5.1 Multiply Polynomials

A Polynomials

A *polynomial* is an algebraic expression formed by *adding or subtracting terms*.
Each *term* of the polynomial contains:

- a *numeric coefficient* multiplied by
- *one or more variables* raised to *non-negative integral* exponent

Example 1. Find if each of the following expression is or is not a polynomial.

$$a)\quad -2 \qquad b)\quad x \qquad c)\quad -x^2 \qquad d)\quad 3xy \qquad e)\quad -2x^{-1}$$
$$f)\quad 1+\frac{1}{3}x \quad g)\quad -2x^2+3x-5 \quad h)\quad \frac{2}{x+1} \quad i)\quad x+xy-2x^2y^5 \quad j)\quad -2x+2^x$$

B Monomials

Monomials are polynomials with *one single term*.

Example 2. Find if each of the following expression is or is not a monomial.

$$a)\quad x \qquad b)\quad xy \qquad c)\quad -2x \qquad d)\quad x+y \quad e)\quad -3x^2$$
$$f)\quad -2xy^2 \quad g)\quad -2xyz \quad h)\quad 1-x+4y-z \quad i)\quad 10 \qquad j)\quad 2^x$$

C Multiply monomials

- ✓ The product of two or more monomials is also a monomial
- ✓ The *numeric coefficient* is equal to the *product* of all numeric coefficients
- ✓ For each variable, apply the exponent rule $x^n x^m = x^{n+m}$

Example 3. Multiply the following monomials.

a) $(-2)(+3x)$

b) $(-2x)(-y)$

c) $(-3x)(-5x)$

d) $(-4x)(\frac{1}{2}xy)$

e) $(-xy^2)(3x^3)$

f) $\left(-\frac{2x}{3}\right)\left(\frac{-3xy}{4}\right)$

D Binomials

- ✓ *Binomials* are polynomials with *two terms*
- ✓ By adding or subtracting two monomials, a binomial is formed
- ✓ Binomials may be *simplified* if they contain *like terms*

Example 4. Find if each of the following expression is or is not a monomial.

$$a)\quad x \qquad b)\quad xy \qquad c)\quad -2x \qquad d)\quad x+y \quad e)\quad -3x^2$$
$$f)\quad -2xy^2 \quad g)\quad -2xyz \quad h)\quad 1-x+4y-z \quad i)\quad 10 \qquad j)\quad 2^x$$

E Distributive Property

The distributive property states that for any numbers a, b, and c:

$$a(b+c) = ab + ac$$

F Multiplying a monomial by a binomial

- ✓ In order to multiply a monomial by a binomial, use the distributive property.

Example 5. Multiply the following monomials and binomials.

a) $2(x-y)$

b) $(-x)(1-2y)$

c) $(-3x)(2x-3y)$

d) $(2x^2y)(xy^2-3x)$

G Combining like terms

Like Terms:

- ✓ *differ* eventually by the *numeric coefficient*
- ✓ have *identical variables* raised to *identical exponents*
- ✓ may be *combined* by using the *distributive property*: $ax + bx = (a+b)x$

Example 6. For each case, combine (collect) like terms.

a) $1 - x + 2 - 4x$

b) $x - xy - 2x + 3xy$

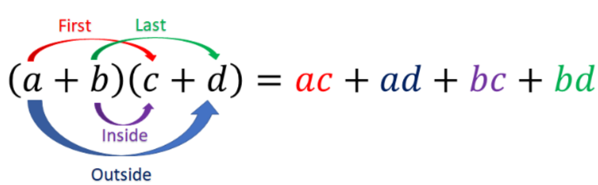
c) $-2 + x - xy + 4 - 5x + 3xy$

d) $x + 1 - x^2 - 2x - 3x^2 + 5$

H Multiplying binomials (FOIL Method)

FOIL:

- ✓ stands for First, Outside, Inside, and Last
- ✓ is used to multiply two binomials (see the diagram below)



Example 7. Use the FOIL method to multiply the following binomials.

a) $(1-2x)(x-3)$

b) $(3x-2y)(-2x+4y)$

I Multiplying binomials (Grid Method)

The *Grid Method* is used to multiply *two or more* polynomials (see the diagram below).

$(x-2)(2x+3) =$

	x	-2
$2x$	$2x^2$	$-4x$
3	$3x$	-6

$= 2x^2 - x - 6$

Example 8. Use the grid method to multiply binomials.

a) $(1+x)(x+x^2)$

b) $(2x+3y)(2x-3y)$

J Multiplying polynomials (Each by Each Method)

- ✓ Multiply *each term* of the first expression by *each term* of the second expression (see the diagram below)

$$(a+b)(c+d+e) = ac + ad + ae + bc + bd + be$$

Example 9. Multiply (expand brackets). Simplify the answer.

a) $(1+x+xy)(x-y)$

b) $(1+x-x^2)(3-x+2x^2)$

c) $(a+b+c)(a+b-c)(a-b+c)(-a+b+c)$

Notes: Textbook Pages 210-216
Homework: Textbook Pages 217-219 #3ab, 4ab, 5ab, 6ab, 7ab, 8ab, 16