Algebra I
8-1: Adding and Subtracting Polynomials

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to ADD AND SUBTRACT POLYNOMIALS

Question/Main Ideas: | **Notes:**

Definition: Monomial

A real number, a variable, or a product of a real number and one or more variables with whole-number exponents

Definition: Degree of a Monomial

The sum of the exponents of its variables

Example 1: Find the Degree of a Monomial

What is the degree of each monomial?

a. $5x^1$ → 1

b. $6x^3y^2$ → $3+2$ → 5

c. 4 → 0

Definition: Polynomial

A monomial or a sum of monomials

Definition: Standard Form of a Polynomial

Variables - Alphabetical from left to right

Same Variable – highest power to lowest power from left to right

Concept: Classifying Polynomials

Degree of a Polynomial: The same degree as the monomial with the greatest exponent.

Polynomial	Degree	Name Using Degree	# of Terms	Name Using Terms
6	0	Constant	1	Monomial
$5x + 9$	1	Linear	2	Binomial
$4x^2 + 7x + 3$	2	Quadratic	3	Trinomial
$2x^3$	3	Cubic	1	Monomial
$8x^4 - 2x^3 + 3x$	4	Quartic	3	Trinomial

Example 3: Classifying Polynomials

Write each polynomial in standard form. What is the name of the polynomial based on its degree and number of terms?

a. $3x + 4x^2$

$4x^2 + 3x$

Quadratic Binomial

b. $4x - 1 + 5x^3 + 7x$

$5x^3 + 11x - 1$

Cubic Trinomial

Now It's Your Turn

Write each polynomial in standard form. What is the name of the polynomial based on its degree and number of terms?

a. $7x^2 - 8x + 11x - 9x^2 + 10$

$-2x^2 + 3x + 11$

Quadratic Trinomial

b. $11x^2 + 6x^2 - 7x^2$

$10x^2$

Quadratic Monomial

Example 4: Adding Polynomials

Simplify.

$$(-7.1x^2 - 180x + 5800) + (21x^2 - 140x + 1900)$$

$(-7.1x^2 + 21x^2) + (-180x + -140x) + (5800 + 1900)$

$13x^2 - 320x + 7700$

Example 5: Subtracting Polynomials

Simplify.

$$(x^3 - 3x^2 + 5x) - (7x^3 + 5x^2 - 12)$$

$(x^3 - 7x^3) + (-3x^2 - 5x^2) + (5x) + (--12)$

$-6x^3 - 8x^2 + 5x + 12$

Now It's Your Turn

Simplify.

a. $(-4m^3 - m + 9) - (4m^2 + m - 12)$

$-4m^3 - m + 9 - 4m^2 - m + 12$

$-4m^3 - 4m^2 - 2m + 21$

b. $(8xy^2 + 6xy) + (-12x^2y + 13xy^2)$

$-12x^2y + 21xy^2 + 6xy$

Summary: _____

Algebra I
8-2: Multiplying and Factoring

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to MULTIPLY A MONOMIAL BY A POLYNOMIAL AND FACTOR A MONOMIAL FROM A POLYNOMIAL

Question/Main Ideas:	Notes:
Concept: Expanding the Distributive Property	Distribute the outside term to each term inside the parenthesis.
Example 1: Multiplying a Monomial by a Trinomial	Simplify $-x^3(9x^4 - 2x^3 + 7)$ $-x^3 \cdot 9x^4 + -x^3 \cdot -2x^3 + -x^3 \cdot 7$ $-9x^7 + 2x^6 - 7x^3$
Now It's Your Turn	Simplify $5n(3n^3 - n^2 + 8)$ $5n \cdot 3n^3 + 5n \cdot -n^2 + 5n \cdot 8$ $15n^4 - 5n^3 + 40n$
Definition: Greatest Common Factor	The term that divides evenly into all terms of a polynomial. What do all the terms have in common?
Example 2: Finding the Greatest Common Factor	Find the GCF. $5x^3 + 25x^2 + 45x$ $5 \cdot x \cdot x \cdot x$ $5 \cdot 5 \cdot x \cdot x$ $3 \cdot 3 \cdot 5 \cdot x$ $\boxed{5x}$
	Your Turn: Find the GCF $3x^4 - 9x^2 - 12x$ $3 \cdot x \cdot x \cdot x \cdot x$ $3 \cdot 3 \cdot x \cdot x$ $2 \cdot 2 \cdot 3 \cdot x$ $\boxed{3x}$

Concept: Factoring out the GCF

Pull the GCF out of each term by dividing each term by the GCF.

Example 3: Factoring out a Monomial

Factor $4x^5 - 24x^3 + 8x$

GCF: $4x$ $\quad 4x(x^4 - 6x^2 + 2)$

Now It's Your Turn

a. Factor $9x^6 + 15x^4 + 12x^2$

GCF: $3x^2$ $\quad 3x^2(3x^4 + 5x^2 + 4)$

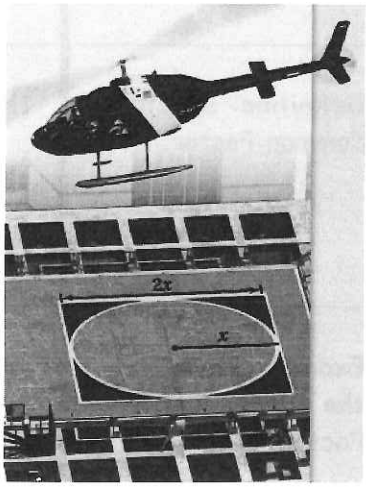
b. What is $-6x^4 - 18x^3 - 12x^2$ written as a product of a polynomial with positive coefficients and a monomial?

GCF: $-6x^2$ $\quad -6x^2(x^2 + 3x + 2)$

Example 4: Factoring a Polynomial Model

A helicopter landing pad, or helipad, is sometimes marked with a circle inside a square so that it is visible from the air. What is the area of the shaded region at the right? Write your answer in factored form.

$A = (2x)^2 - \pi x^2$
$= 4x^2 - \pi x^2$
$= x^2(4 - \pi)$



Now It's Your Turn

Suppose the side lengths of the square are 6x and the radius of the circle is 3x. What is the factored form of the area of the shaded region?

$A = (6x)^2 - \pi(3x)^2$
$= 36x^2 - 9x^2\pi$
$= 9x^2(4 - \pi)$

Summary: _____

Algebra I
8-3: Multiplying Binomials

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to MULTIPLY TWO BINOMIALS

Question/Main Ideas:	Notes:		
Example 1: Multiplying Binomials	Distributive Property $(2x + 4)(3x - 7)$ $2x(3x-7)+4(3x-7)$ $6x^2-14x+12x-28$ $6x^2-2x-28$	Using a Table (Area Model) $(2x + 4)(3x - 7)$ $6x^2 - 2x - 28$	F.O.I.L $(2x + 4)(3x - 7)$ First: $2x \cdot 3x = 6x^2$ Outside: $2x \cdot -7 = -14x$ Inside: $4 \cdot 3x = 12x$ Last: $4 \cdot -7 = -28$ $6x^2-2x-28$

Now It's Your Turn	Simplify each product.	
	a. $(5x - 3)(2x + 1)$ $10x^2+5x-6x-3$ $10x^2-x-3$	b. $(x - 6)(4x + 3)$ $4x^2+3x-24x-18$ $4x^2-21x-18$
	c. $(x - 3)(4x - 5)$ $4x^2-5x-12x+15$ $4x^2-17x+15$	b. $(3x + 1)(x + 4)$ $3x^2+12x+1x+4$ $3x^2+13x+4$
	d. $(3x - 4)(7x - 3)$ $21x^2-9x-28x+12$ $21x^2-37x+12$	e. $(2x^2 + 3)(2x - 5)$ $4x^3-10x^2+6x-15$

Example 2: Multiplying a Trinomial by a Binomial	Simplify $(3x^2 + x - 5)(2x - 7)$. $6x^3-21x^2+2x^2-7x-10x+35$ $6x^3-19x^2-17x+35$	Your Turn: Simplify $(2x^2 - 3x + 1)(x - 3)$. $2x^3-6x^2-3x^2+9x+1x-3$ $2x^3-9x^2+10x-3$

Summary: _____

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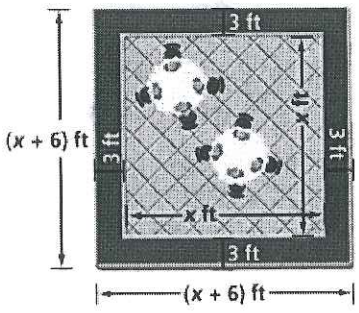
Algebra I
8-4: Multiplying Special Cases

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to FIND THE SQUARE OF A BINOMIAL AND THE PRODUCT OF A SUM AND DIFFERENCE

Question/Main Ideas:	Notes:	
Concept: Squaring a Binomial	Evaluate $(x + 3)^2$ for $x = 2$ $(2+3)^2$ $5^2 = 25$	Evaluate $x^2 + 9$ for $x = 2$ 2^2+9 $4+9=13$
	BIG IDEA: $(x+3)^2 \neq x^2+9$ Cannot distribute exponent over addition/subtract.	
Example 1: Squaring and Cubing a Binomial	Simplify each expression. a. $(x + 8)^2$ $(x+8)(x+8)$ $x^2+8x+8x+64$ $x^2+16x+64$	b. $(2m - 3)^2$ $(2m-3)(2m-3)$ $4m^2-6m-6m+9$ $4m^2-12m+9$
Now It's Your Turn	Simplify each expression. a. $(n - 7)^2$ $(n-7)(n-7)$ $n^2-7n-7n+49$ $n^2-14n+49$	b. $(2x + 9)^2$ $(2x+9)(2x+9)$ $4x^2+18x+18x+81$ $4x^2+36x+81$
Example 2: Applying Squares of Binomials	A square outdoor patio is surrounded by a brick walkway as shown. What is the area of the walkway? Big: $A=(x+6)^2$ Little: $A=x^2$ $(x+6)(x+6)$ $x^2+6x+6x+36$ $x^2+12x+36$ $x^2+12x+36-x^2$ $A=12x+36$	
Now It's Your Turn	Suppose the brick walkway is 4 feet wide. What is the area? Big: $(x+8)^2$ $(x+8)(x+8)$ $x^2+8x+8x+64$ $x^2+16x+64$ Little: $A=x^2$ $x^2+16x+64-x^2$ $A=16x+64$	

Concept: The product of a Sum and Difference

Simplify each expression.

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

$x^2 + 3x - 3x - 9$

$x^2 - 9$

b. $(2x + 5)(2x - 5)$

$4x^2 - 10x + 10x - 25$

$4x^2 - 25$

Look at the two problems above:

c. What do the original problems have in common?

Same binomial - one (+), one (-)

d. What do the solutions have in common?

No x-term

Definition: The product of a Sum and Difference

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

Example 3: Finding the Product of a Sum and Difference

Simplify $(x^3 + 8)(x^3 - 8)$.

$(x^3)^2 - (8)^2$

$x^6 - 64$

Now It's Your Turn

Simplify each expression

a. $(x + 9)(x - 9)$

$x^2 - 9^2$

$x^2 - 81$

b. $(6 + m^2)(6 - m^2)$

$6^2 - (m^2)^2$

$36 - m^4$

$-m^4 + 36$

c. $(3c - 4)(3c + 4)$

$(3c)^2 - 4^2$

$9c^2 - 16$

Summary: _____

Algebra I
8-5: Factoring $x^2 + bx + c$

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to FACTOR TRINOMIALS OF THE FORM $X^2 + BX + C$

Question/Main Ideas:	Notes:
Exploration: Distributive Property	Simplify the following then answer the questions. a. $(x + 6)(x + 4)$ $x^2+10x+24$ b. $(x - 3)(x - 5)$ $x^2-8x+15$ c. $(x - 9)(x + 4)$ $x^2-5x-36$ d. $(x - 1)(x + 6)$ x^2+5x-6 The standard form of a polynomial can be written as $x^2 + bx + c$. Use the information to answer the following questions. 1. Look at the original problems a-d above. What do you notice about the original numbers and the "b" from your answer? Add the 2 original numbers to get b 2. Look at the original problems a-d above. What do you notice about the original numbers and the "c" from your answer? Multiply the 2 original numbers to get c
Factoring $x^2 + bx + c$	Find two numbers that multiply to get "c" and add to get "b"
Example 1: Factoring $x^2 + bx + c$	Factor the following. a. $x^2+8x+15$ Factors: 15: 1, 15; -1, -15; 3, 5; -3, -5 $= 8$ $(x+3)(x+5)$ b. $x^2-11x+24$ $(x-3)(x-8)$ Factors: 24: 1, 24; -1, -24; 2, 12; -2, 12; 3, 8; -3, -8

Now It's Your Turn

Factor the following.

a. $x^2 + 11x + 30$

$5 \cdot 6 = 30$

$5 + 6 = 11$

$(x+5)(x+6)$

b. $x^2 - 6x + 8$

$-2 \cdot -4 = 8$

$-2 + -4 = -6$

$(x-2)(x-4)$

c. $x^2 - 4x - 21$

$-7 \cdot 3 = -21$

$-7 + 3 = -4$

$(x-7)(x+3)$

d. $x^2 + 9x - 36$

$-3 \cdot 12 = -36$

$-3 + 12 = 9$

$(x-3)(x+12)$

Example 2: Factoring a Trinomial with Two Variables

Factor the following.

$x^2 + 6xy - 55y^2$

$-5 \cdot 11 = -55$

$-5 + 11 = 6$

$(x-5y)(x+11y)$

Now It's Your Turn

Factor the following.

$m^2 + 6mn - 27n^2$

$-3 \cdot 9 = -27$

$-3 + 9 = 6$

$(m+9n)(m-3n)$

Summary: _____

Algebra I
8-6: Factoring $ax^2 + bx + c$

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to FACTOR TRINOMIALS OF THE FORM $AX^2 + BX + C$

Question/Main Ideas:	Notes:
Review Concept: Distributive Property Method	Simplify: $(2x + 7)(3x + 1)$ $6x^2 + 2x + 21x + 7$ $6x^2 + 23x + 7$

Concept: Factoring $ax^2 + bx + c$	STEPS TO FACTORING $AX^2 + BX + C$	Example: Factor $5x^2 + 11x + 2$
	Multiply $a \cdot c$	$5 \cdot 2 = 10$
	Find two numbers that multiply $= ac$ add $= b$	$1 \cdot 10 = 10$ $1 + 11 = 11$
	Rewrite b term as the sum of those 2 numbers	$5x^2 + 10x + 1x + 2$
	Group the terms into two groups of two terms	$(5x^2 + 10x) + (1x + 2)$
	Pull the GCF out of each group	$5x(x + 2) + 1(x + 2)$
	Parenthesis should match - Pull out - leave what's left	$(x + 2)(5x + 1)$

Example 1: Factoring $ax^2 + bx + c$	Factor $3x^2 + 4x - 15$	
	$ac = 3 \cdot -15$ $= -45$ $9 \cdot -5 = -45$ $9 + -5 = 4$	$(3x^2 + 9x)(-5x - 15)$ $3x(x + 3) - 5(x + 3)$ $(x + 3)(3x - 5)$

Now It's Your Turn

Factor the following.

a. $6x^2+13x+5$

$6 \cdot 5 = 30$

$10 \cdot 3 = 30$

$10+3=13$

$(6x^2+10x)(3x+5)$

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

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

b. $10x^2+31x-14$

$10 \cdot -14 = -140$

$35 \cdot -4 = -140$

$35+-4=31$

$(10x^2+35x)(4x-14)$

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

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

Review Concept: Greatest Common Factor

The term that all the other terms have in common

Example 2: Factoring out a Monomial First

Factor $18x^2-33x+12$

GCF: 3

$6 \cdot 4 = 24$

$-3 \cdot -8 = 24$

$-3+-8=-11$

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

$3[(6x^2-3x)(-8x+4)]$

$3[3x(2x-1)-4(2x-1)]$

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

Now It's Your Turn

Factor.

a. $8x^2-36x-20$

GCF: 4

$4(2x^2-9x-5)$

$2 \cdot -5 = -10$

$4((2x^2-10x)(1x-5))$

$4[2x(x-5)+1(x-5)]$

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

b. $9x^3-18x^2-27x$

GCF: $9x$

$9x(x^2-2x-3)$

$9x(x-3)(x+1)$

Summary: _____

Algebra I
8-7: Factoring Special Cases

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to FACTOR THE DIFFERENCE OF TWO SQUARES AND FACTOR OUT COMMON FACTORS

Question/Main Ideas:	Notes:	
Definition: Perfect Square Trinomial	If $\left(\frac{b}{a}\right)^2 = c$, then it is a perfect square trinomial. Factors to $\left(x + \frac{b}{a}\right)^2$	
Example 1: Factoring a Perfect Square Trinomial	Factor $x^2 - 12x + 36$ $\frac{-12}{a} = -6$ $(-6)^2 = 36$ $(x-6)^2$	
Now It's Your Turn	Factor the following. a. $x^2 + 6x + 9$ $\left(\frac{6}{2}\right)^2 = 9$ $(x+3)^2$ b. $x^2 - 14x + 49$ $\left(\frac{-14}{2}\right)^2 = 49$ $(x-7)^2$	
Factoring the Difference of Two Squares	$a^2 - b^2 = (a-b)(a+b)$	
Example 2: Factoring the Difference of Two Squares	Factor the following. a. $x^2 - 9 = (x-3)(x+3)$ b. $16x^2 - 81$	Your Turn: Factor the following. a. $x^2 - 100 = (x-10)(x+10)$ b. $25x^2 - 64 = (5x-8)(5x+8)$
Example 3: Factoring Out a Common Factor	Factor $24x^2 - 6$ $6(4x^2-1)$ $6(2x-1)(2x+1)$	Your Turn: Factor $12x^2 - 48$ $12(x^2-4)$ $12(x-2)(x+2)$

Summary: _____

Algebra I
8-8: Factoring by Grouping

Name _____
Date _____ Class Period _____

Learning Target: Today you will be able to FACTOR HIGHER-DEGREE POLYNOMIALS BY GROUPING

Question/Main Ideas:	Notes:
Steps to Factor by Grouping	Pull out the GCF of all terms Groups terms into two groups Pull out GCF in each group Parenthesis should match Pull out common parenthesis, leave others
Example 1: Factoring a Cubic Polynomial	Factor $(3x^3 - 12x^2) + (2x - 8)$ $3x^2(x-4) + 2(x-4)$ $(x-4)(3x^2+2)$
Now It's Your Turn	a. Factor $(8x^3 + 14x^2) + (20x + 35)$ $2x^2(4x+7) + 5(4x+7)$ $(4x+7)(2x^2+5)$ b. How is the factoring method used here like the method used in lesson 8.6? How is it different? Same process. This is used when a polynomial has four terms
Example 2: Factoring a Polynomial Completely	Factor $4x^4 - 8x^3 + 12x^2 - 24x$ GCF: $4x$ $4x[(x^3 - 2x^2) + (3x - 6)]$ $4x[x^2(x-2) + 3(x-2)]$ $4x(x-2)(x^2+3)$

Now It's Your Turn

Factor $6x^4 + 9x^3 + 12x^2 + 18x$

GCF: $3x$

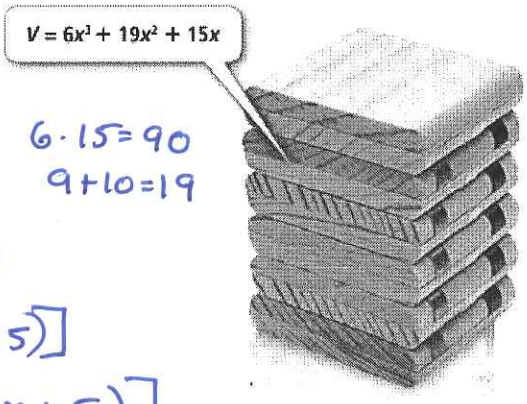
$3x[(2x^3 + 3x^2) + (4x + 6)]$

$3x[x^2(2x+3) + 2(2x+3)]$

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

Example 3: Finding the Dimensions of a Rectangular Prism

The toy shown below is made of several bars that can fold together to form a rectangular prism or unfold to form a "ladder". What expressions can represent the dimensions of the toy when it is folded up? Use factoring.



$6 \cdot 15 = 90$

$9 + 10 = 19$

$x(6x^2 + 19x + 15)$

$x[(6x^2 + 10x) + (9x + 15)]$

$x[2x(3x+5) + 3(3x+5)]$

$x(3x+5)(2x+3)$

Now It's Your Turn

A rectangular prism has volume $60x^3 + 34x^2 + 4x$. What expressions can represent the dimensions of the prism? Use factoring.

GCF: $2x$

$30 \cdot 2 = 60$

$12 \cdot 5 = 60$

$12 + 5 = 17$

$2x[30x^2 + 17x + 2]$

$2x[(30x^2 + 12x) + (5x + 2)]$

$2x[6x(5x+2) + 1(5x+2)]$

$2x(5x+2)(6x+1)$

Summary: Factoring Polynomials

take note

Summary Factoring Polynomials

1. Factor out the greatest common factor (GCF).
2. If the polynomial has two terms or three terms, look for a difference of two squares, a perfect-square trinomial, or a pair of binomial factors.
3. If the polynomial has four or more terms, group terms and factor to find common binomial factors.
4. As a final check, make sure there are no common factors other than 1.

Summary: _____