

# Tips, Formulae and shortcuts for Quadratic Equations

By

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## Cracku Tip 1 – Quadratic Equations

- Quadratic Equations is one of the important topics for CAT
- The theory involved in this topic is very simple and students should be comfortable with the some basic formulas and concepts.
- The techniques like option elimination, value assumption can help to solve questions from this topic quickly.
- This pdf covers all the important formulas and concepts related to Quadratic Equations.

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## Cracku Tip 2 – Quadratic Equations

General Quadratic equation will be in the form of  $ax^2+bx+c = 0$

The values of 'x' satisfying the equation are called roots of the equation.

- The value of roots, p and q =  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- Sum of the roots =  $p+q = \frac{-b}{a}$
- Product of the roots =  $p*q = \frac{c}{a}$
- If c and a are equal then the roots are reciprocal to each other
- If  $b = 0$ , then the roots are equal and are opposite in sign.

## Cracku Tip 3 – Quadratic Equations

Let  $D$  denote the discriminant,  $D = b^2 - 4ac$ . Depending on the sign and value of  $D$ , nature of the roots would be as follows:

- $D < 0$  and  $|D|$  is not a perfect square:

Roots will be in the form of  $p+iq$  and  $p-iq$  where  $p$  and  $q$  are the real and imaginary parts of the complex roots.  $p$  is rational and  $q$  is irrational.

- $D < 0$  and  $|D|$  is a perfect square:

Roots will be in the form of  $p+iq$  and  $p-iq$  where  $p$  and  $q$  are both rational.

- $D = 0$

Roots are real and equal.  $X = -b/2a$

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## Cracku Tip 4 – Quadratic Equations

- $D > 0$  and  $D$  is not a perfect square:  
Roots are conjugate surds
- $D > 0$  and  $D$  is a perfect square:  
Roots are real, rational and unequal

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## Cracku Tip 5 – Quadratic Equations

Signs of the roots: Let P be product of roots and S be their sum

- $P > 0, S > 0$  : Both roots are positive
- $P > 0, S < 0$  : Both roots are negative
- $P < 0, S > 0$  : Numerical smaller root is negative and the other root is positive
- $P < 0, S < 0$  : Numerical larger root is negative and the other root is positive

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## Cracku Tip 6 – Quadratic Equations

- Minimum and maximum values of  $ax^2+bx+c = 0$
- If  $a > 0$ : minimum value =  $\frac{4ac-b^2}{4a}$  and occurs at  $x = -b/2a$
- If  $a < 0$ : maximum value =  $\frac{4ac-b^2}{4a}$  and occurs at  $x = -b/2a$

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## Cracku Tip 7 – Quadratic Equations

If  $A_n X^n + A_{n-1} X^{n-1} + \dots + A_1 X + A_0 = 0$ , then

- Sum of the roots =  $-A_{n-1}/A_n$
- Sum of roots taken two at a time =  $A_{n-2}/A_n$
- Sum of roots taken three at a time =  $-A_{n-3}/A_n$  and so on
- Product of the roots =  $[(-1)^n A_0] / A_n$

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## Cracku Tip 8 – Quadratic Equations

Finding a quadratic equation:

- If roots are given:  $(x-a)(x-b)=0 \Rightarrow x^2-(a+b)x+ab = 0$
- If sum  $s$  and product  $p$  of roots are given:  $x^2-sx+p = 0$
- If roots are reciprocals of roots of equation  $ax^2+bx+c = 0$ , then equation is  $cx^2+bx+a = 0$
- If roots are  $k$  more than roots of  $ax^2+bx+c = 0$  then equation is  $a(x-k)^2+b(x-k)+c = 0$
- If roots are  $k$  times roots of  $ax^2+bx+c = 0$  then equation is  $a(x/k)^2+b(x/k)+c = 0$

## Cracku Tip 9 – Quadratic Equations

- Descartes Rules: A polynomial equation with  $n$  sign changes can have a maximum of  $n$  positive roots. To find the maximum possible number of negative roots, find the number of positive roots of  $f(-x)$ .
- An equation where highest power is odd must have at least one real root

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