IMPORTANT JEE-NEET FORMULAS

Quadratic Equation Formula's

Topics	Formulas
General form of Quadratic Equation	$ax^2 + bx + c = 0$; where a, b, c are constants and $a \neq 0$.
Roots of equations	$\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$, $\beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$
Sum and Product of Roots	If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, then Sum of roots, $\alpha + \beta = -\frac{b}{a}$ Product of roots, $\alpha\beta = \frac{c}{a}$
Discriminant of Quadratic equation	The Discriminant of the quadratic equation $ax^2 + bx + c = 0$ is given by $D = b^2 - 4ac$.
Nature of Roots	If $D = 0$, the roots are real and equal $\alpha = \beta = -\frac{b}{2a}$. If $D \neq 0$, the roots are real and unequal. If $D < 0$, the roots are imaginary and unequal. If $D > 0$ and **D** is a perfect square, the roots are rational and unequal. If $D > 0$ and D is not a perfect square, the roots are irrational and unequal.

Common Roots:	If two quadratic equations $a_1x^2 + b_1x + c_1 = 0$ & $a_2x^2 + b_2x + c_2 = 0$ have both roots common, then $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$. If only one root α is common, then $\alpha = \frac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1} = \frac{b_1c_2 - b_2c_1}{c_1a_2 - c_2a_1}$
Range of Quadratic Expression $f(x) = ax^2 + bx + c$ in restricted domain $x \in [x_1, x_2]$:	If $-\frac{b}{2a}$ not belong to $[x_1, x_2]$ then, $f(x) \in [\min\{f(x_1), f(x_2)\}, \max\{f(x_1), f(x_2)\}]$ If $-\frac{b}{2a} \in [x_1, x_2]$ then, $f(x) \in \left[\min\left\{f(x_1), f(x_2), -\frac{D}{4a}\right\}, \max\{f(x_1), f(x_2), -\frac{D}{4a}\}\right]$
Roots under special cases:	Consider the quadratic equation $ax^2 + bx + c = 0$ If $c = 0$, then one root is zero. Other root is $-\frac{b}{a}$. If $b = 0$, the roots are equal but in opposite sign. If $b = c = 0$, then both roots are zero. If $a = c$, then the roots are reciprocal to each other. If $a + b + c = 0$, then one root is 1 and the second root is $\frac{c}{a}$. If $a = b = c = 0$, then the equation will become an identity and will satisfy every value of x.

Graph of Quadratic equation	The graph of a quadratic equation $\boldsymbol{ax^2 + bx + c = 0}$ is a parabola. If $\boldsymbol{a > 0}$, then the graph of a quadratic equation will be concave upwards. If $\boldsymbol{a < 0}$, then the graph of a quadratic equation will be concave downwards.
Maximum and Minimum value:	Consider the quadratic expression $\boldsymbol{ax^2 + bx + c = 0}$ If $\boldsymbol{a < 0}$, then the expression has the greatest value at $\boldsymbol{x = -\frac{b}{2a}}$. The maximum value is $\boldsymbol{-\frac{D}{4a}}$. If $\boldsymbol{a > 0}$, then the expression has the least value at $\boldsymbol{x = -\frac{b}{2a}}$. The minimum value is $\boldsymbol{-\frac{D}{4a}}$.
Quadratic Expression in Two Variables	The general form of a quadratic equation in two variables x and y is $\boldsymbol{ax^2 + 2hxy + by^2 + 2gx + 2fy + c}$. To solve the expression into two linear rational factors, the condition is $\Delta = 0$ $\Delta = \begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$ $\boldsymbol{abc + 2fgh - af^2 - bg^2 - ch^2 = 0}$ And $\boldsymbol{h^2 - ab > 0}$. This is called the Discriminant of the given expression.