Math-3

Lesson 2-2
Factoring Quadratics with Lead
Coefficient Not = 1,
Irrational and Complex Conjugates

When factoring a quadratic expression, what if there is no common factor AND the lead coefficient is NOT equal to 1?

$$ax^2 + bx + c$$

(These come from multiplying binomials that also do not have lead coefficients of 1.) (2x + 1)(x + 3)

Use the "box method" to multiply the binomials

$$2x^2 + 7x + 3$$

	Х	3
2x	2x ²	6x
1	X	3

Notice a nice pattern when you multiply this out ("simplify")

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

$$2x^2 + 7x + 3$$

"right plus right" does not add up to 7, but notice something.

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

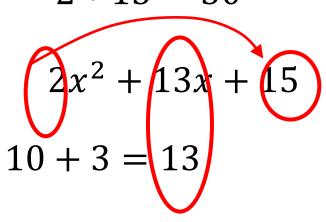
$$6x$$

$$6x + x = 7x$$

$$2 * 3 = 6$$

Are there any other factors of 6 that add up to 7?

$$2 * 15 = 30$$



$$30 = 10 * 3$$

Are there any <u>other</u> factors of 30 that add up to 13?

This tells us to break $\frac{13x}{10x + 3x}$ $2x^2 + 13x + 15$

$$2x^2 + 10x + 3x + 15$$

These are all of the terms in "the box"

	X	5
2x	2x ²	10x
3	3x	(15)

What is the bottom-left term in the box?

$$x^*(_3) = 3x$$

What is the top-right term in the box?

$$2x^*(\underline{5}) = 10x$$

Final check: 3*5 = 15?

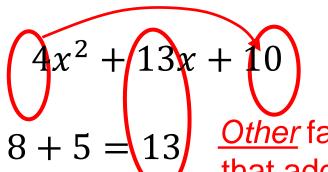
Factored form:

$$2x^2 + 13x + 15$$

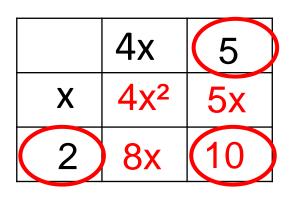
$$\rightarrow (2x+3)(x+5)$$

$$4 * 10 = 40$$

These are all of the terms in "the box"



Other factors of 40 that add up to 13?



40 = 8 * 5

This tells us to break 13x into 8x + 5x

$$4x^2 + 13x + 10$$

 $4x^2 + 8x + 5x + 10$

Factored form:

$$4x^2 + 13x + 10$$

 $\rightarrow (x + 2)(4x + 5)$

Since $4x^2$ can be factored 2 ways, look for the common factors of the 1st row.

'x' is the common factor of $4x^3$ and 5x

Look for the common factors of the 1st column

'4x' is the common factor of $4x^3$ and 8x

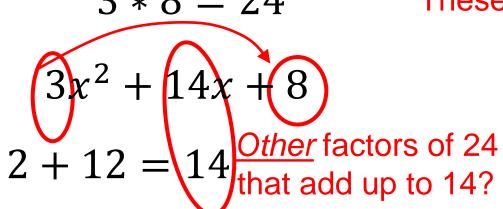
$$4x^*(_2) = 8x$$

$$x^*(_5) = 5x$$

Final check: 2*5 = 10?

$$3 * 8 = 24$$

These are all of the terms in "the box"



	X	4
3x	3x ²	12x
2	2x	8

24 = 2 * 12

This tells us to break 14x into 2x + 12x

$$3x^2 + 14x + 8$$

$$3x^2 + 2x + 12x + 8$$

What is the bottom-left term in the box?

$$x^*(\underline{2}) = 2x$$

What is the top-right term in the box?

$$3x^*(\underline{4}) = 12x$$

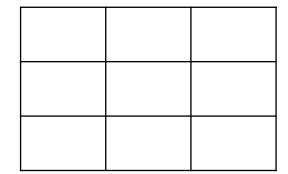
Final check: 2*4 = 8?

Factored form:

$$3x^2 + 14x + 8$$

$$\rightarrow (3x+2)(x+4)$$

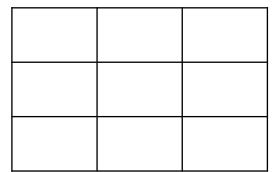
$$5x^2 + 12x + 4$$



$$11x^2 + 2x - 9$$

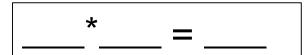


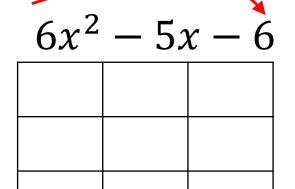
 $12x^2 - 16x + 5$



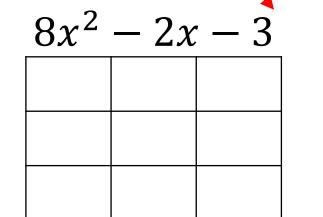
____*___= ____

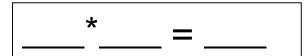
____+__= -16

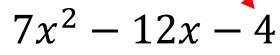


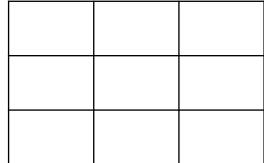






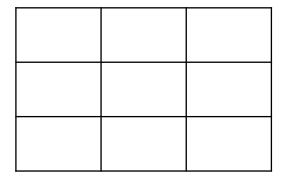








 $6x^2 - 29x + 9$



____*___= ____

____+___= ____

$$x^2 - 1$$

"the difference of two squares"

$$x^2 + 0x - 1$$
 Two numbers multiplied = (-1) and added = 0 $(-1)(+1)$

$$(x-1)(x+1)$$
 "conjugate binomial pair"

$$x^2 - 1 \rightarrow (x - 1)(x + 1)$$

$$x^2 - 4 \rightarrow (x - 2)(x + 2)$$

$$x^2 - 9 \rightarrow (x - 3)(x + 3)$$

$$x^2 - 16 \rightarrow (x - 4)(x + 4)$$

$$x^2 - 1 \rightarrow (x - 1)(x + 1)$$

"conjugate binomial pair"

$$x^2 - 4 \rightarrow (x - 2)(x + 2)$$

"conjugate binomial pair"

Follows this pattern

$$\rightarrow \left(\sqrt{x^2} - \sqrt{4}\right) \left(\sqrt{x^2} + \sqrt{4}\right)$$

What if the second term is not a "perfect square"?

$$x^2 - 2 \rightarrow (x - \sqrt{2})(x + \sqrt{2})$$

"irrational conjugate binomial pair"

$$x^2 - 3 \rightarrow (x - \sqrt{3})(x + \sqrt{3})$$

"irrational conjugate binomial pair"

Use the "box method" to multiply the following binomial pairs

(x)	$(-\sqrt{5})$	(x +	$-\sqrt{5}$

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(x)	l]	ハル		ιı

	X	$-\sqrt{5}$
V		

	Х	-i
X		
i		

$$(x-\sqrt{7})(x+\sqrt{7})$$

	01)			α
1 Y	 / 1	1 Y	_	2i

	X	$-\sqrt{7}$
X		
$\sqrt{7}$		

	X	-2 <i>i</i>
X		
2 <i>i</i>		

$$x = \sqrt{-1}$$

$$x^2 = (\sqrt{-1})^2$$

$$x^2 = -1$$

Factor the following:

$$x^2 + 3$$

$$x^2 + 4$$

$$x^2 - 5$$

$$x^2 - 17$$