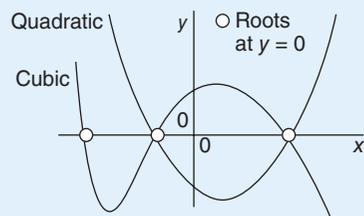


The chemist's toolkit 8 Quadratic and cubic equations

A quadratic equation is an equation of the form

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

Its solutions (its 'roots', see the sketch) are



$$x = \frac{-b \pm (b^2 - 4ac)^{1/2}}{2a}$$

Which root is acceptable is decided by physical criteria; thus, if x is a concentration, only a positive root is meaningful. If x is a change in concentration, then the final concentration, $x_{\text{initial}} + x$, must be positive.

Closed forms are also available for the three roots of cubic equations (equations of the form $ax^3 + bx^2 + cx + d = 0$, see the sketch), but they are very complicated and are best found by using mathematical software or graphically.