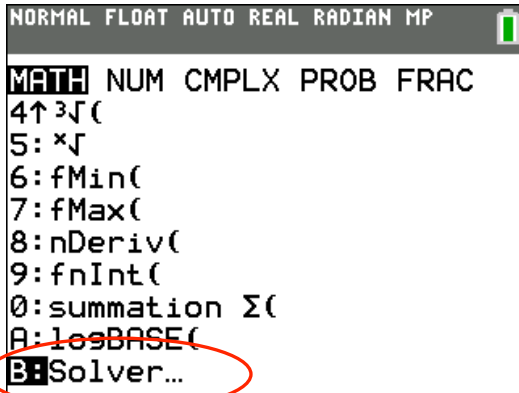


# How to use the Solver on the TI-84+

Using the TI-84 Plus / TI-84 C Silver Edition/ TI-83 Plus

To access the Solver, press the **MATH** key, scroll to the **bottom** of the list, and choose B:Solver...

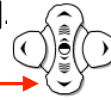


To *quickly* choose B:Solver, you can press **ALPHA** + B (the 'B' is above the APPS key)

Or...

You may press the downward directional arrow key several times to reach the B:Solver and then press **ENTER**.

downward directional arrow key



## Example 1: Solve a multi-step equation

Solve for x:  $5(x + 3) + 2(1 - x) = 14$

Step 1: Enter both sides into E1 and E2:

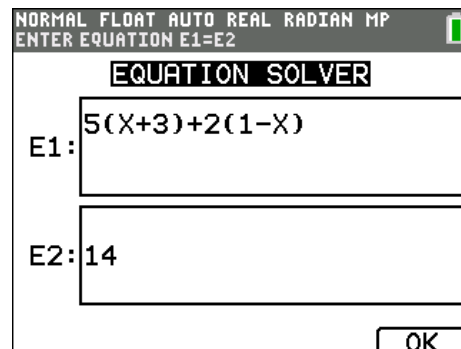
Save paper!



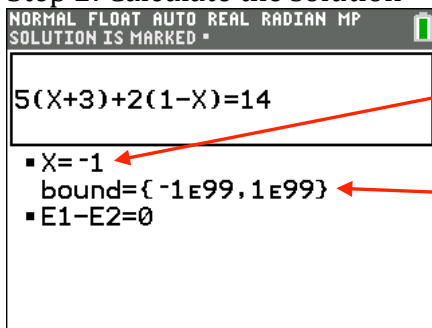
[www.andyborne.com/math](http://www.andyborne.com/math)

### Left Side / Right Side

E1 and E2 represent the left and the right side of an equation. Set E1 as seen here and set E2 to 14. The key **X,T,Θ,n** will insert an X into the expression.



Step 2: Calculate the solution



### Solving for x

Place the blinking cursor here and press the keys: **ALPHA** **ENTER**.

bound? This is a teeny, tiny list, a lower bound, and an upper bound. Basically, it says, "try numbers in between these numbers."

## Example 2: Equations the Solver doesn't handle very well.

Some types equations have **more than one** solution for  $x$ : absolute value equations and quadratic equations. This quadratic equation has two solutions:

$$x^2 - x - 20 = 0 \quad \text{answer is } x = 5 \text{ or } -4$$

When solving this one, you see the limitations of the internal circuits and algorithms used to “find” the solution.  $-3.9999\dots$  should be rounded to  $-4$ .

<p>NORMAL FLOAT AUTO REAL RADIAN MP SOLUTION IS MARKED *</p> $x^2 - x - 20 = 0$ <ul style="list-style-type: none"> <li>▪ <math>X = -3.999999999999999</math></li> <li>bound = { -1E99, 1E99 }</li> <li>▪ E1-E2=0</li> </ul> <p>Oops. TI-84 has some issues with round off.</p>	<p>NORMAL FLOAT AUTO REAL RADIAN MP SELECT VARIABLE: PRESS ALPHA SOLVE</p> $x^2 - x - 20 = 0$ <ul style="list-style-type: none"> <li>▪ <math>X = -3.999999999999999</math></li> <li>bound = { 0, 1E99 }</li> <li>▪ E1-E2=0</li> </ul> <p>change bound to look for only positive solutions...</p>	<p>NORMAL FLOAT AUTO REAL RADIAN MP</p> <p><b>ERROR: BAD GUESS</b></p> <p>1: Quit 2: Goto</p> <p>Place valid GUESS between the lower and upper bounds.</p> <p>...results in an error!</p>
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Not only is the rounding slightly wrong, but the Solver correctly solved only ONE of the answers to (badly rounded)  $-4$ . The other answer is  $5$ , but it solves only one answer at a time. When the bound is manually changed set to  $\{0, 1e99\}$  this SHOULD tell the calculator to look for solutions that are only positive numbers, and since  $5$  is within that bound, (and negative  $4$  is not) it should solve  $X$  to  $5$ , but alas, it does not.

## Example 3: How to make the solver cry

<p>NORMAL FLOAT AUTO REAL RADIAN MP</p> $ X  = -3$ <p>X=■</p> <p>bound = { -1E99, 1E99 }</p> <p>E1-E2=17207249126485</p>	<p>NORMAL FLOAT AUTO REAL RADIAN MP</p> <p><b>ERROR: NO SIGN CHANGE</b></p> <p>1: Quit 2: Goto</p> <p>Calculations are not detecting a sign change to give an estimated result for the allowed number of iterations.</p>
--	--

$|X| = -3$  has no solution.

The Solver will also have troubles with complex numbers. Solving  $\text{sqrt}(X) = 3i$  won't work.

<p>NORMAL FLOAT AUTO REAL RADIAN MP SELECT VARIABLE: PRESS ALPHA SOLVE</p> $X = X + 1$ <p>X=</p> <p>bound = { -1E99, 1E99 }</p>	<p>NORMAL FLOAT AUTO REAL RADIAN MP SOLUTION IS MARKED *</p> $X = X + 1$ <ul style="list-style-type: none"> <li>▪ <math>X = 10995117377272</math></li> <li>bound = { -1E99, 1E99 }</li> <li>▪ E1-E2=0</li> </ul>
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This should be a “no solution” equation, but somehow -mysteriously- it finds a huge number as a solution.

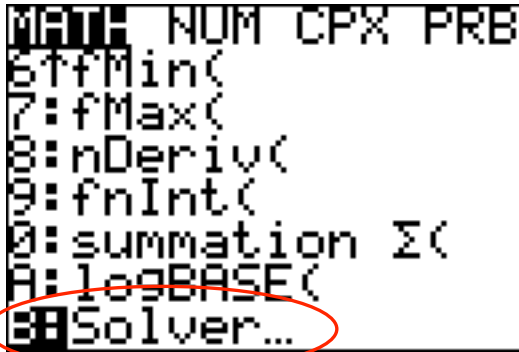
Note: a calculator with a Computer Algebra System (CAS) solves equations symbolically and will handle these issues. The TI-89 Titanium or TI-nspire CAS are two current models.

$\text{solve}( x  = -3, x)$	false
$\text{solve}(x = x + 1, x)$	false
$\text{solve}(x^2 - x - 20 = 0, x)$	$x = -4$ or $x = 5$

# How to use the Solver on the TI-84+ SE

## also using the TI-84 Plus / TI-83 Plus

To access the Solver, press the **MATH** key, scroll to the **bottom** of the list, and choose B:Solver...

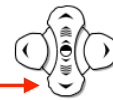


To *quickly* choose B:Solver, you can press **ALPHA** + B (the 'B' is above the APPS key)

Or...

You may press the downward directional arrow key several times to reach the B:Solver and then press **ENTER**.

downward directional arrow key



Save paper!



[www.andyborne.com/math](http://www.andyborne.com/math)

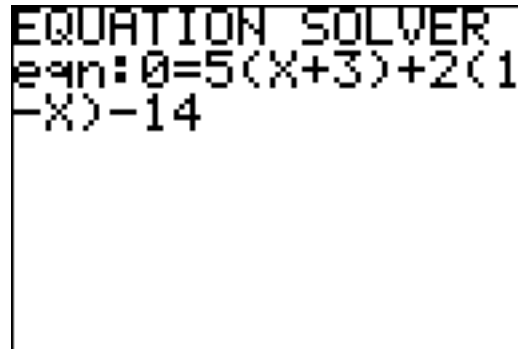
### Example 1: Solve a multi-step equation

Solve for  $x$ :  $5(x + 3) + 2(1 - x) = 14$

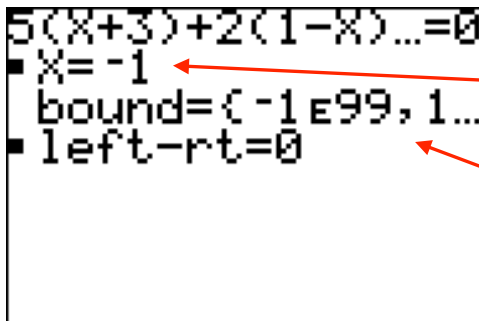
Step 1: Solve in terms of zero, with zero on the left:  $0 = 5(x + 3) + 2(1 - x) - 14$

#### Solve in terms of zero

Some re-working of the equation may be necessary to put it in terms of zero. In this case, subtract 14 from both sides. The key **X,T,θ,n** will insert an X into the expression.



Step 2: Calculate the solution



#### Solving for x

Place the blinking cursor here and press the keys: **ALPHA****ENTER**.


bound? This is a teeny, tiny list, a lower bound, and an upper bound. Basically, it says, "try numbers in between these numbers."

## Example 2: Equations the Solver doesn't handle very well.

Some types equations have **more than one** solution for  $x$ : absolute value equations and quadratic equations. This quadratic equation has two solutions:

$$x^2 - x - 20 = 0 \quad \text{answer is } x = 5 \text{ or } -4$$

When solving this one, you see the limitations of the internal circuits and algorithms used to "find" the solution. -3.9999...should be rounded to -4.

<pre>X^2-X-20=0 X=-3.999999999... bound=(-1E99,1... left-rt=0</pre> <p>Oops. TI-84 has some issues with round off.</p>	<pre>X^2-X-20=0 X=-3.999999999... bound=(0,1E99}</pre>  <p>change bound to look for only positive solutions...</p>	<pre>ERR:BAD GUESS 1:Quit 2:Goto</pre> <p>...results in an error!</p>
--	---	---

Not only is the rounding slightly wrong, but the Solver correctly solved only ONE of the answers to (badly rounded) -4. The other answer is 5, but it solves only one answer at a time. When the bound is manually changed set to  $\{0, 1e99\}$  this SHOULD tell the calculator to look for solutions that are only positive numbers, and since 5 is within that bound, (and negative 4 is not) it should solve  $X$  to 5, but alas, it does not.

## Example 3: How to make the solver cry

```
abs(X)+3=0
X=
bound=(-1E99,1...
```

```
ERR:NO SIGN CHNG
1:Quit
2:Goto
```

$|X| = -3$  has no solution.

The Solver will also have troubles with complex numbers. Solving  $\text{sqrt}(X) = 3i$  won't work.

```
X-(X+1)=0
X=
bound=(-1E99,1...
```

```
X-(X+1)=0
X=175921860444...
bound=(-1E99,1...
left-rt=0
```

This should be a no solution equation, but somehow -mysteriously- it finds a huge number as a solution.

Note: a calculator with a Computer Algebra System (CAS) solves equations symbolically and will handle these issues. The TI-89 Titanium or TI-*n*spire CAS are two current models.

$\text{solve}( x =-3,x)$	false
$\text{solve}(x=x+1,x)$	false
$\text{solve}(x^2-x-20=0,x)$	$x=-4$ or $x=5$