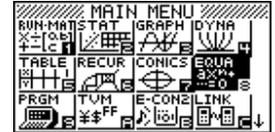


# Using basic programming for illustrating formula substitution

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## 1. Solving equations

Select **EQUA** mode from the **MAIN MENU** by using the arrow keys to highlight the **EQUA** icon then press **EXE** or pressing the **[8]** key.



N.B. Any algebraic or trigonometric equation can be solved in this area of the calculator **BUT** only one solution is found at a time, hence multiple solutions to equations should be solved in the **GRAPHING** icon using **G-Solve** from the **MAIN MENU** or any polynomial up to degree 6 in Polynomial [F2] in **EQUA** mode. To type letters press the **[ALPHA]** key then the key with the appropriate red letter on top of it. The equals sign is accessed by pressing **[SHIFT]**.

Using the **Solver** feature in **EQUA**tion mode:



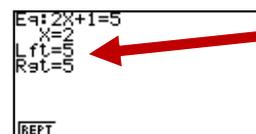
**F3** for **SOLVER**



Enter in the equation here.

### Example 1:

Solve  $2x + 1 = 5$

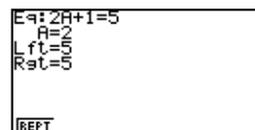


The calculator performs a 'check'. It uses the variables calculated and substitutes these into the left (**Lft**) and right (**Rgt**) sides of the equation and you should see these two values to be the same.

Enter the equation and then press **EXE** to store and **[F6]** to solve the equation.

**N.B.** You are able to use any letter of the alphabet 9 A ~ Z, and also  $\theta$  and  $\Gamma$ ) as the variable in the equation.

The example  $2A + 1 = 5$  is shown.

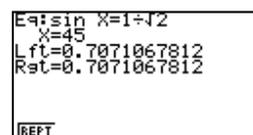
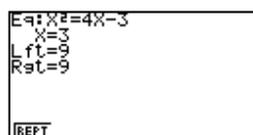
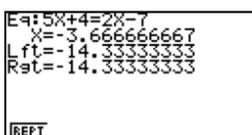
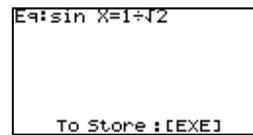
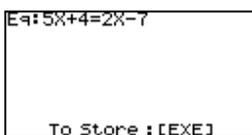


### Other examples:

(a)  $5x + 4 = 2x - 7$

(b)  $x^2 = 4x - 3$

(c)  $\sin x = 1/\sqrt{2}$



### Example 2:

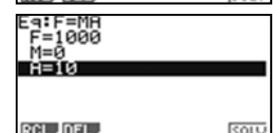
Using **Force = Mass × Acceleration** i.e.  $F = MA$  ( $= M \times A$ ), find the value of the mass of the object, if the Force = 1000 Newton and the acceleration =  $10 \text{ ms}^{-2}$ .

### Answer:

Given that  $F = MA$  and  $F = 1000$ ,  $A = 10$  find the value of  $M$ .

Type in the equation  $F = MA$ , then press **EXE** to store. Set **all** of the variables to 0.

**[0] EXE, [0] EXE** etc.,

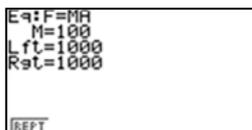


Then change the known values of each variable(s) to those that are defined in the problem.



Now, move the 'cursor' so that it is 'sitting' over the top of the variable that you want to calculate the answer to, in this case 'M'.

Now, use **SOLVE**, by pressing [F6] or EXE.

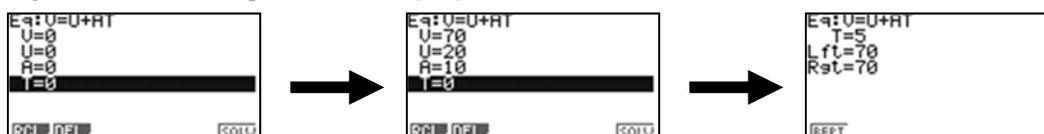


**Example 3:**

Given that  $V = U + AT$  and  $U = 20 \text{ ms}^{-1}$ ,  $V = 70 \text{ ms}^{-1}$  and  $A = 10 \text{ ms}^{-2}$ , find the value of T (time).

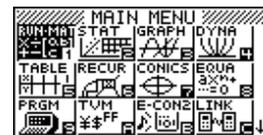
**Answer:**

Type in the equation  $V = U + AT$ . Enter the appropriate value for each variable as shown in example 1, highlight  $T = 0$  and then press **SOLVE** [F6].



**2. Algebraic Substitution**

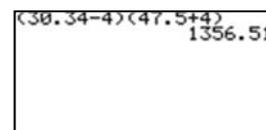
Select **RUN-MAT** mode from the main menu by using the arrow keys to highlight the **RUN-MAT** icon then press **EXE** or pressing the [1] key.



**Example 1:**

Calculate the value of **V**, where  $V = (A - 4)(B + 4)$  where  $A = 30.34$  and  $B = 47.5$

Enter the calculation by replacing each letter in the formula with its corresponding number. Then press the **EXE** key for the answer.

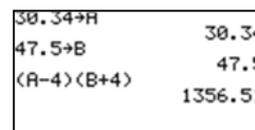


When you have a number of algebraic substitutions to do, it would be easier to use the memory of the calculator. There are 28 different storage places i.e A ~ Z,  $\theta$  and  $\Gamma$ . You can 'assign' a value to the letters you want to use, then enter the algebraic expression into the calculator.

**Example 2:**

Calculate the value of **V**, where  $V = (A - 4)(B + 4)$  where  $A = 30.34$  and  $B = 47.5$

Using the  $\rightarrow$  'assigns' a number to a letter (variable). Press **EXE** for the calculator to store the value in the memory.



**Answer:**

$V = (30.34 - 4)(47.5 + 4) = 1356.51$

Algebraic substitution is where an independent numerical variable, usually  $x$ , is substituted into an equation for a dependent variable, usually  $y$ .

**Hints:** To have '?' and ':' statements, the menu trails are:

**SHIFT VARS**, then [F4] for [?] and **SHIFT VARS**, then [F6] followed by [F5] for [:].



**Example 3:**

Calculate the value of the following when  $x = -2, 0,$  and  $2,$  in the expression  $2x^2 + 4x - 1.$

**Answer:**

Type in ?  $\rightarrow$  x:  $2x^2 + 4x - 1$



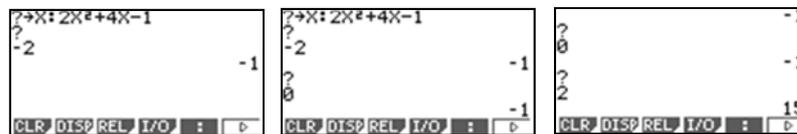
Then press **EXE** to initiate this expression. A '?' will display, this is the calculators way of saying, "Enter in a number".



Enter in -2, then press **EXE** the answer -1 is displayed, the calculator has done this:  $2 \times (-2)^2 + 4 \times (-2) - 1 = -1$

Press **EXE** again, this brings up the '?' again, type in 0 and press **EXE**.

Repeat the above sequence, calculating the expression of  $2x^2 + 4x - 1$  for each of the x-values required.

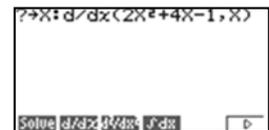


**Example 4:**

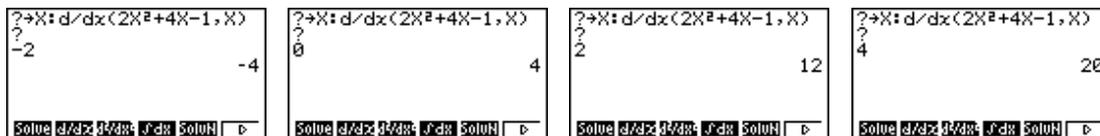
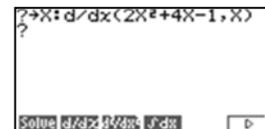
Calculate the  $f'(x)$  values of the following, when  $x = -2, 0, 2$  and  $4,$  expression given by:  $f(x) = 2x^2 + 4x - 1.$

**Answer:**

Type in ?  $\rightarrow$  x:  $d/dx(2x^2 + 4x - 1, x)$  and repeat the process explained in example 1.



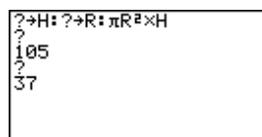
[Note: The differentiation symbol d/dx is obtained via: **SHIFT OPTN [F4]** (for CALC).]



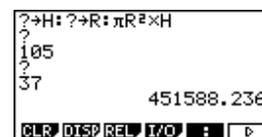
**Other examples:**

In the following examples the ' $\rightarrow$ ', '?' and ':' are used a number of times to calculate a value of a given expression.

1. Volume of a cylinder,  $V = \pi r^2 h.$

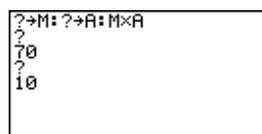


H = 105 mm and R = 37 mm



Volume, V = 451 588.236 mm<sup>3</sup> (3 d.p.)

2. Force = Mass  $\times$  Acceleration i.e.  $F = MA (= M \times A).$



M = 70 kg and A = 10 ms<sup>-2</sup>



Force, F = 700 Newtons (N)