

Section 5.1b – Multiplication of Binomials and Trinomials

This booklet belongs to: _____ Block: _____

- There are **two methods** that can effectively be used for multiplying polynomials
- **Method 1: Distributive Method** *(BEST FOR LARGE POLYNOMIALS)*
- **Method 2: Horizontal Method (FOIL)** *(BEST FOR TWO BINOMIALS)*

Method 1: Distributive Method

Example 1: Multiply $(2x - 3)(x + 2)$

Solution 1:

$$\begin{aligned}(2x - 3)(x + 2) &= (2x - 3)(x) + (2x - 3)(2) \\ &= 2x^2 - 3x + 4x - 6 \\ &= \mathbf{2x^2 + x - 6}\end{aligned}$$

Example 2: Multiply $(x^2 - 2)(3x^2 - 4x + 3)$

Solution 2:

$$\begin{aligned}(x^2 - 2)(3x^2 - 4x + 3) &= (x^2 - 2)(3x^2) + (x^2 - 2)(-4x) + (x^2 - 2)(3) \\ &= 3x^4 - 6x^2 - 4x^3 + 8x + 3x^2 - 6 \\ &= \mathbf{3x^4 - 4x^3 - 3x^2 + 8x - 6}\end{aligned}$$

Example 3: Multiply $(3x + y)(2x^2 - 5xy + 4y^2)$

Solution 3:

$$\begin{aligned}(3x + y)(2x^2 - 5xy + 4y^2) &= (3x + y)(2x^2) + (3x + y)(-5xy) + (3x + y)(4y^2) \\ &= 6x^3 + 2x^2y - 15x^2y - 5xy^2 + 12xy^2 + 4y^3 \\ &= \mathbf{6x^3 - 13x^2y + 7xy^2 + 4y^3}\end{aligned}$$

Method 2: Horizontal Method (FOIL)

- *FOIL* is the acronym for *First, Outside, Inside, Last*.

In $(a + b)(c + d)$:

First refers to $a \cdot c$

Outside refers to $a \cdot d$

Inside refers to $b \cdot c$

Last refers to $b \cdot d$



Example 4: Multiply $(x - 6)(x + 4)$

$$\begin{aligned}
 \text{Solution 4: } (x - 6)(x + 4) &= (x)(x) + (x)(4) + (-6)(x) + (-6)(4) \\
 &\quad \text{First} \quad \text{Outside} \quad \text{Inside} \quad \text{Last} \\
 &= x^2 + 4x - 6x - 24 \\
 &= x^2 - 2x - 24
 \end{aligned}$$

Example 5: Multiply $(2x - 3)(3x + 1)$

$$\begin{aligned}
 \text{Solution 5: } (2x - 3)(3x + 1) &= (2x)(3x) + (2x)(1) + (-3)(3x) + (-3)(1) \\
 &\quad \text{First} \quad \text{Outside} \quad \text{Inside} \quad \text{Last} \\
 &= 6x^2 + 2x - 9x - 3 \\
 &= 6x^2 - 7x - 3
 \end{aligned}$$

- **FOIL DOES NOT WORK WITH LARGER POLYNOMIALS**
- **IT IS DESIGNED TO USE THE DISTRIBUTIVE METHOD WITH BINOMIALS ONLY**
- **WITH LARGER POLYNOMIALS THE DISTRIBUTIVE METHOD IS THE BEST OPTION**

Verifying your Multiplication

- The process of multiplying Polynomials has multiple steps and can have potential error spots
- The beauty here is that it is possible to verify your result
- Simply take any number (0 or 1 is usually a good choice) and substitute it in for your variable
- The left and right side of the equations should match up.
- If they don't an error has been made

Consider:

$$(2x - 3)(3x + 1) = 6x^2 - 7x - 3$$

$$(2(0) - 3)(3(0) + 1) = 6(0)^2 - 7(0) - 3$$

$$(-3)(1) = -3$$

$$(-3) = (-3)$$

Since both sides of the equation equals -3 , the answer is verified for $x = 0$.

Common Errors when Multiplying Polynomials

1. $(x + 3)^2 \neq x^2 + 9 \rightarrow (x + 3)^2 = (x + 3)(x + 3) = x^2 + 6x + 9$
2. $(x - 8)^2 \neq x^2 - 64 \rightarrow (x - 8)^2 = (x - 8)(x - 8) = x^2 - 16x + 64$
3. $(x + 2)(x - 2) \neq x^2 - 4x + 4 \rightarrow (x + 2)(x - 2) = x^2 - 4$

General Rules**Square of a Binomial**

$$(a + b)^2 = a^2 + 2ab + b^2 \qquad (a - b)^2 = a^2 - 2ab + b^2$$

Product of Sum and Difference

$$(a - b)(a + b) = a^2 - b^2$$

Section 5.1b – Practice Problems**EMERGING LEVEL QUESTIONS**

Multiply, leave all answers in descending order

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

2. $(3y - 4)(2y + 3)$

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

4. $(4y^2 + 3)(3y - 1)$

5. $(-3y - 4)(2y - 3)$

6. $(5x - y)(5x - y)$

7. $(2x - 1)(2x^2 + 3x - 1)$

8. $(5x - 6)(2x^2 + 7x - 3)$

9. $(3y - 2x)(4y^2 - 3xy + x^2)$

10. $(x^2 + 2y)(2x^2 + 3xy - y^2)$

Multiply, leave all answers in descending order

11. $(a + b)^2$

12. $(2x + 1)^2$

13. $(x - y)^2$

14. $(3x + 2y)^2$

15. $(-x - 2y)^2$

16. $(-3x^2 + 2y^2)^2$

PROFICIENT LEVEL QUESTIONS

17. $(-a^3b + c^2d^2)^2$

18. $(2a^2b^2 - 4c^3d)^2$

Multiply, leave all answers in descending order

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

20. $(2x + 1)(2x - 1)$

21. $(x - y)(x + y)$

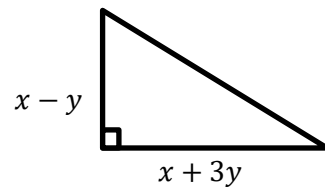
22. $(3x + 2y)(3x - 2y)$

23. $(-x - 2y)(-x + 2y)$

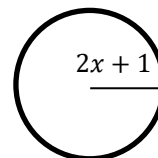
24. $(-x^2 - 2y^2)(-x^2 + 2y^2)$

Calculate the area of the following figures

25. *Right Triangle*

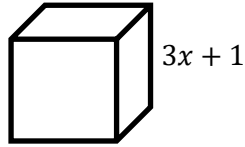


26. *Circle*

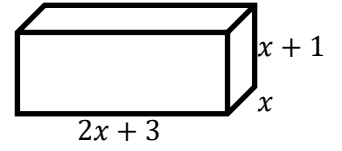


Calculate the volume of the following figures

27. *Cube*



28. *Rectangle*



EXTENDING LEVEL QUESTIONS

Find each product

29. $(x + 1)^3$

30. $(y - 3)^3$

31. $(2x + y)^3$

32. $(3x - 2y)^3$

Section 5.1b – Answer Key

1. $6x^2 + 7x + 2$
2. $6y^2 + y - 12$
3. $3x^3 + 3x^2 + 4x + 4$
4. $12y^3 - 4y^2 + 9y - 3$
5. $-6y^2 + y + 12$
6. $25x^2 - 10xy + y^2$
7. $4x^3 + 4x^2 - 5x + 1$
8. $10x^3 + 23x^2 - 57x + 18$
9. $-2x^3 + 9x^2y - 17xy^2 + 12y^3$
10. $2x^4 + 3x^3y - x^2y^2 + 4x^2y + 6xy^2 - 2y^3$
11. $a^2 + 2ab + b^2$
12. $4x^2 + 4x + 1$
13. $x^2 - 2xy + y^2$
14. $9x^2 + 12xy + 4y^2$
15. $x^2 + 4xy + 4y^2$
16. $9x^4 - 12x^2y^2 + 4y^4$
17. $a^6b^2 - 2a^3bc^2d^2 + c^4d^4$
18. $4a^4b^4 - 16a^2b^2c^3d + 16c^6d^2$
19. $a^2 - b^2$
20. $4x^2 - 1$
21. $x^2 - y^2$
22. $9x^2 - 4y^2$
23. $x^2 - 4y^2$
24. $x^4 - 4y^4$
25. $\frac{x^2+2xy-3y^2}{2}$
26. $4\pi x^2 + 4\pi x + \pi$
27. $27x^3 + 27x^2 + 9x + 1$
28. $2x^3 + 5x^2 + 3x$
29. $x^3 + 3x^2 + 3x + 1$
30. $y^3 - 9y^2 + 27y - 27$
31. $8x^3 + 12x^2y + 6xy^2 + y^3$
32. $27x^3 - 54x^2y + 36xy^2 - 8y^3$

Extra Work Space