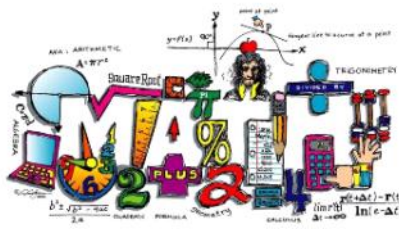


# Lesson 2

## Operations on Polynomials

Date:

*Chapter 1: Polynomials*  
**Lesson 2: Operations  
on Polynomials**  
*BEDMAS*



# Polynomials

## REMINDER

In an algebraic expression, the **terms** are the different parts of the expression separated by a + or -.

Ex:  $x^2 + 2x - 3$

term term term

- **Monomial:** 1 term algebraic expression Ex:
- **Binomial:** 2-term algebraic expression Ex:
- **Trinomial:** 3-term algebraic expression Ex:
- **Polynomial:** Many-term algebraic expression Ex:

- **The degree of a monomial:** Sum of the exponents of its variables

Ex:  $3x^3y^4z^1$  Degree: 8

- **The coefficient of a term:** The number at the front of a variable

Ex:  $3x^2y$

- **LIKE TERMS:** Terms with variables raised to the same exponents

Ex:  $4x^2 + 6x^2$   ~~$4x^2y + 3x^2y$~~

Add Subtract Multiply Divide

Don't forget BEMDAS

### Adding Polynomials

Example:

$$(5x^2y + 3x - 9) + (4x^2y - 2x + 7)$$

$$9x^2y + x - 2$$

STEPS:

- 1) Drop the brackets if it's a plus sign at the front of the brackets.
- 2) Put like terms together.



Polynomials are in **simplest form** when they contain no like terms.

$$\underbrace{x^2 + 2x} + 1 + \underbrace{3x^2 - 4x}$$

when **simplified** becomes

$$4x^2 - 2x + 1$$

<b>Like Terms</b> $2xy, 4xy, -3xy$	<b>Like Terms</b> $4a^2b^3, 9a^2b^3$	<b>Not Like Terms</b> $x^2, x, 2x^3, 4$
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## Subtracting Polynomials

Example:

$$\underbrace{(4x^2 + 11x - 13)} - \underbrace{(-2x^2 - 7x + 8)}$$

STEPS:

- 1) Change the sign of each term inside the brackets if it's a minus sign at the front of the brackets.
- 2) Put like terms together.

$$4x^2 + 11x - 13 + 2x^2 + 7x - 8$$

$$6x^2 + 18x - 21$$

## Multiplying a Polynomial by a Monomial

Example:

1)  $5ab(3a^2 + 4b - 7)$

$$15a^3b + 20ab^2 - 35ab$$

2)  $\frac{3}{4}x^2(\frac{2}{3}x - 8x^2)$

$$\frac{6}{12}x^3 - \frac{24}{4}x^4$$

$$\frac{1}{2}x^3 - 6x^4$$

STEPS:

1) Multiply each of the term of the polynomial by the monomial.

Reminder:

When multiplying variables, use the law of exponents.

3)  $4x + 5x(3x - 4)$

$$4x + 15x^2 - 20x$$

$$15x^2 - 16x$$

## Multiplying a BINOMIAL by a BINOMIAL

Example:

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

$$6x^2 - 12x + 10x - 20$$

$$6x^2 - 2x - 20$$

First Outer Inner Last

example  $(x+3)(x+2)$

F:  $(x+3)(x+2)$

O:  $(x+3)(x+2)$

I:  $(x+3)(x+2)$

L:  $(x+3)(x+2)$

2)  $(x-2)^2$

$$(x-2)(x-2)$$

$$x^2 - 2x - 2x + 4$$

$$x^2 - 4x + 4$$

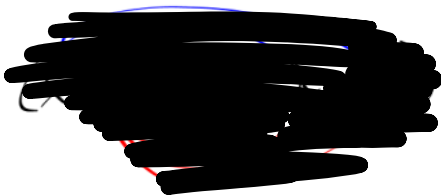
3)  $(x+1)(x-3)(x-2)$

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

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

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

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



## Dividing a Polynomial by a Monomial

Example:

$$(12x^3 + 8x^2y - 3x) \div 3x$$

$$\frac{12x^3 + 8x^2y - 3x}{3x}$$

$$4x^2 + \frac{8}{3}xy - 1$$

STEPS:

- 1) Divide each of the term of the polynomial by the monomial.

Reminder:

When dividing variables, use the law of exponents.

$$(-15x^3y^2 + 25x^2y - 55xy^4) \div -5xy^2$$

$$3x^2 - 5xy^{-1} + 11y^2$$

from workbook p.7-8 #17b)

$$P = \frac{2}{3}x^2 - \frac{3}{2}x + 1$$

$$Q = \frac{3}{2}x^2 + \frac{5}{6}x - \frac{1}{3}$$

$$\text{et } R = \frac{3}{2}x - \frac{1}{6}$$

Déterminez

$$P - Q + R$$

$$\left(\frac{2}{3}x^2 - \frac{3}{2}x + 1\right) - \left(\frac{3}{2}x^2 + \frac{5}{6}x - \frac{1}{3}\right) + \left(\frac{3}{2}x - \frac{1}{6}\right)$$

$$\frac{-5}{6}x^2 - \frac{5}{6}x + \frac{7}{6}$$

Evaluate an algebraic expression:

Simply replace any variables with the prescribed value.

Ex. Evaluate if  $P(x)$  if  $x = -4$

$$\begin{aligned}P(x) &= 2x^2 - 3x + 7 \\ &= 2(-4)^2 - 3(-4) + 7 \\ &= 2(16) - 3(-4) + 7 \\ &= 32 + 12 + 7 \\ &= 51\end{aligned}$$

Simplify:

a)  $2x^3 - 5x^3 + 7x^3$    $4x^3$

b)  $4x^2y - 6x^2y + x^2y$    $-x^2y$

c)  $\frac{3}{4}x^2 + \frac{2}{3}x^2 - x^2$    $\frac{5}{12}x^2$

d)  $-\frac{2}{3}xy^2 + \frac{3}{4}xy^2 - \frac{5}{6}xy^2$    $-\frac{3}{4}xy^2$



What is the product?

- a)  $-3x^2 \times 4x^3$  [red box]  $-12x^5$
- b)  $2x^2y^3 \times -3xy^2$  [red box]  $-6x^3y^5$
- c)  $-17x^2 \times -3x$  [red box]  $51x^3$
- d)  $-7x^2y \times 5x^2y^2$  [red box]  $-35x^4y^3$
- e)  $3x^2y \times -5xy \times -2xy^2$  [red box]  $30x^4y^4$
- f)  $20x^2y^2 \times -0.5x \times -1.2y^2$  [red box]  $12x^3y^4$
- g)  $\frac{3}{4}x^2y \times \frac{2}{5}xy^2 \times \frac{10}{9}x$  [red box]  $\frac{1}{3}x^4y^3$
- h)  $\frac{-3}{5}x^2y^3 \times \frac{2}{3}xy \times \frac{-5}{2}xy^2$  [red box]  $x^4y^6$

what is the quotient?

- a)  $-12x^4 \div 3x^6$  [red box]  $-4x^{-2}$
- b)  $18x^6 \div 12x^4$  [red box]  $\frac{3}{2}x^2$
- c)  $18x^6y^4 \div 9x^2y^2$  [red box]  $2x^4y^2$
- d)  $-12x^2y^4 \div 6x^3y$  [red box]  $-2x^{-1}y^3$
- e)  $(-5x^3)^2 \div 10x^4$  [red box]  $\frac{5}{2}x^2$
- f)  $(4x^2y^3)^3 \div (2xy^2)^4$  [red box]  $4x^2y^3$

Simplify the following polynomials

$$-2x^2 - x + 1$$

a)  $P(x) = 3x^2 + 2x - 5x^2 - 3x + 1$  \_\_\_\_\_

b)  $P(x, y) = 3x^3y - 2xy^2 + 4x^3y - xy^2$  \_\_\_\_\_

c)  $P(z) = 4z^3 - 5z^2 + 8z^3 - z^2 + 4z - 5 + 6z^2 - 12z^3$  \_\_\_\_\_

d)  $P(x) = \frac{3}{2}x^2 + 5x^3 - \frac{2}{3}x^2 - \frac{3}{2}x^3 + \frac{3}{4}x - \frac{5}{2}x$  \_\_\_\_\_

$$\frac{7}{2}x^3 - \frac{5}{6}x^2 - \frac{7}{4}x$$

$$7x^3y - 3xy^2$$

$$4x - 5$$

Evaluate the following polynomials

a)  $P(x) = 3x^2 + 5x$  for  $x = -2$  \_\_\_\_\_

$$2$$

b)  $P(x) = x^2 - 5x + 3$  for  $x = 0$  \_\_\_\_\_

$$3$$

c)  $P(x) = 3x^2 + 2x - 5$  for  $x = -1.5$  \_\_\_\_\_

$$-6.25$$

d)  $P(x) = 2x^2 - 7x - 15$  for  $x = -\frac{3}{2}$  \_\_\_\_\_

$$0$$

Given  $P = 3x^2 - 2x + 1$ ,  $Q = -x^2 - 3x + 2$  and  $R = -2x + 5$ . Determine:

a)  $P + Q + R$                      

b)  $P - Q + R$                      

c)  $P - Q - R$                      

d)  $-P + Q - R$                      

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

b)  $4x^2 - x + 4$

c)  $4x^2 + 3x - 6$

d)  $-4x^2 + x - 4$

Perform the operations

a)  $(4x^2 - 8x + 1) - (2x^2 - 3x + 5)$   $2x^2 - 5x - 4$                      

b)  $(3x^2 - 2xy^2 + 3xy) + (2x^2 + 3x^2y - 5xy)$                      

c)  $(3a^2b - 5ab^2) - (2a^2b + 3ab^2)$   $a^2b - 8ab^2$                      

b)  $5x^2 + xy^2 - 2xy$

What is the product?

a)  $3x^2(2x - 5)$  \_\_\_\_\_

b)  $-3y(y^2 - 2y)$  \_\_\_\_\_

c)  $-2x^2(3xy^2 + 5x^2y)$  \_\_\_\_\_

d)  $(2xy - 5x)(-3x^2y)$  \_\_\_\_\_

a)  $6x^3 - 15x^2$

b)  $-3y^3 + 6y^2$

c)  $-6x^3y^2 - 10x^4y$

d)  $-6x^3y^2 + 15x^3y$

Multiply the binomials:

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

b)  $(x - 5)(3 - x)$  \_\_\_\_\_

c)  $(2a + b)(3a - 2b)$  \_\_\_\_\_

d)  $(5 - 2x)(3x - 4)$  \_\_\_\_\_

a)  $x^2 + x - 6$

b)  $-x^2 + 8x - 15$

c)  $6a^2 - ab - 2b^2$

d)  $-6x^2 + 23x - 20$

Perform the operations:

$$\begin{array}{r} (3x + 5y)^2 - (3x - 5y)^2 \quad \underline{60xy} \quad \blacksquare \\ (2x + 3)(4x^2 + 9)(2x - 3) \quad \underline{16x^4 - 81} \quad \blacksquare \end{array}$$

What makes Polynomial Operations difficult?

What are your strategies to combat this?

You can now do:

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