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CAT Quadratic Equations Formulas

- Quadratic Equations is also an important topic For CAT Exam.
- The theory involved in this topic is very simple and students should be comfortable with 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.
- General Quadratic equation will be in the form of

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- The values of ‘x’ satisfying the equation are called roots of the equation.
- The value of roots, p and q = $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- The above formula is known as the Shreedhara Acharya's Formula, after the ancient Indian Mathematician who derived it.
- Sum of the roots = p+q = $\dfrac{-b}{a}$
- Product of the roots = p × q = $\dfrac{c}{a}$
- 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.

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 $\left\{x = \frac{-b}{2a}\right\}$
- D > 0 and D is not a perfect square:

Roots are conjugate surds of the form $p + \sqrt{q}$ and $p - \sqrt{q}$

- D > 0 and D is a perfect square:

Roots are real, rational and unequal

➔ **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

Minimum and maximum values of $ax^2 + bx + c = 0$

- If $a > 0$: minimum value $= \frac{4ac-b^2}{4a}$ and

occurs at $x = \frac{-b}{2a}$

- If $a < 0$: maximum value $= \frac{4ac-b^2}{4a}$ and

occurs at $x = \frac{-b}{2a}$

If $A_n X^n + A_{n-1} X^{n-1} + ... + A_1 X + A_0$**, then**

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

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

- 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 $a(x/k)^2 + b(x/k) + c = 0$
- 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 the highest power is odd must have at least one real root.