



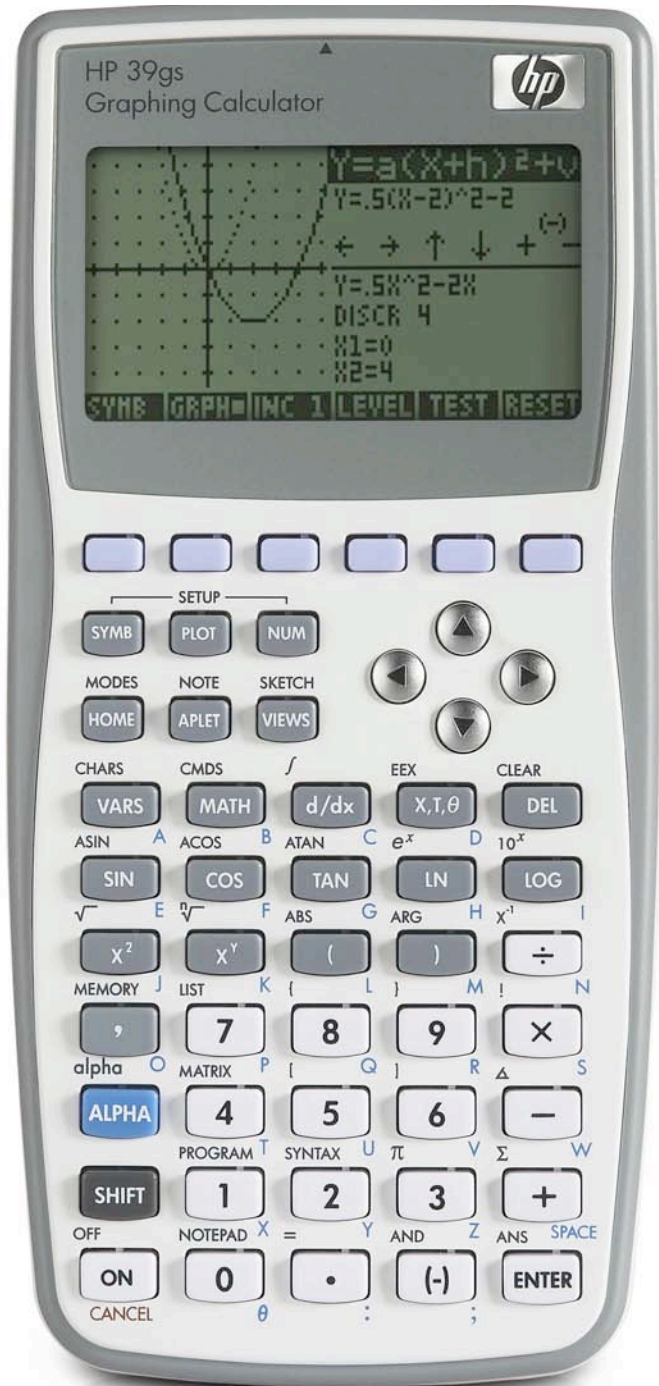
## hp calculators

HP 39gs Solving Equations

The Solve aplet

Multiple & invalid solutions

Adapting equations



The Solve aplet

Solve will rival the Function aplet as your 'most used'. It solves equations, finds zeros of expressions involving multiple variables, even involving derivatives & integrals.

What acceleration is needed to increase the speed of a car from 16.67 m/s (60kph or 38mph) to 28.78 m/s (100kph or 60mph) in a distance of 100m (110 yd)?

Enter the equation  $v^2 = u^2 - 2ad$  into E1 in the SYMB view and ensure it has a check mark by it. Only one equation can be used at one time.



Figure 1

Press NUM to change to the NUM view. You will see something similar to the screen on the right. What values are showing on your screen will depend on what happens to be in the memories V, U, A and D at the time. Pressing SHIFT CLEAR will zero all values.

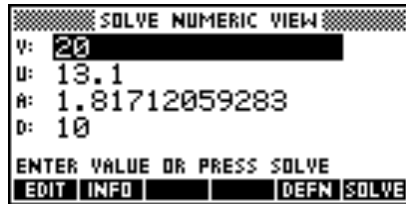


Figure 2

Move the highlight to V and enter the value 28.78, then to U and enter 16.67 and finally to D and enter 100.

Now move the highlight back to A (the value you're trying to find) and press the SOLVE button. You should find that you obtain the answer to our problem of 2.47 m/s<sup>2</sup>.

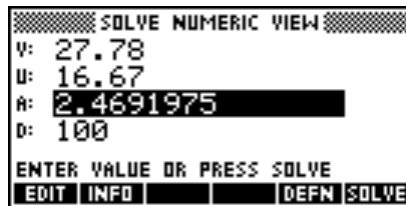


Figure 3

Now move the highlight back to A (the value you're trying to find) and press the SOLVE button. You should find that you obtain the answer to our problem of 2.47 m/s<sup>2</sup>.

Multiple & Invalid Solutions

A cylinder with a volume of 750 cm<sup>3</sup> must have a surface area of 700 cm<sup>2</sup>. What are the possible values for the radius of the can?

Re-arranging the equation for volume in terms of r we get  $h = \frac{V}{\pi r^2}$ . Substituting this into the equation for surface area we

obtain  $A = 2\pi r \left( r + \frac{V}{\pi r^2} \right)$ . We can now enter this into the SYMB view as shown below.

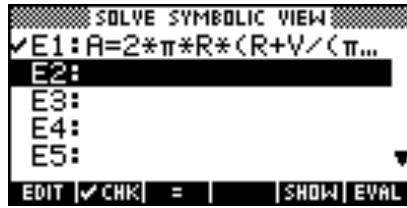


Figure 4

In this case we suspect that there may be multiple solutions so we will use the PLOT view to get approximations. The point which is critical to remember is that the position of the highlight in the NUM view determines which of the variables is to be used for the independent (horizontal) axis. After entering the values for the volume and surface area we must ensure the highlight is on R before plotting.

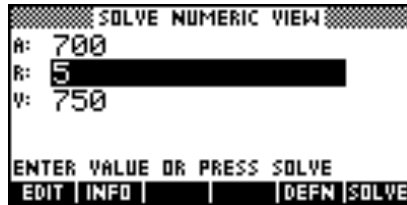


Figure 5

Set the axes as shown right and then PLOT the result. As suspected, there are multiple solutions as indicated by the plot.



Figure 6

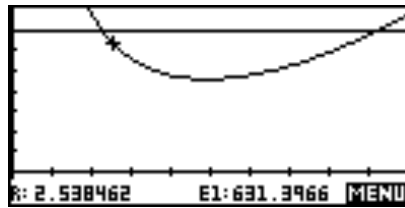


Figure 7

The two resulting curves represent the left and right hand sides of the equation, both of them in terms of R (the active variable). On the left is A, which is a constant value of 700, and on the right is  $2\pi r \left( r + \frac{V}{\pi r^2} \right)$ .

There are two possible solutions where the left hand side of the equation is equal to the right hand side. Move the cursor near to the left hand solution, as shown in Figure 7, and then change back to the NUM view. The approximation is transferred into R and pressing SOLVE will then refine it further.

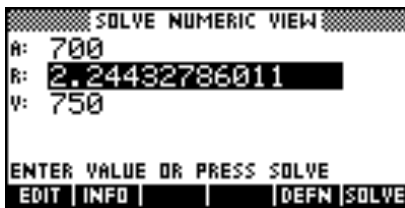


Figure 8

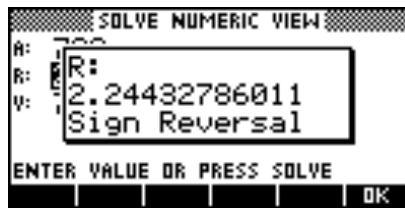


Figure 9

Press INFO to verify that it is a solution. Reports of 'Sign Reversal' (as shown in figure 9) or 'Zero' are ok. The second solution is obtained similarly.

hp calculators

HP 39gs Solving Equations

The importance of the INFO report can be seen if we change the value of A to 400 instead of 700. It can be seen right that pressing SOLVE still gives a solution but pressing INFO tells us that it is invalid ('Extremum'). Pressing PLOT shows why.

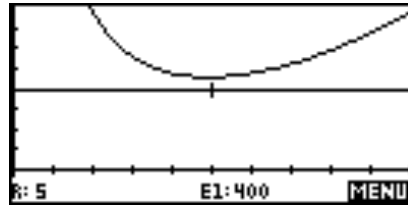


Figure 10

The graph shows that the left and right sides of the equation will never be equal. The value found by pressing SOLVE is merely the closest approach. Users have a tendency to simply accept the answer given and it is important to check using INFO

Adapting equations

Equations in physics and engineering often have subscripts or Greek letters in them.

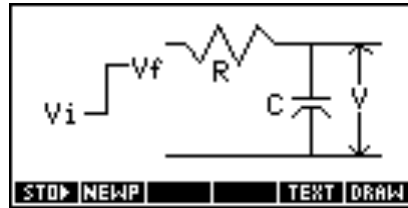


Figure 11

Since the calculator uses only capitals from A to Z you will need to adapt such equations. For example: consider RC Transients

Given the equation  $V = Vf - (Vf - Vi)e^{-\frac{t}{RC}}$  and the values shown below, calculate the value of V. Here we need to replace Vf with F and Vi with I. This gives the equation shown below.

$$Vi = 0 \text{ V}, C = 50\mu\text{F},$$

$$Vf = 10 \text{ V}$$

$$R = 100\omega, t = 2\text{ms}$$

Figure 12

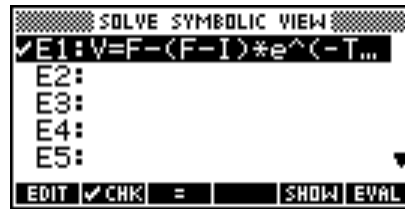


Figure 13

Because the calculator is unable to attach and convert units it is necessary to change ms into seconds and microF to F.

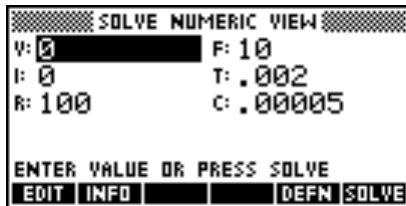


Figure 14

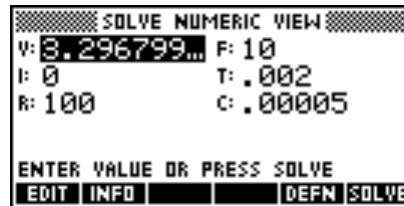


Figure 15