Using formulae

In formulae, letters are used to represent numbers. For example, the formula
\[ A = lw \]
can be used to find the area of a rectangle. Here \( A \) is the area, \( l \) the length and \( w \) the width. In this formula, \( lw \) means \( l \times w \). Formulae are usually written in this way without multiplication signs.

The perimeter of the rectangle would be given by the formula
\[ P = 2l + 2w \]
Here again there are no multiplication signs, and \( 2l \) means \( 2 \times l \) and \( 2w \) means \( 2 \times w \).

Example

The perimeter of a rectangle can be found using the formula
\[ P = 2l + 2w \]
Find the perimeter if \( l = 8 \) and \( w = 4 \).

Solution

The letters \( l \) and \( w \) should be replaced by the numbers 8 and 4.

This gives \[ P = 2 \times 8 + 2 \times 4 = 16 + 8 = 24 \]

Construct and use simple formulae

A formula describes how one quantity relates to one or more other quantities. For example, a formula for the area of a rectangle describes how to find the area, given the length and width of the rectangle.

The perimeter of the rectangle would be given by the formula
\[ P = 2l + 2w \]
Here again there are no multiplication signs and \( 2l \) means \( 2 \times l \) and \( 2w \) means \( 2 \times w \).

Example

(a) Write down a formula for the perimeter of the shape shown.

(b) Find the perimeter if
\[ a = 2 \text{ cm}, \; b = 3 \text{ cm} \text{ and } c = 5 \text{ cm} \]

Solution

(a) \[ P = 2a + 2b + c \]

(b) If \( a = 2, \; b = 3 \text{ and } c = 5 \)
\[ P = 2 \times 2 + 2 \times 3 + 5 = 4 + 6 + 5 = 15 \text{ cm} \]
Making formulas from words

**Type 1**

1) Multiply x  
2) Divide x  
3) Square x \((x^2)\)  
4) Add or subtract a number

**Example 1:**  
"To find y, multiply x by three and then subtract four"

**Answer:**  
Start with \(x\)  
\[3x\]  
Times it by 3  
Subtract 4  
\[\text{so } y = 3x - 4\]

**Example 2:**  
"To find y, square x, divide this by three and then subtract seven. Write a formula for y."

**Answer:**  
Start with \(x\)  
\[x^2\]  
Square it  
\[\frac{x^2}{3}\]  
Divide it by 3  
\[\frac{x^2}{3} - 7\]  
\[y = \frac{x^2}{3} - 7\]

**Type 2**

**Example:**  
Dean is designing a rectangular sign. The length of the sign must be 1.5 m greater than its width. The plastic the sign is to be made from costs £9 per m\(^2\). Write a formula that Dean could use to work out the cost, \(C\), of the plastic needed to make a sign of width \(w\) m.

**Answer:**  
The width of the sign is \(w\) m, so the length is \((w + 1.5)\) m.  
The area of the sign \(= l \times w = (w + 1.5) \times w = w^2 + 1.5w\)  
So the cost of the plastic is \(C = 9(w^2 + 1.5w)\)  
or \(C = 9w^2 + 13.5w\)