

Substituting into Formula – W/C 29th June 2020

The good news is that this is the last topic of Year 9. Next week, there will be another Reflection Sheet, which will give you the opportunity to check that you are up to date with all of your work as well as evaluating how you now feel about all of the topics. This will help us in September to know what extra intervention to put in place for you.

Your topic on 15th June showed you how to substitute into the n^{th} term for a sequence so it is not new to you; but this will extend your skills further. The skills that you used on 8th June with Directed Numbers and solving equation on 11th May, will also be invaluable.

Substitution means putting numbers in place of letters to calculate the value of an expression.

Example: If $a = -2$, $b=4$ and $c=3$ find the value of the following expressions:

1. $5b + a$ $= (5 \times 4) + (-2)$ $= 20 - 2$ $= 18$	First replace every letter with its value, adding in x where appropriate. e.g. $5b = 5 \times 4$, I also find it helpful to put brackets around each term.
2. $bc - 4a$ $= (4 \times 3) - (4 \times -2)$ $= 12 - - 8$ $= 12 + 8$ $= 20$	Avoid short cuts – you will make mistakes with the signs if you are not careful!
3. $2b^2c$ $= 2 \times 4^2 \times 3$ $= 2 \times 16 \times 3$ $= 96$	This means $2 \times b^2 \times c$ (Do not be tempted to square $2b$!!!)

We can also **Substitute into formula**.

Example: The formula to convert the temperature in degrees Fahrenheit ($^{\circ}\text{F}$) to the temperature in degrees Celsius ($^{\circ}\text{C}$) is:

$$c = \frac{5(f - 32)}{9} \quad \text{where } f \text{ represents the temperature in } (^{\circ}\text{F}) \text{ and } c \text{ represents the temperature in } (^{\circ}\text{C}).$$

If we want to find the temperature in ($^{\circ}\text{C}$) when it is 68°F , we substitute 68 for the f in the formula. *(This means we take the f 'off the pitch' and in its place put the number 68)*

$$c = \frac{5(f - 32)}{9}$$

FIRST - rewrite the formula in the same way but just replacing the f with 68

$$c = \frac{5(68 - 32)}{9}$$

Now, using BODMAS, find c

$$c = \frac{5 \times 36}{9} = 20$$

So, $68^{\circ}\text{F} = 20^{\circ}\text{C}$

Creating formula

Formulae are created for something that is calculated often.

For instance, plumbers often apply a call out charge plus an hourly rate to their customers. Writing a formula for the total cost of a job would be useful for a plumber so that they could quickly calculate costs for their customers more easily. Once a formula is written, the plumber would only need to input how long the job would take in hours, and come up with a total cost to quote very easily.

Example 1

A plumber has a call out fee of £40, plus an hourly rate of £18. Write a formula to calculate the cost of any job and calculate the cost of a job estimated to take 2 hours.

The total cost (T) would be equal to the call out charge of £40 plus £18 for every hour (h) worked.

This can be written as: $T = 40 + 18h$

Now, the total cost for customers can be worked out easily by substituting the number of hours the job will take.

A job estimated to take 2 hours can be calculated like this ($h = 2$):

$$T = 40 + (18 \times 2) = 40 + 36 = \text{£}76$$

Example 2

On a given day the plumber charges £130. How long did the plumber work for?

This time, it is not the total cost (T) that is to be calculated but the hours (h). In this instance the formula will need to be solved to find h:

$$T = 40 + 18h$$

Substitute the total cost as £130:

$$130 = 40 + 18h$$

$$\begin{array}{r} -40 \quad -40 \\ 130 = 40 + 18h \\ \hline 90 = 18h \end{array}$$

$$90 = 18h$$

$$\begin{array}{r} \div 18 \quad \div 18 \\ 90 = 18h \\ \hline 5 = h \end{array}$$

$$5 = h$$

Solve the equation.

Subtract 40 from both sides

Divide both sides by 18

The plumber worked for 5 hours to earn £130.

Task 1: Watch [mathswatch](#) clip 95

Task 2: Complete the worksheet below. For each question, write the formula in your book and then rewrite it substituting in the values given for each letter, then finally find its value (Don't forget to use BODMAS, where appropriate)

1. **Substitute** the given values of x into the **formulae** to find values for y :

- a) $y = x + 4$, when $x = 3$
- b) $y = 3x$, when $x = 1$
- c) $y = 50 - 4x$, when $x = 5$
- d) $y = 10x - 10$, when $x = 6$
- e) $y = 3(x + 1)$, when $x = 4$
- f) $y = 2(20 - x)$, when $x = 10$
- g) $y = 6(x + 2) - 8$, when $x = 2$
- h) $y = x^2$, when $x = 7$
- i) $y = \frac{6x}{5}$, when $x = 10$
- j) $y = \frac{x+4}{2}$, when $x = 8$

2. **Find** the value of x , when $a = 3$ and $b = 6$

- a) $x = 2a$
- b) $x = \frac{b}{3}$
- c) $x = ab$
- d) $x = a^2$
- e) $x = b^2 + 4$
- f) $x = \frac{a+2}{5}$
- g) $x = 2b + 4a$
- h) $x = b - a$
- i) $x = \frac{b}{a}$
- j) $x = \frac{4a+b}{2}$

3. The speed of a car can be worked out using the **formula**:

$S = \frac{D}{T}$, where S means speed in kilometres per hour, D means distance in kilometres and T means time in hours.

Find the **speed** of the car when:

- a) $D=12$ and $T=3$
- b) $D=70$ and $T=2$
- c) $D=20$ and $T=0.5$
- d) $D=80$ and $T=2.5$



4. A **pattern** has the following formula : $T = 3n + 1$, where n is the term number and T is the term. **Copy** and **complete** the following table for the pattern:

n	1	2	3	4	5
T					

5. The cost of staying in a hotel is given by the formula $C = 50d + 20$, where C is the cost in £ and d is the number of days a person stays. Find the cost of staying for:
- a) 3 days
 - b) 6 days
 - c) 2 weeks



Task 3: Complete the **mathswatch** assignment.