

# Simplifying expressions

In algebra, letters are used to stand for values that can change (**variables**) or for values that are unknown (**unknowns**).

A **term** is a number or letter on its own, or numbers and letters multiplied together, for example  $-2$ ,  $3x$ ,  $5a^2$ .

An **expression** is a set of terms combined using the operations  $+$ ,  $-$ ,  $\times$  or  $\div$ , for example  $4x - 3$  or  $5x + 5y$  or  $3x^2 - 2x + 6$ .

An **equation** states that two expressions are equal in value, for example  $3y - 4 = 10$ .

## Writing expressions

Eg. Pens are sold in packs of 6 and rulers are sold in boxes of 10.

A teacher buys  $p$  packs of pens and  $r$  boxes of rulers. Write an expression for the total number of pens and rulers bought.

Firstly, assign letters to the items:  $p$  for the number of packs of pens and  $r$  for the number of boxes of rulers.

There are 6 pens in each pack, so the number of pens bought is  $6 \times p$  which is  $6p$ .

There are 10 rulers in each box, so the number of rulers bought is  $10 \times r$  which is  $10r$ .

The number of pens and rulers bought is  $6p + 10r$ .

Eg. A rectangle has a width of  $x$  cm. The height is 3 cm less than the width.

Write an expression for the perimeter of the rectangle.

The perimeter is found by adding together the lengths of the sides of a shape.

The width of the rectangle is given as  $x$ . The height of the rectangle is 3 less than the width and therefore is equal to  $x - 3$ .

$$\text{Perimeter} = x + x + x - 3 + x - 3$$

$$\text{Perimeter} = 4x - 6$$

Eg. John is  $n$  years old. Kim is three years younger than John. Vanessa is half Kim's age.

Write an expression for each person's age.

John is  $n$  years old

Kim is three years younger than John and therefore is  $n - 3$  years old

Vanessa is half Kim's age and is therefore equal to  $n - 3$  divided by 2,  $\frac{n-3}{2}$

## Collecting like terms

Collecting **like terms** means to simplify terms in expressions in which the variables are the same. In the expression  $5a + 2b + 3a - 6b$ , the terms  $5a$  and  $+3a$  are like terms, as are  $2b$  and  $-6b$ .

It's important to note that a term carries the sign (+ or -) in front of it and not the one behind it

Eg. Simplify  $b + b + b + b$ .

Adding the four like terms together gives  $4b$ .

Eg. Simplify  $5m + 3m - 2m$ .

In this expression, all the terms are like terms as the variable in each term is  $m$ . Simplify the expression in order; the answer is  $6m$

Eg. Simplify  $9c - 7d + c + 3d + 5$ .

This expression contains three types of terms: the terms that contain  $c$ 's, terms that contain  $d$ 's and terms that are numbers alone.

To simplify this expression, collect the like terms.

$9c + c$  gives  $10c$ ;  $-7d + 3d$  gives  $-4d$  and there is  $+5$  as well.

So the answer is  $10c - 4d + 5$

Eg. Simplify  $5a - 2b + 3c - 4a + 4b - 5c$

$5a - 4a$  gives  $a$ ;  $-2b + 4b$  gives  $+2b$  and  $+3c - 5c$  gives  $-2c$

So the answer is  $a + 2b - 2c$

If there is only one of the letter, like in the answer to  $5a - 4a$ , do not write 1 in front of a. A letter on its own means that there is only one of them.

## Using letters and numbers

Algebraic expressions can be added and subtracted by collecting like terms, but expressions can also be multiplied and divided.

Eg. Simplify  $a \times a$ .

Multiplying a number or letter by itself is called **squaring**. This means  $a \times a = a^2$  (read as 'a squared'). In  $a^2$ , the 2 is known as the index number or power. Powers tell us how many times a number or letter has been **multiplied by itself**.

Eg. Simplify  $b \times b \times b$ .

In this example, b is being multiplied by itself three times. The power of b will be three, so,  $b \times b \times b = b^3$ .

Eg. Simplify  $3d \times 5d$ .

First multiply the numbers and then multiply the letters

The answer is  $15d^2$

Eg. Simplify  $2 \times a \times b$

The answer is  $2ab$

Eg. Simplify  $3a \times 4b$

The answer is  $12ab$

Eg. Simplify  $\frac{16e^2}{2e}$ .

This is equal to  $16e^2 \div 2e = 8e$