

6-1 Arithmetic Operations with Polynomials

Content Objective: Students will be able to add, subtract and multiply polynomial expressions.

Language Objective: Students will use background knowledge to draw connections between simplifying lower degree polynomials to simplifying higher degree polynomials and extend their knowledge of the distributive property to multi level distribution. They will do this by communicating in groups and individual work. Students will also be able to use the following vocabulary in the appropriate context:

- Term
- Polynomial
- Monomial
- Binomial
- Trinomial

Simplifying Polynomials Task

Addition and Subtraction: Combine the terms that are alike in each expression (simplify).

1.  $2 + x + 5$

2.  $13 - 2y - 5 + 6y$

3.  $3x + 4y + 12 - 7y + 6 + 4x - 2 + 13y$

—

4.  $7 + 3x^2 + 3 + 2x^2$

5.  $x^2 - 2 + 5x^2 + 15$

6.  $-4 + 7 + y^2 - 3x^2 + 22 - 5y^2$

—

$$\boxed{-3x^2 - 4y^2 + 25}$$

7)  $2x^3 + x^3 + 5 + 3$

8)  $y^3 + x^3 + y^3 + x^3$

9)  $(14x + 5) + (10x + 5)$

10)  $(19x^2 + 12x + 12) + (7x^2 + 10x + 13)$

11)  $(6x + 14) - (9x + 5)$

$$\begin{array}{r} \text{---} \quad \text{---} \quad \text{---} \quad \text{---} \\ 3x + 7 - x + 5 \\ \boxed{2x + 12} \end{array} \quad \begin{array}{l} 2x + 12 \\ 2x + 2 \end{array}$$

Multiplication: Simplify by distributing the monomial with the binomial. Draw **arrows** to indicate all terms have been distributed.

12)  $3(x + 5)$

13)  $2y(y - 2)$

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

Simplify by distributing the monomial with the trinomial. Draw arrows to indicate that all terms have been distributed.

$$(5)(3x^2 + 2x + 6) = 5 \cdot 3x^2 + 5 \cdot 2x + 5 \cdot 6 = 15x^2 + 10x + 30$$

$$15) (-3x)(-4x^2 - 10x + 12)$$

$$16) (-2x)(11x^3 - 10x^2 + 4x + 6)$$

How do we do this?

$$u = a + b$$

$$\begin{aligned} & (a+b)(c+d) \\ & \quad \underbrace{\hspace{1.5cm}}_{u} \underbrace{\hspace{1.5cm}}_{(c+d)} \\ & \quad cu + du \\ & \quad \underbrace{c(a+b)} + \underbrace{d(a+b)} \\ & \quad actbc + ad + bd \end{aligned}$$

$$(x+2)(x+6)$$

$$x^2 + 6x + 2x + 12$$

$$x^2 + 8x + 12$$

Binomial  $\times$  Binomial

F first  
O outside  
I inside  
L last

$$(x+2)(x+6)$$

$$x^2 + 6x + 2x + 12$$

Simplify by distributing the binomial with another binomial. Draw arrows to indicate that all terms have been distributed.

$$(x+2)(x+6) = x \cdot x + x \cdot 6 + 2 \cdot x + 2 \cdot 6 = x^2 + 6x + 2x + 12 = x^2 + 8x + 12$$

$$16) (9x+7)(6x+4)$$

$$54x^2 + 36x + 42x + 28$$

$$54x^2 + 78x + 28$$

$$17) (6x+3)(-5x+2)$$

$$-30x^2 + 12x - 15x + 6$$

$$-30x^2 - 3x + 6$$

$$18) (16x-19)(8x-8)$$

$$128x^2 - 128x + 152x - 152$$

$$128x^2 - 280x + 152$$

Based on what you know about multiplying [polynomials](#) using the distributive property. Discover on your own how to simplify by distributing the [binomial](#) with the [trinomial](#). **Draw arrows** to indicate that all terms have been distributed.

19)  $(2x - 3)(4x^2 + x - 6)$

$$8x^3 + \underline{2x^2} - 12x - \underline{12x^2} - 3x + 18$$

$$8x^3 - 10x^2 - 15x + 18$$

Write in your own words the definition or provide an example of the following terms based on the information from this task. Each vocabulary word can be found underlined throughout the task.

20) Term -

21) Polynomial -

22) Monomial -

23) Binomial -

24) Trinomial -

A polynomial can have constants, variables and exponents, but never division by a variable.

<u>constants</u> (like 3, -20, or $\frac{1}{2}$ )	
<u>variables</u> (like $x$ and $y$ )	
<u>exponents</u> (like the 2 in $y^2$ ), but only 0, 1, 2, 3, ... etc are allowed	no negative exponents
... <b>not</b> division by a variable (so something like $\frac{2}{x}$ is right out)	

Polynomial or Not?

exponents: 0,1,2,...

$$5xy^2 - 3x + 5y^3 - 3$$

terms

A Polynomial

$$3xy^{-2}$$

$$\frac{2}{x+2}$$

Not Polynomials

Expand

~~$$x^2 + 16$$~~

$$(x+4)^2$$

$$(x+4)(x+4)$$

$$x^2 + 4x + 4x + 16$$

$$x^2 + 8x + 16$$

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

## Learning Check

Students can...

simplify the following expressions:

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

3.  $(2x + 4)^2$