

GCSE Maths – Algebra

Equivalent Algebraic Expressions

Worksheet

NOTES



SOLUTIONS



This worksheet will show you how to work out different types of algebra questions. Each section contains a **worked example**, a **question with hints** and then **questions for you to work through** on your own.

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



Section A

Worked Example

Categorise the following into expression, equations, and identities:

a) $x^2 + 4$ b) $x^2 + 4x = 5$ c) $4y^2 + y^2 = 5y^2$
d) $x^2\sqrt{y}$ e) $x^2 + y^2 = 25$ f) $16y^2 + 8y + 4 = 2$

Step 1: Firstly, we need to work out which ones are expressions. We know that expressions are a group of terms related to each other using mathematical operations, and do not have an equals sign.

The above definition tells us that a) and d) are expressions.

Step 2: Now, we want to see which ones are equations. An equation is a statement with an equals sign stating two expressions are equal.

Using this, we can see that b), e) and f) are equations.

Step 3: Lastly, we look for the identities. An identity is an equation that is true no matter what values are inputted.

Hence, only c) is an identity.

Guided Example

Categorise the following into expression, equations, and identities:

a) $xy + z = w$ b) $4x^2 + x$ c) $z^2 + 2z = 4$
d) $2(x^2 + y^2) = 2x^2 + 2y^2$ e) xyz f) $4x^2 - x^2 = 3x^2$

Step 1: Using the definition, identify which of the list are expressions.

Step 2: Using the definition, identify which of the list are equations.

Step 3: Using the definition, identify which of the list are identities.



Now it's your turn!

If you get stuck, look back at the worked and guided examples.

1. Categorise the following into expressions, equations, and identities:

a) $x + y + z$

c) $3x + 2x - 4z + 4z^2 = 5x + 4(z^2 - z)$

e) $\sin x + \cos x$

b) $x + y + z = 64$

d) $7x^2 + 2x + 2021 = 0$

f) $\tan x = \frac{\sin x}{\cos x}$

2. Write an expression that contains the information below for any number, n :

Start with a number, n , subtract 14 and multiply the result by 2

3. If the area of a rectangle is 50, and the sides are labelled with x and y :
- Write an equation for the area
 - Write an expression for the perimeter



Section B – Higher Only

Worked Example

Prove that the square of an odd number is odd.

Step 1: Firstly, we represent any odd number by the expression $2n + 1$ where n can be any integer. Then we square it:

$$(2n + 1)^2 = (2n + 1)(2n + 1) = 4n^2 + 2n + 2n + 1 = 4n^2 + 4n + 1$$

Step 2: Now we know that $(2n + 1)^2 = 4n^2 + 4n + 1$, we need to factorise parts of it in a way that allows us to prove the statement:

Only focus on parts of the product and look for a factor that we can take out (divide terms by). In this case, we can divide the first and second terms by 4, so let's take that out as a factor.

$$4n^2 + 4n + 1 = 4(n^2 + n) + 1$$

By doing the above, we can see that $(2n + 1)^2$ is the sum of an even part, $4(n^2 + n)$ (since it is divisible by 4), and 1. We know that an even number plus 1 is odd, hence it is odd.

Guided Example

Prove that $(n + 2)^2 - (n - 2)^2$ is always divisible by 8, when n is an integer.

Step 1: Expand the brackets.

Step 2: Simplify the answer.

Step 3: Use the simplified result to prove the required result.



Now it's your turn!

If you get stuck, look back at the worked and guided examples.

4. Prove that the square of an even number is always even.
5. Prove that $(n + 13)^2 - (n + 2)^2$ is always divisible by 11, where n is any integer.
6. Prove that the sum of three consecutive numbers is always divisible by 3.

