Learning Enhancement Team

UEA
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STUDENT SUPPORT SERVICE

Steps into Algebra

Opening Brackets

This guide gives a simple procedure for opening brackets in algebra.

Why is opening brackets important?

In mathematics it is common to see brackets within expressions and equations; it is often useful to open these brackets in order to help when cancelling down and collecting like-terms. Opening brackets involves algebraic multiplication. If you find multiplication in algebra difficult you should read the study guide: *SNALPHABET* before continuing.

The grid method for opening brackets

The conventional way of opening brackets involves drawing lines from each term inside one bracket and connecting them to all the terms in a second bracket (you may remember this from the phrase "eye-brow, eye-brow, nose and mouth"). Although this technique is useful, it involves a precise procedure and can get complicated when the brackets contain more than two terms. Another, more visual and straightforward technique is given in this guide. The method is best illustrated by an example.

Example: Expand the brackets $(x+2)(x+3)$.

1. Firstly construct a grid with dimensions equal to the number of terms within each bracket. Here you have two terms in each bracket, so draw a two by two grid. Write the first term from the first bracket at the top of the first column and the second term from the first bracket at the top of the second column. Write the first term of the second bracket at the end of the first row and the second term from the second bracket at the end of the second row. This gives:

$$\begin{array}{cc|l} +x & +2 & \\ \hline & & +x \\ \hline & & +3 \end{array}$$

You should include the sign associated with each term, even if it is not present in the brackets.

2.   In each box write the result of multiplying the term at the top of the column the box is in by the term at the end of the row the box is in. For example the top left box has $+x$ at the top of the column and $+x$ at the end of the row, giving $(+x) \times (+x) = +x^2$. Write your answers using the SNALPHABET system. You should find:

$$
\begin{array}{cc}
+x & +2 \\
\hline
\boxed{+x^2 \quad +2x} & +x \\
\boxed{+3x \quad +6} & +3
\end{array}
$$

	$+x$	$+2$	
	$+x^2$	$+2x$	$+x$
	$+3x$	$+6$	$+3$

3.   Write out the terms in the boxes in turn, including the signs:

$$(x+2)(x+3) = +x^2 + 2x + 3x + 6$$

After collecting any like-terms (you can add $2x$ and $3x$) and tidying up the extra + sign at the beginning, you find that:

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

Some more complicated examples

Example: Expand $(-x^2 + 6x - 4)(-x - 3)$.

First draw your grid; this is a three by two as there are three terms in the first bracket and two terms in the second bracket. Here the terms from the first bracket go at the top of the columns and the terms from the second bracket go at the end of the rows:

	$-x^2$	$+6x$	-4	
				$-x$
				-3

Now fill in the grid using SNALPHABET:

	$-x^2$	$+6x$	-4	
	$+x^3$	$-6x^2$	$+4x$	$-x$
	$+3x^2$	$-18x$	$+12$	-3

Finally write out the terms in the boxes and collect like-terms. As $-6x^2 + 3x^2 = -3x^2$ and $+4x - 18x = -14x$:

$$\left(-x^2 + 6x - 4\right)\left(-x - 3\right) = +x^3 - 6x^2 + 4x + 3x^2 - 18x + 12 = x^3 - 3x^2 - 14x + 12$$

Example: Expand $(2x - 4)^2$.

It is common to write $(2x - 4)^2 = 4x^2 - 16$. You will see that this is incorrect. As $(2x - 4)^2 = (2x - 4)(2x - 4)$, you can expand the brackets using the method above. Construct a two by two grid and fill the boxes in using SNALPHABET to get:

$$\begin{array}{cc} +2x & -4 \end{array}$$

$+4x^2$	$-8x$	$+2x$
$-8x$	$+16$	-4

After writing out the terms in the boxes and collecting like-terms:

$$(2x - 4)^2 = +4x^2 - 8x - 8x + 16 = 4x^2 - 16x + 16$$

Example: Expand $-4x(x + y - 5z)$.

Construct a 3 by 1 grid. You can think of $-4x$ as being in its own bracket. Fill in the boxes using SNALPHABET as usual:

$$\begin{array}{ccc} +x & +y & -5z \end{array}$$

$-4x^2$	$-4xy$	$+20xz$	$-4x$

Giving:

$$-4x(x + y - 5z) = -4x^2 - 4xy + 20xz$$

Example: Expand and simplify $(x - 4)(2x - 5) - (x^2 + 3x - 2)$.

Here there are two terms, each require brackets to be opened using the technique outlined above. The first term requires a 2 by 2 grid:

$$\begin{array}{cc} +x & -4 \end{array}$$

$+2x^2$	$-8x$	$+2x$
$-5x$	$+20$	-5

The second term requires a 3 by 1 grid. It is common (and incorrect) to put the minus sign only in front of the x^2 term, in fact, *all* the terms in the bracket are multiplied by -1:

$$
\begin{array}{|c|c|c|}
\hline
+x^2 & +3x & -2 \\
\hline
-x^2 & -3x & +2 \\
\hline
\end{array} \quad -1
$$

Using these two results you find that:

$$(x-4)(2x-5)-(x^2+3x-2) = +2x^2-8x-5x+20-x^2-3x+2$$

$$= x^2 -16x+22$$

after collection of like-terms.

Want to know more?

If you have any further questions about this topic you can make an appointment to see a **Learning Enhancement Tutor** in the **Student Support Service**, as well as speaking to your lecturer or adviser.

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