



8th grade Notes & Activity

Topic : ALGEBRA

Sub-Topic: ALGEBRA- SUBSTITUTION INTO A FORMULAE

To substitute the values of pronumerals into a formula means to replace the pronumerals with their corresponding values. When all but one pronumeral in the formula are replaced with numbers, the value of the remaining pronumeral can be evaluated.

WORKED Example Substitute the given values of the pronumerals into the formula and hence find the value of P. $P = 2(l + w)$, $l = 4$, $w = 8$.

THINK.

1. Write the question.
2. Replace l with 4 and w with 8.
3. To find the value of P, perform addition inside the brackets first and then multiply the result by 2

WRITE.

$$\begin{aligned} P &= 2(l + w), l = 4, w = 8, P = ? \\ P &= 2(4 + 8) \\ &= 2 \times 12 \\ &= 24 \end{aligned}$$

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

WORKED Example $2b^2c$, where $b=4$ and $c=3$, use the values of b and c to calculate the numerical value of the expression:

$$2b^2c = 2 \times b^2 \times c$$

Remember that the rules of BIDMAS/BODMAS show that the order of operations (the order sums should always be completed in) is: Brackets, Indices or Powers, Divide/Multiply and Add/Subtract. This means that the value of b^2 should be calculated before multiplying by 2 or c , as indices come before multiplication

$$\text{This gives: } 2b^2c = 2 \times b^2 \times c = 2 \times 4^2 \times 3$$

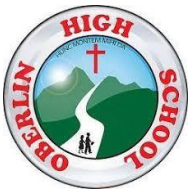
$$(\text{substituting } b=4 \text{ and } c=3) = 2 \times 16 \times 3 = 96$$

WORKED Example Work out the value of $d+(3e+f)^2$ when $d=2$, $e=-3$ and $f=1$

This expression contains brackets and **indices**. The brackets should be worked out first, and then the indices should be calculated before the multiplication. The addition should be worked out last.

$$d+(3e+f)^2 = 2+(3 \times -3+1)^2$$

The letters d , e and f have been substituted for their numerical values.



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$$2+(3x-3+1)^2 = 2+(-9+1)^2=2+(-8)^2$$

The bracket has been worked out first.

$2+(-8)^2=2+64$. -8^2 means -8×-8 , which is $+64$ using sign rules (two signs that are the same make a positive). $2+64=66$. The addition part of the expression has to be worked out last following BIDMAS.

WORKED Example

Substitution into formulae works the same way as substitution into expressions, and it is important to follow the rules of BODMAS.

A common formula is used to convert Fahrenheit (F) to Celsius (C):

$$F = \frac{9C}{5} + 32$$

What is the temperature in Fahrenheit if it is 20°C ? Substitute the value of **C** into the equation

$F = \frac{9C}{5} + 32$ to work out the temperature in Fahrenheit.

$$F = \frac{9C}{5} + 32 = \frac{9 \times 20}{5} + 32 = \frac{180}{5} + 32 = 36 + 32 = 68^\circ\text{F}$$

The temperature of 20°C is the same as 68°F using the formula.

WORKED Example

The formula to work out the force in Newtons of an object is $F=ma$, where **m** is mass in kilograms and **a** is the acceleration of the object. What is the force of an object that has a mass of 16 kg and an acceleration of 7 m/s^2 ?

Remember **ma** that means **m** \times **a**.

$$F = m \times a = 16 \times 7 \text{ (the values for } m \text{ and } a \text{ have been substituted)}$$

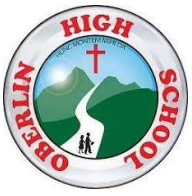
$$16 \times 7 = 112 \text{ (the units for force are Newtons, which was given in the question)}$$

The final answer is 112 Newtons or 112 N.

WORKED Example

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.



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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:

$$T = 40 + 18h$$

Substitute the number of hours as 2 hours: $T = 40 + 18 \times 2 = 40 + 36 = \text{£}76$

Use BIDMAS to complete the multiplication before the addition.

A two-hour job would cost £76.

WORKSHEET: ALGEBRA- SUBSTITUTION INTO A FORMULAE

- The area of a rectangle is found using the formula $A=lw$ and the perimeter using $P=2l + 2w$. Find the area and perimeter if:
 - $l = 4$ and $w = 2$
 - $l = 10$ and $w = 3$
- The formula $v = u + at$ is used to find the final speed. Find v if:
 - $u = 6$, $a = 2$ and $t = 5$
 - $u = 0$, $a = 4$ and $t = 3$
- Use the formula $F = ma$ to find F if:
 - $m = 10$ and $a = 3$
 - $m = 200$ and $a = 2$
- 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 :



Maths is FUN

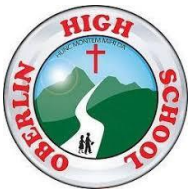
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