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Master 3.1a Activate Prior Learning: Factoring Trinomials

A trinomial has the form $ax^2 + bx + c$, where *a, b,* and *c* are non-zero constants.

Factoring Trinomials of the Form $x^2 + bx + c$

The factors will be (x + an integer)(x + an integer).

The integers in the binomials have a sum of b and a product of c.

For example, to factor $x^2 – 3x – 28$:

Find two integers whose sum is –3 and whose product is –28.

Factors of –28	Sum of the Factors
1, –28	1 – 28 = –27
–1, 28	–1 + 28 = 27
2, –14	2 – 14 = –12
–2, 14	–2 + 14 = 12
4, –7	4 – 7 = –3
–4, 7	–4 + 7 = 3

The factors with a sum of –3 are 4 and –7.
So, $x^2 – 3x – 28 = (x + 4)(x – 7)$

Factoring Trinomials of the Form $ax^2 + bx + c$

The factors will be $(ex + f)(gx + h)$, where $eg = a$ and $fh = c$.

For example, use logical reasoning to factor $2x^2 – 7x + 6$.
The factors of the first term, $2x^2$, are: x and $2x$
The factors of the constant term, 6, are: 1, 6; 2, 3; –1, –6; and –2, –3
The coefficient of the middle term is –7, so the factors are negative.
Consider –1, –6 and –2, –3. Use guess and test.
$(x – 1)(2x – 6) = 2x^2 – 8x + 6$ $(x – 6)(2x – 1) = 2x^2 – 13x + 6$
$(x – 2)(2x – 3) = 2x^2 – 7x + 6$ $(x – 3)(2x – 2) = 2x^2 – 8x + 6$

So, $2x^2 – 7x + 6 = (x – 2)(2x – 3)$

Check Your Understanding

1. Factor each trinomial.

a) $x^2 + 7x + 10$ **b)** $x^2 + 11x + 18$ **c)** $x^2 – 9x + 20$
d) $x^2 – 11x + 30$ **e)** $x^2 – 2x – 15$ **f)** $x^2 + 3x – 10$
g) $x^2 – 4x – 60$ **h)** $x^2 + x – 42$ **i)** $x^2 – 5x – 36$

2. Factor each trinomial.

a) $2x^2 + 7x + 5$ **b)** $3x^2 + 11x + 6$ **c)** $2x^2 – 5x + 3$
d) $5x^2 – 16x + 3$ **e)** $2x^2 + 9x – 5$ **f)** $3x^2 – 7x – 6$
g) $4x^2 + 3x – 10$ **h)** $6x^2 – 11x – 10$ **i)** $6x^2 – 35x – 6$

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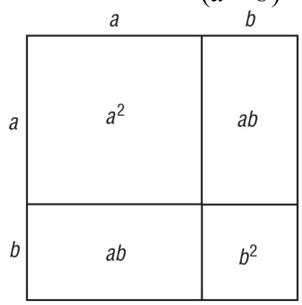
Master 3.1b Activate Prior Learning: Factoring Special Products

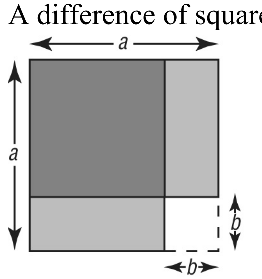
Factoring a Perfect Square Trinomial
A perfect square trinomial has the form:

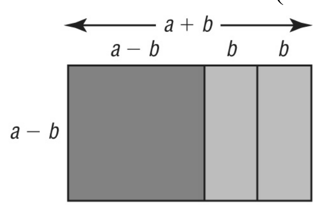
$$a^2 + 2ab + b^2 = (a + b)(a + b) = (a + b)^2 \quad \text{or} \quad a^2 - 2ab + b^2 = (a - b)(a - b) = (a - b)^2$$



To factor a perfect square trinomial such as $9x^2 - 24x + 16$:
The first term, $9x^2$, is a perfect square since: $9x^2 = (3x)^2$
The last term, 16, is a perfect square since: $16 = (4)^2$ and $16 = (-4)^2$
The middle term, $-24x$, is twice the product of $3x$ and -4 since: $-24x = 2(3x)(-4)$
So, $9x^2 - 24x + 16 = (3x - 4)(3x - 4)$
$= (3x - 4)^2$

Factoring a Difference of Squares
A difference of square has the form: $a^2 - b^2 = (a - b)(a + b)$





To factor a difference of squares such as $81x^2 - 25$:
The first term, $81x^2$, is a perfect square since: $81x^2 = (9x)^2$
The second term, 25, is a perfect square since: $25 = (5)^2$
So, $81x^2 - 25 = (9x)^2 - (5)^2$
$= (9x - 5)(9x + 5)$

Check Your Understanding

1. Is each trinomial a perfect square? If your answer is yes, factor the trinomial.
a) $4x^2 + 4x + 1$ **b)** $9x^2 + 30x + 25$ **c)** $16x^2 + 4x + 1$
d) $25x^2 - 20x + 4$ **e)** $x^2 - 12x + 36$ **f)** $10x^2 + 70x + 49$
g) $49x^2 + 84xy + 36y^2$ **h)** $64x^2 - 48x - 9$ **i)** $64x^2 - 48x + 9$

2. Is each binomial a difference of squares? If your answer is yes, factor the binomial.
a) $9x^2 - 1$ **b)** $25x^2 - 4$ **c)** $x^2 - 16$
d) $49x^2 + 4$ **e)** $x^2 - 12$ **f)** $121x^2 - 49$
g) $4x^2 - 81y^2$ **h)** $9 - 100x^2$ **i)** $9y^2 - 100x^2$

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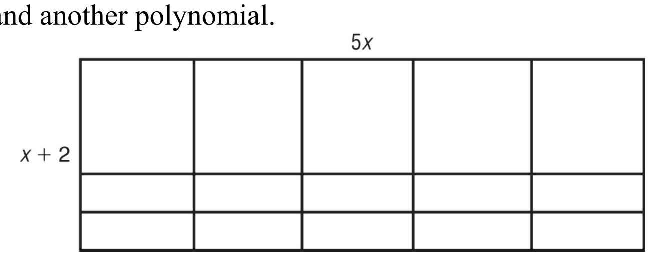
Master 3.1c Activate Prior Learning: Factoring Polynomials

Factoring Polynomials with Common Factors
Identify the greatest common factor (GCF), then use the distributive property to write the polynomial as the product of the GCF and another polynomial.

For example, to factor $5x^2 + 10x$:
The factors of $5x^2$ are: $(\underline{5})(\underline{x})(x)$
The factors of $10x$ are: $(2)(\underline{5})(\underline{x})$
The GCF is: $(5)(x) = 5x$
So, $5x^2 + 10x = 5x(x) + 5x(2)$
$= 5x(x + 2)$



Factoring Trinomials with Common Factors
First remove any GCF, then identify the type of trinomial.

For example, to factor $36x^2 – 48x + 16$:
Remove the GCF: $36x^2 - 48x + 16 = 4(9x^2 - 12x + 4)$
Factor the perfect square trinomial: $= 4(3x - 2)(3x - 2)$
$= 4(3x - 2)^2$

For example, to factor $12x^2 – 39x + 27$:
Remove the GCF: $12x^2 - 39x + 27 = 3(4x^2 - 13x + 9)$
The trinomial is not a perfect square so use logical reasoning to factor.
$12x^2 - 39x + 27 = 3(4x - 9)(x - 1)$

Check Your Understanding

1. Factor each polynomial by removing the GCF.

a) $3x^2 - 15x$ **b)** $5x^2 + 20x - 5$
c) $12x^2y - 28xy^2$ **d)** $7x^3 - 21x^2 + 35x$
e) $9x^3 - 16x^2$ **f)** $36x^3 + 27x^2$

2. Factor each polynomial completely.

a) $3x^2 - 12$ **b)** $2x^2 + 4x - 16$
c) $45x^2 - 120x + 80$ **d)** $4x^2y + 2xy - 6y$
e) $6x^2 - 13x + 6$ **f)** $100x^2y^2 - 4x^2$
g) $4x^2 + 16x + 12$ **h)** $48x^2 + 72x + 27$
i) $6x^2 - 12x - 90$ **j)** $6x^2 - 3x - 45$