Substitution

This section will cover the following topics

Definition of Expression and Equation
Evaluating an Expression Using Substitution
Checking the Solution to an Equation Using Substitution

Definition of Expression and Equation

Both expressions and equations combine numbers, variables (such as x and y), and arithmetic operations (such as $+$, $-$, $\times$, and $\div$). The difference between expressions and equations is equations have an equals sign and expressions do not. Below are some examples of each kind.

Expressions	Equations
$2x$	$2x = 6$
$2x + 3y$	$2x + 3y = 7$
$3xy^2 + 2x$	$3xy^2 + 2x + 5$

Evaluating an Expression Using Substitution

The word "evaluate" means to find the numerical value of an expression and it requires that you know the value of all variables. For example, the expression $2x$ cannot be evaluated unless we know what number x is equal to. Let's say, for example, that we did know $x = 3$. We could then use substitution to find the value of $2x$ by simply replacing every x with 3. That is, $2x - 2(3)$ or $2x = 6$.

More Examples

Example 1

Expression	$2x + 3y$
Value of the Variables	$x = -1, y = 3$
Substitution and Evaluation	$2(-1) + 3(3) =$ $-2 + 9 = 7$

Example 2

Expression	$3xy^2 + 2x$
Value of the Variables	$x = 1, y = 3$
Substitution and Evaluation	$3(1)(3)^2 + 2(1)^2$ $27 + 2 = 29$

A Quick Tip

Substitution is a very useful tool when taking a placement exam. You can expect to see a few of these on the exam, and with just a bit of practice you can increase your placement score.

Checking the Solution to an Equation Using Substitution

The idea of using substitution with equations is the same as using substitution on expressions with one exception; both side of the equation must be equal (the same number). For example, if we have the equation $2x = 6$ and we substitute $x = 3$, then get $2(3) = 6$ or $6 = 6$. This is a true statement; 6 does equal 6. We would say that the solution $x = 3$ "checks".
But let's say we instead have the equation $2x = 6$ and we substitute $x = 4$. We get $2(4) = 6$ or $8 = 6$. This is a false statement; 8 does not equal 6, and we say that the solution $x = 4$ does not check".

More Examples

Example 1

Equation	$2x + 3y = 7$
Value of the Variables	$x = -1, y = 3$
Substitution and Evaluation	$2(-1) + 3(3) = 7$ $-2 + 9 = 7$ $7 = 7$ *The solution checks*

Example 2

Equation	$3xy^2 + 2x = 5$
Value of the Variables	$x = 1, y = 3$
Substitution and Evaluation	$3(1)(3)^2 + 2(1)^2 = 5$ $27 + 2 = 5$ $29 = 5$ *The solution does not check*

A Quick Tip

If you get an equation to solve on the placement exam, either solve it directly or check each possible answer using substitution as an alternative strategy. Choose the strategy that gives you the best chance to succeed!

Practice Problems

Evaluate the following expressions or check the equation using substitution

1. $a + 2b - 3c$ $a = 1, b = -2, c = 3$	2. $3xy^2z^3$ $x = \frac{1}{2}, y = 3, z = 2$	3. $x^2 - 2x + 7$ $x = -4$
4. $3x + 1 = 4$ $x = 1$	5. $3x - 2 = 4x^2$ $x = -2$	6. $x^2 + 3x - 1 = -3$ $x = -1$

Answers

1. *–12*	2. *108*	3. *31*
4. *The solution checks*	5. *The solution does not check*	6. *The solution checks*

Additional Help

You can also search YouTube.com for "substitute values into expressions"