

# SYNTHETIC FACTORING TRINOMIALS OF THE FORM $ax^2 + bx + c$

UVU Math Lab

## Synthetic Factoring (aka Darren Wiberg – Jon Anderson Method):

1. Given  $ax^2 + bx + c$ , find the value of  $ac$ .
2. Find the pair of integers whose product is  $ac$  and whose sum is  $b$ . That is, find  $m$  and  $n$  so that  $mn = ac$  and  $m + n = b$ .
3. Create fractions of the form  $\frac{m}{a}$  and  $\frac{n}{a}$ .
4. Simplify the fractions formed in step 3, say  $\frac{m}{a} = \frac{q}{p}$  and  $\frac{n}{a} = \frac{s}{r}$ .
5. Form the factors:  $(px + q)(rx + s)$ .
6. Multiply out the factored form to verify your answer.

Example 1:	Example 2:	Grouping method from textbooks
$12x^2 - x - 6$ $ac = -72, b = -1$ $mn = -72 = -9 \cdot 8$ $m + n = -1 = -9 + 8$ $\frac{-9}{12} = \frac{m}{a}, \frac{8}{12} = \frac{n}{a}$ $\frac{-3}{4} = \frac{q}{p}, \frac{2}{3} = \frac{s}{r}$ $(4x - 3)(3x + 2)$	$3x^2 - 11x + 10$ $ac = 30$ $30 = -5 \cdot -6$ $\frac{-5}{3}, \frac{-6}{3}$ $\frac{-5}{3}, \frac{-2}{1}$ $(3x - 5)(x - 2)$	$3x^2 - 11x + 10$ $ac = 30$ $30 = -5 \cdot -6$ $3x^2 - 11x + 10$ $= 3x^2 - 5x - 6x + 10$ $= (3x^2 - 5x) + (-6x + 10)$ $= x(3x - 5) - 2(3x - 5)$ $= (3x - 5)(x - 2)$

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## The Magic Squares Method:

1. Given  $ax^2 + bx + c$ , find the value of  $ac$ .
2. Find the pair of integers whose product is  $ac$  and whose sum is  $b$ . That is, find  $m$  and  $n$  so that  $mn = ac$  and  $m + n = b$ .
3. Write four terms in the magic box as indicated:  
 $ax^2$ : top left always,  $+c$ : bottom right always,  $+mx$  &  $+nx$  in either remaining diagonal box.

$ax^2$	$+mx$
$+nx$	$+c$

4. Pull out the greatest common factors from each row and each column.
5. Form the pair of factors.
6. Multiply out the factored form to verify your answer.

Example 1:	Example 2:								
$12x^2 - x - 6$	$3x^2 - 11x + 10$								
$ac = -72, b = -1$	$ac = 30$								
$mn = -72 = -9 \cdot 8$ $m + n = -1 = -9 + 8$	$30 = -5 \cdot -6$								
$4x$ $-3 *$ $\uparrow$ $\uparrow$	$3x$ $-5 *$ $\uparrow$ $\uparrow$								
$3x \leftarrow$ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td><math>12x^2</math></td> <td><math>-9x</math></td> </tr> <tr> <td><math>8x</math></td> <td><math>-6</math></td> </tr> </table>	$12x^2$	$-9x$	$8x$	$-6$	$x \leftarrow$ <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td><math>3x^2</math></td> <td><math>-5x</math></td> </tr> <tr> <td><math>-6x</math></td> <td><math>10</math></td> </tr> </table>	$3x^2$	$-5x$	$-6x$	$10$
$12x^2$	$-9x$								
$8x$	$-6$								
$3x^2$	$-5x$								
$-6x$	$10$								
$+2 * \leftarrow$	$-2 * \leftarrow$								
$(4x - 3)(3x + 2)$	$(3x - 5)(x - 2)$								

\* Note we only pulled out a negative if the value in box  $mx$  or  $nx$  was negative.