

WorkBook

SUBSTITUTION

WorkNotes

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Substitution

OBJECT

The object of substitution is to find the value of an expression or formula given a value for each of the pronumerals.

PROCESS

Substitution is completed by replacing the pronumerals and then calculating the value of the resulting expression.

Example; Evaluate $3d + 4$ if $d = 7$.

Step	Solution	Explanations
	$3d + 4$	First step is to rewrite the expression.
1.	$= 3 \times (7) + 4$	Replace the pronumeral with the given value remembering that there is a multiplication between the 3 and the d .
2.	$= 25$	

GLOSSARY

Pronumeral	A letter or symbol used to represent a number.
Expression	A mathematical expression is a combination of numbers, pronumerals and operations.
Substitution	Replacing the pronumerals with the assigned values.
Operation	A mathematical operation modifies or changes the value of a number or expression
Addition	Other words that indicate this operation; add, plus, sum, and,
Subtraction	Other words that indicate this operation; subtract, minus, difference, take-away,
Multiplication	Other words that indicate this operation; multiply, times, product,
Division	Other words that indicate this operation; divide, goes into, quotient,

It is important to note that simple substitutions show the method when performing several substitutions into more complex formulae.

You will see that I use Parentheses (brackets) when I substitute. While this is not necessary it is very useful.

First consider the simple one step substitutions.

Even though most learners can determine the solution in 'their head' it has to be done using 'the method' in order to learn the method. It is the process that has to be learned and applied in other areas.

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Example 1

Evaluate $a + 4$ if $a = 6$.

Step	Solution	Explanations
	$d + 4$	First step is to rewrite the expression.
1.	$= (6) + 4$	Replace the pronumeral with the given value.
2.	$= 10$	Calculate the answer either mentally or using a calculator.

Example 2

Evaluate $b - 3$ if $b = 8$.

Step	Solution	Explanations
	$b - 3$	First step is to rewrite the expression.
1.	$= (8) - 3$	Replace the pronumeral with the given value.
2.	$= 5$	Calculate the answer either mentally or using a calculator.

Example 3

Evaluate $4c$ if $c = 5$.

Step	Solution	Explanations
	$4c$	First step is to rewrite the expression.
1.	$= 4 \times (5)$	Replace the pronumeral with the given value remembering that there is a multiplication between the 4 and the c . Yes: $4c$ is 4 lots of c .
2.	$= 20$	Calculate the answer either mentally or using a calculator.

Example 4

Evaluate $\frac{d}{3}$ if $d = 18$.

Step	Solution	Explanations
	$\frac{d}{3}$	First step is to rewrite the expression.
1.	$= \frac{18}{3}$	Replace the pronumeral with the given value remembering that the fraction bar is a division.
2.	$= 6$	Calculate the answer either mentally or using a calculator.

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Example 5

Evaluate $3e + 4$ if $e = 7$.

Step	Solution	Explanations
	$3e + 4$	First step is to rewrite the expression.
1.	$= 3 \times (7) + 4$	Replace the pronumeral with the given value remembering that there is a multiplication between the 3 and the e .
2.	$= 25$	

Example 6

Evaluate $\frac{f}{3} - 5$ if $f = 45$.

Step	Solution	Explanations
	$\frac{f}{3} - 5$	First step is to rewrite the expression.
1.	$= \frac{45}{3} - 5$	Replace the pronumeral with the given value.
2.	$= 15 - 5$	This step is optional. It is here to show you each part of the solution if you are processing the answer mentally. Remember that the fraction bar is a division.
3.	$= 25$	

Multiple pronumerals

Example 7

Evaluate $g + h$ if $g = 5$ and $h = 11$.

Step	Solution	Explanations
	$g + h$	First step is to rewrite the expression.
1.	$= 5 + 11$	Replace both pronumerals with the given values.
2.	$= 16$	

Example 8

Evaluate $2k + 5m$ if $k = 6$ and $k = 3$.

Step	Solution	Explanations
	$2k + 5m$	First step is to rewrite the expression.
1.	$= 2 \times (6) + 5 \times (3)$	Replace both pronumerals with the given values remembering that there is a multiplication between the numbers and their coefficients (the numbers and the pronumerals).
2.	$= 27$	$(12 + 15)$

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Example 9

Evaluate $2pqr$ if $p = 4$, $q = 10$ and $r = 3$.

Step	Solution	Explanations
	$2pqr$	First step is to rewrite the expression.
1.	$= 2 \times (4) \times (10) \times (3)$	Replace the pronumeral with the given value remembering that there is a multiplication between each of the numbers and the pronumerals.
2.	$= 240$	

Substitution into expressions with indices (powers)

Example 10

Evaluate s^2 if $s = 6$.

Step	Solution	Explanations
	s^2	First step is to rewrite the expression.
1.	$= (6)^2$	Replace the pronumeral with the given value remembering that it is the square of number.
2.	$= 36$	

Example 11

Evaluate $3v^2$ if $v = 5$.

Step	Solution	Explanations
	$3v^2$	First step is to rewrite the expression.
1.	$= 3 \times (5)^2$	Replace the pronumeral with the given value remembering that there is a multiplication between the 3 and the v^2 .
2.	$= 75$	3×25

Substitution involving integers

Example 12

Evaluate $2a + 6$ if $a = -5$.

Step	Solution	Explanations
	$2a + 6$	First step is to rewrite the expression.
1.	$= 2 \times (-5) + 6$	Replace the pronumeral with the given value remembering that there is a multiplication between the 2 and the a .
2.	$= -4$	$2 \times (-5) + 6$ $= -10 + 6$
		See

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Example 13

Evaluate $4b^2 - 3b + 2$ if $b = 3$.

Step	Solution	Explanations
	$4b^2 - 3b + 2$	First step is to rewrite the expression.
1.	$= 4 \times (3)^2 - 3 \times (3) + 2$	Replace the pronumeral with the given value remembering that there is a multiplication between the numbers and their coefficients (the numbers and the pronumerals).
2.	$= 29$	$4 \times 9 - 9 + 2$ $= 36 - 9 + 2$

Example 14

Evaluate $5(c + d)$ if $c = 7$ and $d = 4$.

Step	Solution	Explanations
	$5(c + d)$	First step is to rewrite the formula.
1.	$= 5 \times (7 + 4)$	Replace the pronumeral with the given value remembering that there is a multiplication between the numbers and the brackets.
2.	$= 55$	5×11

Application of substitution for problem solving

Example 15

Given that the perimeter of a rectangle is given by $P = 2(l + b)$ find the perimeter of a rectangle with length (l) of 25 cm and width (w) of 12 cm.

Step	Solution	Explanations
	$P = 2(l + b)$	First step is to rewrite the formula.
1.	$= 2 \times (25 + 12)$	Replace the pronumeral with the given value remembering that there is a multiplication between the numbers and the brackets.
2.	$= 74$	2×37
3.	Perimeter is 74 cm	The actual answer.