# Solving the Quadratic Equation with a Calculator

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The quadratic equation appears frequently in the solution to equilibrium problems. It is written as:

$$ax^2 + bx + c = 0$$

When the coefficients, a, b and c are real, the solution is usually expressed as:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Unfortunately, this solution runs into difficulty when either $a$ or $c$ or both are small. Then one of the roots will involve subtraction of $b$ from a very nearly equal quantity (discriminant). This will be obtained inaccurately. A more robust way to compute the roots is from the quantity q, defined as follows:

$$q \equiv -\frac{1}{2}\left[b + \mathrm{sgn}(b)\sqrt{b^2 - 4ac}\right]$$

The two roots are now:

$$x_1 = \frac{q}{a} \quad \text{and} \quad x_2 = \frac{c}{q}$$

We can find the roots according to this prescription with the following calculator program:

PROGRAM: QUADROOT
:Prompt A,B,C
: if $B \le 0$
: $-(1/2)*(B - \sqrt{B^2 - 4*A*C)}) \to Q$
: $-(1/2)*(B + \sqrt{B^2 - 4*A*C)}) \to Q$
: Disp "ROOT 1",
,Q/A
: Disp "ROOT 2"
,C/Q
:STOP