Year 9 Algebraic Expressions – Revision Notes

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Year 9 · Maths · Expanding, Index Laws and Algebraic Fractions · Key ideas and worked examples

For grown-ups and learners: read each part and try the worked example. Then work through the sheets: Foundation, Developing, Challenge, then Mixed Practice to revise everything. Show your working: it earns marks in tests and helps you spot mistakes.

1. The order of operations with letters

Letters follow the same rules as numbers. Work out brackets, then indices, then × and ÷, then + and –. So in $2a \times 3a - a^2$ the multiplication comes first: $6a^2 - a^2 = \mathbf{5a^2}$. In $(3x)^2 - 4x^2$ the index comes first: $9x^2 - 4x^2 = \mathbf{5x^2}$. Only like terms (the same letters and powers) can be added: $3x^2 + 2x$ cannot be simplified.

Example: Simplify $6y \times 3y^2 \div 3y$.
→ Work from left to right: $6y \times 3y^2 = 18y^3$
→ $18y^3 \div 3y = 6y^2$
Answer: $6y^2$

2. Index laws with letters

Multiply the numbers and **add** the indices: $4x^3 \times 5x^2 = \mathbf{20x^5}$. Divide the numbers and **subtract** the indices: $18a^7 \div 6a^3 = \mathbf{3a^4}$. For a power of a term, raise the number and **multiply** the indices: $(2y^3)^4 = 2^4y^{12} = \mathbf{16y^{12}}$. A negative index means a reciprocal: $x^2 \div x^5 = x^{-3} = \mathbf{1/x^3}$.

Example: Simplify $(4p^3)^2$.
→ Raise the number to the power 2: $4^2 = 16$
→ Multiply the indices: $3 \times 2 = 6$
Answer: $16p^6$

3. Expanding two brackets

Multiply **each** term in the first bracket by **each** term in the second. Then collect like terms: $(x + 4)(x - 3) = x^2 - 3x + 4x - 12 = \mathbf{x^2 + x - 12}$. A square means two equal brackets: $(x + 5)^2 = (x + 5)(x + 5) = \mathbf{x^2 + 10x + 25}$, not $x^2 + 25$.

Example: Expand and simplify $(n - 3)(n - 9)$.
→ Multiply every term by every term
→ $n^2 - 9n - 3n + 27$
→ Collect the n terms: $n^2 - 12n + 27$
Answer: $n^2 - 12n + 27$

4. Algebraic fractions

Simplify an algebraic fraction by cancelling **common factors** of the whole numerator and the whole denominator. Factorise first: $(x^2 + 3x)/(5x + 15) = x(x + 3)/(5(x + 3)) = \mathbf{x/5}$. You cannot cancel part of a sum: $(x + 4)/4$ is $x/4 + 1$, not $x + 1$.

Example: Factorise, then simplify $(y^2 + 2y)/(2y + 4)$.
→ Factorise both: $y(y + 2)$ and $2(y + 2)$
→ Cancel $(y + 2)$: $y/2$
Answer: $y/2$

5. From words to expressions

Follow the order of the words. “Add 3 to n, then square” is $\mathbf{(n + 3)^2}$, but “square n, then add 3” is $\mathbf{n^2 + 3}$. “The square root of n, then add 5” is $\sqrt{n} + 5$, while “add 5, then find the square root” is $\sqrt{(n + 5)}$. A cube with edge $2x$ has volume $(2x)^3 = 8x^3$.

Example: Write an expression for this: add 6 to n, then square the result.
→ Start with n and follow the steps in order
→ $(n + 6)^2$
Answer: $(n + 6)^2$

Think like a mathematician: test a few cases (**specialising**), look for the rule that always works (**generalising**), and explain why you are sure (**convincing**). When you check someone's working, say what is wrong and how to **improve** it.

Common mistakes: writing $(x + 3)^2 = x^2 + 9$. Multiplying the indices when you should add them. Forgetting to raise the number in $(3x^2)^3$. Cancelling a number that is only part of the numerator. Losing a sign when expanding $-2(x - 4)$.