

## Multiplying Polynomials Handout

### 1. Multiplying a Monomial by a Monomial

Multiply the coefficients and add the exponents for variables with the same base.

Example:  $3a^2 \cdot 2a^5 = (3 \cdot 2)a^{2+5} = 6a^7$

Simplify the following:

1.  $(8x^3)(2x^5)$

2.  $(3xy^3)(6xz)$

3.  $(-4x^2)(7y^5z^3)$

4.  $(6x^2)(-3y^3)(2z^5)$

5.  $(3a^3)(-5a^4)(2a^2)$

6.  $(4x^2y^3)(7x^3y^5)$

7.  $(-6x^3y^4)(-2x^5z^2)$

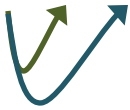
8.  $(7a^2b^2c^4)(-3a^4c^2d^4)$

### 2. Multiplying a Monomial by a Polynomial

Use the distributive property to remove the parentheses and simplify.

Example:

$$3a^3(2a^4 - 4a^5) = 3a^3 \cdot 2a^4 - 3a^3 \cdot 4a^5 = (3 \cdot 2)a^{3+4} - (3 \cdot 4)a^{3+5} = 6a^7 - 12a^8$$



Simplify the following:

1.  $2(x-7)$

2.  $-6(3h+5)$

3.  $2x(x+20)$

4.  $7x(6x+4y)$

5.  $3n^2(n^2-6n)$

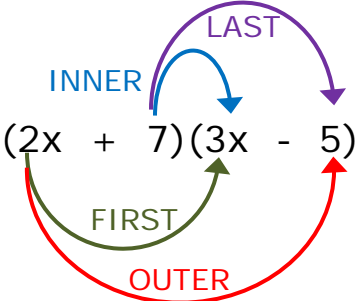
6.  $2x^3(3k^2+5k-4)$

7.  $4y^3(2xy^2-x^2y^2+y)$

8.  $9x^2y(x^2+xy+y^2)$

## Multiplying Polynomials Handout

3. Multiply a Binomial by a Binomial using FOIL and the box methods.

FOIL Method	Box Method																											
<p>FOIL Method: Series of four steps using the distributive property.</p> <div style="text-align: center;">  </div> <p>(F) FIRST: <math>2x \cdot 3x = 6x^2</math>  (O) Outer: <math>2x \cdot (-5) = -10x</math>  (I) Inner: <math>7 \cdot 3x = 21x</math>  (L) Last: <math>7 \cdot (-5) = -35</math></p> <p>Combine Like Terms:</p> $6x^2 - 10x + 21x - 35 = 6x^2 + 11x - 35$	<p>Box Method: Draw a box with four squares. Place the binomials on the outside of the boxes.</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="width: 40px; height: 40px;"></td> <td style="width: 40px; height: 40px;"></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="width: 40px; height: 40px;"></td> <td style="width: 40px; height: 40px;"></td> </tr> </table> </div> <p>Multiply terms:</p> <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="text-align: center;"><math>2x \cdot 3x</math></td> <td style="text-align: center;"><math>2x(-5)</math></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="text-align: center;"><math>7(3x)</math></td> <td style="text-align: center;"><math>7(-5)</math></td> </tr> </table> </div> <div style="text-align: center; margin-top: 20px;"> <table border="1" style="margin: auto;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="text-align: center;"><math>6x^2</math></td> <td style="text-align: center;"><math>-10x</math></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="text-align: center;"><math>21x</math></td> <td style="text-align: center;"><math>-35</math></td> </tr> </table> </div> <p>Write the product as an expression and combine Like Terms:</p> $6x^2 - 10x + 21x - 35 = 6x^2 + 11x - 35$		3x	-5	2x			+7				3x	-5	2x	$2x \cdot 3x$	$2x(-5)$	+7	$7(3x)$	$7(-5)$		3x	-5	2x	$6x^2$	$-10x$	+7	$21x$	$-35$
	3x	-5																										
2x																												
+7																												
	3x	-5																										
2x	$2x \cdot 3x$	$2x(-5)$																										
+7	$7(3x)$	$7(-5)$																										
	3x	-5																										
2x	$6x^2$	$-10x$																										
+7	$21x$	$-35$																										

Use the FOIL and Box Method to find each product:

- |                     |                   |
|---------------------|-------------------|
| 1. $(a+3)(a-2)$     | 5. $(x-5y)(a+2y)$ |
| 2. $(t-3)(2t+3)$    | 6. $(2y-5)(3y+7)$ |
| 3. $(2x+3)(2x-3)$   | 7. $(2b-1)(2b-1)$ |
| 4. $(3s-2t)(2s-3t)$ | 8. $2(x+y)(x-y)$  |

## Multiplying Polynomials Handout

### 4. Multiply a Binomial by a Polynomial.

#### Distributive Method

Distribute the binomial to each term in the polynomial.

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

Then use the method to multiply a monomial by a binomial:

$$(2x-7)(3x^2) = 6x^3 - 21x^2$$

$$(2x-7)(x) = 2x^2-7x$$

$$(2x-7)(-5) = -10x+35$$

Combine Like Terms:

$$6x^3 - 21x^2 + 2x^2 - 7x - 10x + 35 =$$

$$6x^3 - 19x^2 - 17x + 35$$

#### Box Method

Box Method: Draw a box with six squares. Place the binomials on the outside of the boxes.

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

Multiply terms:

	$3x^2$	$+x$	$-5$
$2x$	$2x \cdot 3x^2$	$2x(x)$	$2x(-5)$
$-7$	$-7(3x^2)$	$-7(x)$	$-7(-5)$

	$3x^2$	$+x$	$-5$
$2x$	$6x^3$	$2x^2$	$-10x$
$-7$	$-21x^2$	$-7x$	$+35$

Write the product as an expression and combine Like Terms:

$$6x^3 - 21x^2 + 2x^2 - 7x - 10x + 35 =$$

$$6x^3 - 19x^2 - 17x + 35$$

Use both methods to find each product.

1.  $(3x - 2)(2x^2 - x + 2)$
2.  $(-11x + 3)(-10x^2 - 7x - 9)$
3.  $(x - 3)(x^2 + 3x + 9)$
4.  $(7x + 3)(7x^2 + 3x + 10)$

5.  $(-x + 1)(4x^2 - x + 8)$
6.  $(-4x - 3)(-x^2 - 2x - 1)$
7.  $(2x+1)(4x^2 - 2x + 1)$
8.  $(-6x^4 + 5x^2 + 3x)(x + 4)$

## Multiplying Polynomials Handout KEY

### 1. Multiplying a Monomial by a Monomial

Multiply the coefficients and add the exponents for variables with the same base.

Example:  $3a^2 \cdot 2a^5 = (3 \cdot 2)a^{2+5} = 6a^7$

Simplify the following:

1.  $(8x^3)(2x^5)$   $16x^8$

2.  $(3xy^3)(6xz)$   $18x^2y^3z$

3.  $(-4x^2)(7y^5z^3)$   $-28x^2y^5z^3$

4.  $(6x^2)(-3y^3)(2z^5)$   $-36x^2y^3z^5$

5.  $(3a^3)(-5a^4)(2a^2)$   $-30a^9$

6.  $(4x^2y^3)(7x^3y^5)$   $28x^5y^8$

7.  $(-6x^3y^4)(-2x^5z^2)$   $12x^8y^4z^2$

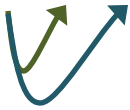
8.  $(7a^2b^2c^4)(-3a^4c^2d^4)$   $-21z^6b^2c^6d^4$

### 2. Multiplying a Monomial by a Polynomial

Use the distributive property to remove the parentheses and simplify.

Example:

$$3a^3(2a^4 - 4a^5) = 3a^3 \cdot 2a^4 - 3a^3 \cdot 4a^5 = (3 \cdot 2)a^{3+4} - (3 \cdot 4)a^{3+5} = 6a^7 - 12a^8$$



Simplify the following:

1.  $2(x-7)$   $2x-14$

2.  $-6(3h+5)$   $-18h-30$

3.  $2x(x+20)$   $2x^2+40x$

4.  $7x(6x+4y)$   $42x^2+28xy$

5.  $3n^2(n^2-6n)$   $3n^4-18n^3$

6.  $2x^3(3k^2+5k-4)$   $6x^3k^2+10x^3k-8x^3$

7.  $4y^3(2xy^2-x^2y^2+y)$   $8xy^5-4x^2y^5+4y^4$

8.  $9x^2y(x^2+xy+y^2)$   
 $9x^4y+9x^3y^2+9x^2y^3$

## Multiplying Polynomials Handout KEY

3. Multiply a Binomial by a Binomial using FOIL and the box methods.

FOIL Method	Box Method																																				
<p>FOIL Method: Series of four steps using the distributive property.</p> <div style="text-align: center;"> </div> <p>(F) FIRST: <math>2x \cdot 3x = 6x^2</math>  (O) Outer: <math>2x \cdot (-5) = -10x</math>  (I) Inner: <math>7 \cdot 3x = 21x</math>  (L) Last: <math>7 \cdot (-5) = -35</math></p> <p>Combine Like Terms:  <math>6x^2 - 10x + 21x - 35 = 6x^2 + 11x - 35</math></p>	<p>Box Method: Draw a box with four squares. Place the binomials on the outside of the boxes.</p> <div style="text-align: center;"> <table style="border-collapse: collapse; margin: 10px;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> <td></td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="border: 1px solid black; width: 40px; height: 40px;"></td> <td style="border: 1px solid black; width: 40px; height: 40px;"></td> <td></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="border: 1px solid black; width: 40px; height: 40px;"></td> <td style="border: 1px solid black; width: 40px; height: 40px;"></td> <td></td> </tr> </table> </div> <p>Multiply terms:</p> <div style="text-align: center;"> <table style="border-collapse: collapse; margin: 10px;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> <td></td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="border: 1px solid black; padding: 5px;"><math>2x \cdot 3x</math></td> <td style="border: 1px solid black; padding: 5px;"><math>2x(-5)</math></td> <td></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="border: 1px solid black; padding: 5px;"><math>7(3x)</math></td> <td style="border: 1px solid black; padding: 5px;"><math>7(-5)</math></td> <td></td> </tr> </table> </div> <div style="text-align: center; margin-top: 10px;"> <table style="border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">3x</td> <td style="text-align: center;">-5</td> <td></td> </tr> <tr> <td style="text-align: center;">2x</td> <td style="border: 1px solid black; padding: 5px;"><math>6x^2</math></td> <td style="border: 1px solid black; padding: 5px;"><math>-10x</math></td> <td></td> </tr> <tr> <td style="text-align: center;">+7</td> <td style="border: 1px solid black; padding: 5px;"><math>21x</math></td> <td style="border: 1px solid black; padding: 5px;"><math>-35</math></td> <td></td> </tr> </table> </div> <p>Write the product as an expression and combine Like Terms:  <math>6x^2 - 10x + 21x - 35 = 6x^2 + 11x - 35</math></p>		3x	-5		2x				+7					3x	-5		2x	$2x \cdot 3x$	$2x(-5)$		+7	$7(3x)$	$7(-5)$			3x	-5		2x	$6x^2$	$-10x$		+7	$21x$	$-35$	
	3x	-5																																			
2x																																					
+7																																					
	3x	-5																																			
2x	$2x \cdot 3x$	$2x(-5)$																																			
+7	$7(3x)$	$7(-5)$																																			
	3x	-5																																			
2x	$6x^2$	$-10x$																																			
+7	$21x$	$-35$																																			

Use the FOIL and Box Method to find each product:

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 1. $(a+3)(a-2)$ $a^2+a-6$            | 5. $(x-5y)(a+2y)$ $xa+2xy-5ay-10y^2$ |
| 2. $(t-3)(2t+3)$ $2t^2-3t-9$         | 6. $(2y-5)(3y+7)$ $6y^2-y-35$        |
| 3. $(2x+3)(2x-3)$ $4x^2-9$           | 7. $(2b-1)(2b-1)$ $4b^2-4b+1$        |
| 4. $(3s-2t)(2s-3t)$ $6s^2-13st+6t^2$ | 8. $2(x+y)(x-y)$ $2x^2-2y^2$         |

## Multiplying Polynomials Handout KEY

### 4. Multiply a Binomial by a Polynomial.

#### Distributive Method

Distribute the binomial to each term in the polynomial.

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

Then use the method to multiply a monomial by a binomial:

$$\begin{aligned} (2x-7)(3x^2) &= 6x^3 - 21x^2 \\ (2x-7)(x) &= 2x^2 - 7x \\ (2x-7)(-5) &= -10x + 35 \end{aligned}$$

Combine Like Terms:

$$\begin{aligned} 6x^3 - 21x^2 + 2x^2 - 7x - 10x + 35 &= \\ 6x^3 - 19x^2 - 17x + 35 & \end{aligned}$$

#### Box Method

Box Method: Draw a box with six squares. Place the binomials on the outside of the boxes.

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

Multiply terms:

	$3x^2$	$+x$	$-5$
$2x$	$2x \cdot 3x^2$	$2x(x)$	$2x(-5)$
$-7$	$-7(3x^2)$	$-7(x)$	$-7(-5)$

	$3x^2$	$+x$	$-5$
$2x$	$6x^3$	$2x^2$	$-10x$
$-7$	$-21x^2$	$-7x$	$+35$

Write the product as an expression and combine Like Terms:

$$\begin{aligned} 6x^3 - 21x^2 + 2x^2 - 7x - 10x + 35 &= \\ 6x^3 - 19x^2 - 17x + 35 & \end{aligned}$$

Use both methods to find each product.

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| 1. $(3x - 2)(2x^2 - x + 2)$      | $6x^3 - 7x^2 + 8x - 4$               |
| 2. $(-11x + 3)(-10x^2 - 7x - 9)$ | $110x^3 + 47x^2 + 78x - 27$          |
| 3. $(x - 3)(x^2 + 3x + 9)$       | $x^3 - 27$                           |
| 4. $(7x + 3)(7x^2 + 3x + 10)$    | $49x^3 + 42x^2 + 79x + 30$           |
| 5. $(-x + 1)(4x^2 - x + 8)$      | $4x^3 + 5x^2 - 9x - 8$               |
| 6. $(-4x - 3)(-x^2 - 2x - 1)$    | $4x^3 + 11x^2 + 10x + 3$             |
| 7. $(2x+1)(4x^2 - 2x + 1)$       | $8x^3 + 1$                           |
| 8. $(-6x^4 + 5x^2 + 3x)(x + 4)$  | $-6x^5 - 24x^4 + 5x^3 + 23x^2 + 12x$ |