Substitution

Prior Knowledge:

- Four operations with positive and negative numbers.
- Using BIDMAS.
- How to calculate the perimeter of 2D shapes.

Substitution involves replacing letters (variables) with numbers. You may be asked to substitute into a formula or an expression.

Remember:

$5a$ means $5 \times a$

ab means $a \times b$

a^2 means $a \times a$

Always use BIDMAS when substituting into a formula or expression.

Example 1

If $a = 3$, $b = 1$ and $c = 5$, work out the value of the expression $ab + c$.

Remembering that $ab = a \times b$, we substitute (replace) the letters with the values we have been given.

$a \times b + c$
$3 \times 1 + 5$

The rules of BIDMAS tell us to complete the multiplication first, followed by the addition.

$3 + 5 = 8$

Example 2

If $a = -2$, $b = 5$ and $c = -3$, work out the value of the expression $ab + ac$.

This time, we have been given negative values, which means we should take extra care when substituting into the expression.

Remembering that $ab = a \times b$ and $ac = a \times c$, we substitute the letters with the values we have been given.

$a \times b + a \times c$

$-2 \times 5 + -2 \times -3$

The rules of BIDMAS tell us to complete the multiplications first. Remember the rules for adding and multiplying negative numbers.

$-2 \times 5 = -10$

$-2 \times -3 = 6$

$-10 + 6 = -4$

Example 3

The cost (c), in pounds, of hiring a bike is given by $c = 14d + 12$ where d is the number of days the bike is hired.

Calculate the total cost (c) of hiring the bike for 2 days.

This time, we are being asked to substitute into a formula. We can approach the question in the same way by substituting the letters with any values we have been given.

Remember that $14d = 14 \times d$

$c = 14d + 12$

$c = 14 \times 2 + 12$

$c = 40$

The cost of hiring the bike for 2 days is £40.

Your Turn

1. If $a = 5$, $b = 2$ and $c = 4$, work out the value of the following expressions:

   a. ab

   b. ac

   c. bc

   d. abc

   e. $a + b$

   f. $c - b$

   g. $b - a$

   h. $ab + c$

   i. $ac - b$

   j. $bc + a$

   k. $ab + ac$

   l. ab^2

2. If d = -3, e = -6 and f = 8, work out the value of the following expressions:

   a. de

   _____

   b. ef

   _____

   c. df

   _____

   d. def

   _____

   e. $d + f$

   _____

   f. $d - e$

   _____

   g. $f - d$

   _____

   h. $e \div d$

   _____

   i. $de + f$

   _____

   j. $df - e$

   _____

   k. $de + fd$

   _____

   l. df^2

   _____

3. If b = -5, explain why b^2 cannot be a negative answer.

   _____

   _____

4. The formula that converts millimetres (mm) to centimetres (cm) is mm = 10 × cm. Use this formula to convert the following measurements:

   a. 4cm into mm.

   _____

   b. 8cm into mm.

   _____

   c. 10mm into cm.

   _____

   d. 3.1cm into mm.

   _____

   e. 9.4mm into cm.

   _____

5. The formula for converting from Celsius (C) to Fahrenheit (F) is F = $\frac{9}{5}$C + 32. Use this formula to convert 5°C into Fahrenheit (°F).

   _____

   _____

   _____

Challenge

Find the perimeter (p) of the following shapes when x = 2.5cm.

$3x + 2$

$5x - 2$