Simplifying, expanding and dividing

Leaving Certificate · Ordinary Level

Understand the idea

How to start

A term includes its sign. In $4x - 3 + 2x$, the terms are $4x$, -3 and $+2x$.

1. Simplify means write an equal expression with fewer unnecessary parts.
2. Expand means multiply out brackets. Every term inside must be multiplied.
3. Keep signs with terms when moving like terms beside one another.

Key terms & definitions

Like terms
Terms with the same variable part and powers.

Expand
Remove brackets by distributing multiplication.

Polynomial
A sum of terms with non-negative whole-number powers of the variables.

Key ideas

• Collect only like terms: their variable parts and powers must match.

• Distribute a factor to every term in a bracket. A minus sign before a bracket changes every sign inside.

• For two brackets, multiply every term in the first by every term in the second. Collect like terms afterwards.

Quick reminder

• Collect only like terms.

• Multiply every term when expanding brackets.

• Check division by multiplying the quotient and divisor.

Worked examples

Example 01 · Start here: collect just two like terms

Simplify $6x + 4x$.

Why this method?

Both terms count the same type of quantity: x. Add their coefficients and keep x.

$6x + 4x = (6 + 4)x$	**Step 1** Six lots of x and four lots of x make ten lots of x.
$= 10x$	**Step 2** The letter part stays x; we have not multiplied x by x.

Example 02 · Collecting like terms

Simplify $9x + 12 + 9x - 10$. What is the constant term?

Blue follows the x terms. Purple follows the constant terms, including their signs.

Why this method?

Identify the terms, brackets or divisor first. Each written line should show how the expression changes without changing its value.

$9x + 12 + 9x - 10$	**Step 1** Start with the whole expression, keeping each sign with its term.
$9x + 9x + 12 - 10$	**Step 2** Put the x terms together and the number terms together.
$18x + 2$	**Step 3** Nine x plus nine x is eighteen x. Twelve minus ten is two.
The constant term is 2.	**Step 4** The question also asks for the term with no x.

Think about it: Before moving on: why can you add the x terms together but not add an x term to a number?

Example 03 · Expanding one bracket

Expand $6(x+9)$. What is the constant term?

Amber follows the outside multiplier. It must multiply both terms inside the bracket.

Why this method?

Identify the terms, brackets or divisor first. Each written line should show how the expression changes without changing its value.

$6\,(x+9)$	**Step 1** Six multiplies everything inside the bracket.
$6\times x+6\times 9$	**Step 2** Multiply each term by 6, including the number 9.
$6x+54$	**Step 3** Write the complete expanded expression.
The constant term is 54.	**Step 4** The number term has no variable.

Think about it: Before moving on: why does the number outside have to multiply the number inside the bracket as well as the x?

Example 04 · Start here: expand two simple brackets

Expand $(x+2)(x+3)$.

Blue follows the products made by x. Purple follows the products made by $+2$. Collect only the like terms.

Why this method?

Every term in one bracket must multiply every term in the other. Write the four products so none is missed.

$x(x+3)=x^2+3x$	**Step 1** The first x multiplies every term in the second bracket.
$2(x+3)=2x+6$	**Step 2** The $+2$ also multiplies every term in the second bracket.
$x^2+3x\ +2x+6$	**Step 3** Put all four products together before collecting terms.

$x^2 + 5x + 6$	**Step 4** Only $3x$ and $2x$ are like terms, so combine them.

Example 05 · Subtract a whole bracket

Simplify $(3x + 5) - (x + 2)$.

Why this method?

Subtract every term of the second bracket. The minus applies to the whole bracket.

$3x + 5 - x - 2$	**Step 1** Change both signs in the second bracket.
$(3x - x) + (5 - 2)$	**Step 2** Group only like terms.
$2x + 3$	**Step 3** Combine the x terms and the numbers separately.

Example 06 · Expand and reduce

Simplify $(x + 4)(x - 3) - 2x$.

$x^2 - 3x + 4x - 12 - 2x$	**Step 1** Multiply each term in the first bracket by both terms in the second.
$x^2 - x - 12$	**Final step** Combine the x terms, keeping the squared term separate.

Common mistake

Combining terms with different letter parts. $3x + 2x^2$ cannot become $5x^3$. Only like terms combine: $3x + 2x = 5x$.

Exam technique

Set out long division in powers of x and include a zero coefficient for any missing power.

Try it yourself

Work on paper before checking the answers at the end. These questions are for self-checking, not submitted homework.

Question 1

Simplify $2x + 9 + 4x - 3$. What is the constant term?

Question 2

Expand $9(x + 6)$. What is the constant term?

Question 3 · **Build confidence**

Simplify $9a - 2a + 5$.

Question 4 · **Apply or explain**

A learner writes $3(x + 4) = 3x + 4$. Correct it and explain.

Before you move on

Try these without looking at a worked example. Revisit any part that is still difficult.

- Collect like terms without changing their letter part.
- Multiply every term when expanding a bracket.
- Explain why x and x squared are not like terms.

Watch an explanation

Cognito — Collecting Like Terms

Cognito — Expanding Double Brackets

Open the website chapter to load the embedded players. Use the rates and rules in your question for financial examples.

Self-check answers

Question 1

6

Question 2

54

Question 3

$7a + 5$.

Collect the a terms. The constant remains separate.

Question 4

$3(x + 4) = 3x + 12$.

Multiply both x and 4 by 3.

Open the full chapter online