomial is normally put in ascending or descending order.

What is ascending order?

Going from small to big exponents.

What is descending order?

Going from big to small exponents.

Put in descending order:

1) $8x - 3x^2 + x^4 - 4$

$x^4 - 3x^2 + 8x - 4$

2) Put in descending order in terms of x:

$12x^2y^3 - 6x^3y^2 + 3y - 2x$

$-6x^3y^2 + 12x^2y^3 - 2x + 3y$

Like Terms

Like Terms refers to monomials that have the same variable(s) but may have different coefficients. The variables in the terms must have the same powers.

Which terms are like? $3a^2b$, $4ab^2$, $3ab$, $-5ab^2$

$4ab^2$ and $-5ab^2$ are like.

Even though the others have the same variables, the exponents are not the same.

$3a^2b = 3aab$, which is different from $4ab^2 = 4abb$.

Like Terms

Constants are like terms.

Which terms are like? 2x, -3, 5b, 0

-3 and 0 are like.

Which terms are like? 3x, $2x^2$, 4, x

3x and x are like.

Which terms are like? 2wx, w, 3x, 4xw

2wx and 4xw are like.

Adding Polynomials

Add: $(x^2 + 3x + 1) + (4x^2 + 5)$

Step 1: **Underline like terms:**

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

Notice: '3x' doesn't have a like term.

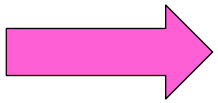
Step 2: **Add the coefficients of *like terms*, do not change the powers of the variables:**

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

$$\mathbf{5x^2 + 3x + 6}$$

Adding Polynomials

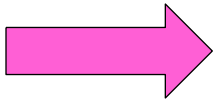
Some people prefer to add polynomials by stacking them.
If you choose to do this, be sure to line up the like terms!

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

$$\begin{array}{r} (x^2 + 3x + 1) \\ +\ (4x^2 \qquad +5) \\ \hline \end{array}$$

$$\mathbf{5x^2 + 3x + 6}$$

Stack and add these polynomials: $(2a^2+3ab+4b^2) + (7a2+ab+-2b^2)$

$(2a^2+3ab+4b^2) + (7a2+ab+-2b^2)$ 

$$\begin{array}{r} (2a^2 + 3ab + 4b^2) \\ +\ (7a^2 + ab + -2b^2) \\ \hline \end{array}$$

$$\mathbf{9a^2 + 4ab + 2b^2}$$

Adding Polynomials

- Add the following polynomials; you may stack them if you prefer:

1) $(3x^3 - 7x) + (3x^3 + 4x) = 6x^3 - 3x$

2) $(2w^2 + w - 5) + (4w^2 + 7w + 1) = 6w^2 + 8w - 4$

3) $(2a^3 + 3a^2 + 5a) + (a^3 + 4a + 3) =$

$3a^3 + 3a^2 + 9a + 3$

Subtracting Polynomials

Subtract: $(3x^2 + 2x + 7) - (x^2 + x + 4)$

<u>Step 1</u>: Change subtraction to addition (*Keep-Change-Change.*).

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

<u>Step 2</u>: Underline OR line up the like terms and add.

$$\begin{array}{r} (3x^2 + 2x + 7) \\ + (- x^2 + - x + - 4) \\ \hline 2x^2 + x + 3 \end{array}$$

Subtracting Polynomials

- Subtract the following polynomials by changing to addition (Keep-Change-Change.), then add:

1) $\left(x^2 - x - 4\right) - \left(3x^2 - 4x + 1\right) = -2x^2 + 3x - 5$

2) $\left(9y^2 - 3y + 1\right) - \left(2y^2 + y - 9\right) = 7y^2 - 4y + 10$

3) $\left(2g^2 + g - 9\right) - \left(g^3 + 3g^2 + 3\right) = -g^3 - g^2 + g - 12$

Objective

The student will be able to:

multiply two polynomials using the FOIL method, Box method and the distributive property.

Designed by Skip Tyler, Varina High School

There are three techniques you can use for multiplying polynomials.

The best part about it is that they are all the same! Huh? Whaddaya mean?

It's all about how you write it…Here they are!

1)Distributive Property

2)FOIL

3)Box Method

Sit back, relax (but make sure to write this down), and I'll show ya!

1) Multiply. $(2x + 3)(5x + 8)$

Using the distributive property, multiply

$2x(5x + 8) + 3(5x + 8)$.

$10x^2 + 16x + 15x + 24$

Combine like terms.

$10x^2 + 31x + 24$

A shortcut of the distributive property is called the **FOIL** method.

The FOIL method is ONLY used when you multiply 2 binomials. It is an acronym and tells you which terms to multiply.

2) Use the FOIL method to multiply the following binomials:

$(y + 3)(y + 7)$.

$(y + 3)(y + 7)$.

F tells you to multiply the FIRST terms of each binomial.

y^2

$(y + 3)(y + 7)$.

O tells you to multiply the OUTER terms of each binomial.

$y^2 + 7y$

$(y + 3)(y + 7)$.

I tells you to multiply the INNER terms of each binomial.

$y^2 + 7y$ **+ 3y**

$(y + 3)(y + 7)$.

L tells you to multiply the LAST terms of each binomial.

$y^2 + 7y + 3y$ **+ 21**

Combine like terms.

$y^2 + 10y + 21$

Remember, FOIL reminds you to multiply the:

First terms

Outer terms

Inner terms

Last terms

The third method is the Box Method. This method works for every problem!

Here's how you do it.

Multiply $(3x - 5)(5x + 2)$

Draw a box. Write a polynomial on the top and side of a box. It does not matter which goes where.

This will be modeled in the next problem along with FOIL.

	3x	-5
5x		
+2		

3) Multiply $(3x - 5)(5x + 2)$

First terms: $15x^2$

Outer terms: $+6x$

Inner terms: $-25x$

Last terms: -10

Combine like terms.

$15x^2 - 19x - 10$

	$3x$	-5
$5x$	$15x^2$	$-25x$
$+2$	$+6x$	-10

You have 3 techniques. Pick the one you like the best!

4) Multiply $(7p - 2)(3p - 4)$

First terms: $21p^2$

Outer terms: $-28p$

Inner terms: $-6p$

Last terms: $+8$

Combine like terms.

$21p^2 - 34p + 8$

	$7p$	-2
$3p$	$21p^2$	$-6p$
-4	$-28p$	$+8$

Multiply $(y + 4)(y – 3)$

1. $y^2 + y – 12$ ✓
2. $y^2 – y – 12$
3. $y^2 + 7y – 12$
4. $y^2 – 7y – 12$
5. $y^2 + y + 12$
6. $y^2 – y + 12$
7. $y^2 + 7y + 12$
8. $y^2 – 7y + 12$

Multiply $(2a - 3b)(2a + 4b)$

1. $4a^2 + 14ab - 12b^2$
2. $4a^2 - 14ab - 12b^2$
3. $4a^2 + 8ab - 6ba - 12b^2$
4. ✓ $4a^2 + 2ab - 12b^2$
5. $4a^2 - 2ab - 12b^2$

5) Multiply $(2x - 5)(x^2 - 5x + 4)$

You cannot use FOIL because they are not BOTH binomials. You must use the distributive property.

$2x(x^2 - 5x + 4) - 5(x^2 - 5x + 4)$

$2x^3 - 10x^2 + 8x - 5x^2 + 25x - 20$

Group and combine like terms.

$2x^3 - 10x^2 - 5x^2 + 8x + 25x - 20$

$2x^3 - 15x^2 + 33x - 20$

5) Multiply $(2x - 5)(x^2 - 5x + 4)$

You cannot use FOIL because they are not BOTH binomials. You must use the distributive property or box method.

	x^2	$-5x$	$+4$
$2x$	$2x^3$	$-10x^2$	$+8x$
-5	$-5x^2$	$+25x$	-20

Almost done! Go to the next slide!

5) Multiply $(2x - 5)(x^2 - 5x + 4)$

Combine like terms!

	x^2	$-5x$	$+4$
$2x$	$2x^3$	$-10x^2$	$+8x$
-5	$-5x^2$	$+25x$	-20

$2x^3 - 15x^2 + 33x - 20$

Multiply $(2p + 1)(p^2 - 3p + 4)$

1. $2p^3 + 2p^3 + p + 4$
2. $y^2 - y - 12$
3. $y^2 + 7y - 12$
4. $y^2 - 7y - 12$