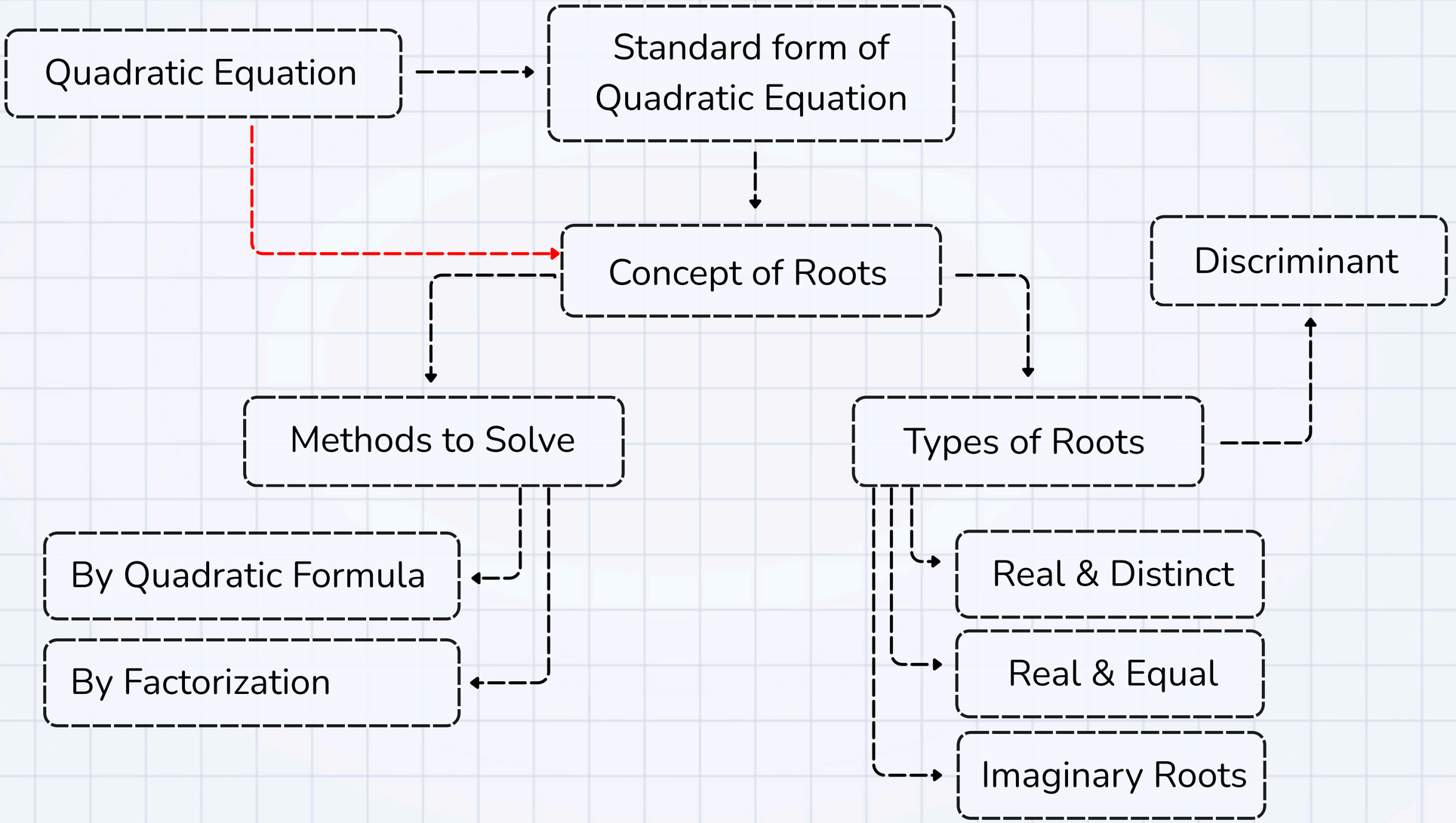
CHAPTER : 4

QUADRATIC EQUATION

Chapter Flow



Quadratic Equation

- Quadratic Equation is an equation, whose highest degree is ‘2’
- Quadratic equations can be expressed as a **product of two** linear factors **(when factorization is possible)**.

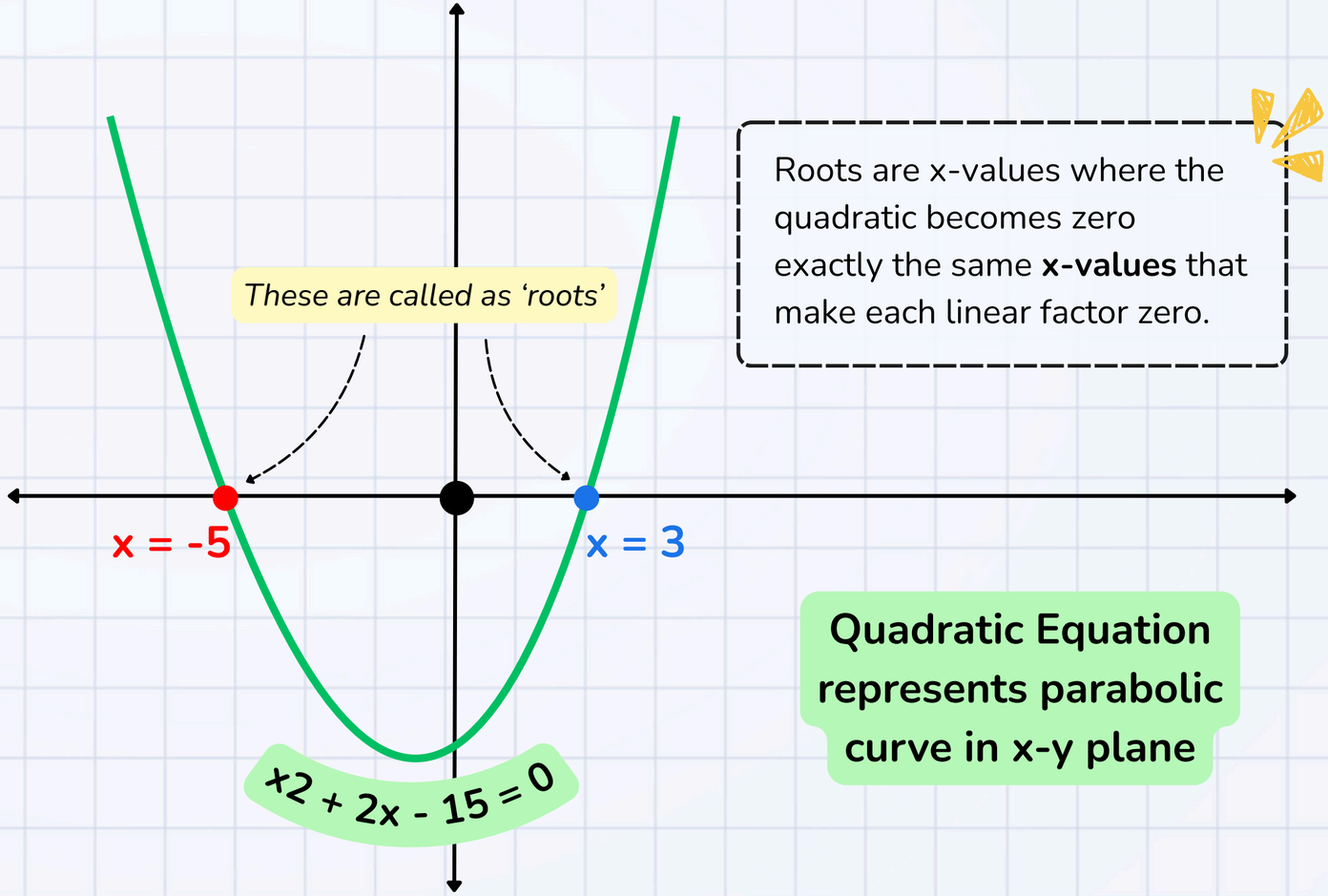
$(x + 5) = 0$ $(x - 3) = 0$

If we multiply these two equations

$(x + 5) \times (x - 3) = 0$

We get this equations

$x^2 + 2x - 15 = 0$

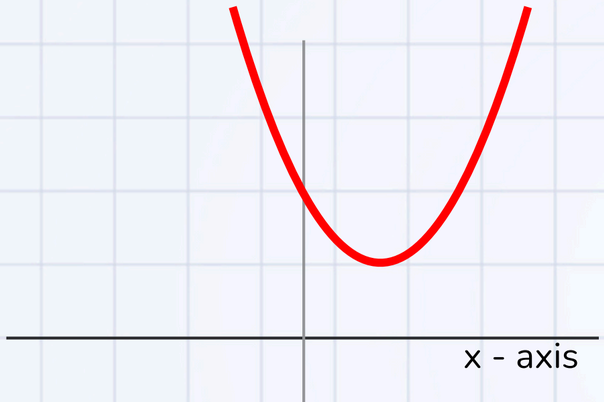


Roots are x-values where the quadratic becomes zero exactly the same **x-values** that make each linear factor zero.

Quadratic Equation represents parabolic curve in x-y plane

Quadratic Equation (Types of Roots)

Quadratic Equation is a parabola, and parabola can be exist in **3 possibilities** only. **(when variable is ‘x’)**



No Real Roots

No intersection with ‘x’ axis

Real Equal Roots

1 point intersection with ‘x’ axis

Real Distinct Roots

2 point intersection with ‘x’ axis

Standard Form of Quadratic Equations & Concept of Roots

Standard Form of Quadratic Equation is as Follows :

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

- Here, a, b, c are constants (real numbers).
- where $a \neq 0$

Discriminant of Quadratic Equation

It is a value that helps to decide the **nature of roots.**
Discriminant of a Quadratic Equation is denoted by D & it is given by

$$D = b^2 - 4ac$$

Here, a, b, c are coefficients from Quadratic Equations

If

$b^2 - 4ac > 0$	Real and Distinct Roots
$b^2 - 4ac = 0$	Real and Equal Roots
$b^2 - 4ac < 0$	No real roots (complex roots)

NOTE

The value of the discriminant **is not a root** of the quadratic equation. Do not confuse it with the roots.

Methods to solve : Quadratic Formula

For any quadratic equation in the following form,

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

- Where a, b, c are constants (real numbers).
- Also $a \neq 0$

Roots can be given by this formula.

$$x = \frac{-b \pm \sqrt{D}}{2a}$$

Where D = Discriminant
i.e ($D = b^2-4ac$)

This is known as Quadratic Formula

Let's say equation have 2 roots 'x_1' & 'x_2', Then

This is value of root 1

$$x_1 = \frac{-b + \sqrt{D}}{2a}$$

This is value of root 2

$$x_2 = \frac{-b - \sqrt{D}}{2a}$$

When D = 0 then roots becomes **equal**

$$x_1 = \frac{-b}{2a} \qquad x_2 = \frac{-b}{2a}$$

Methods to solve : Factorization Method

For any quadratic equation in the following form,

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

- Where a, b, c are constants (real numbers).
- Also $a \neq 0$

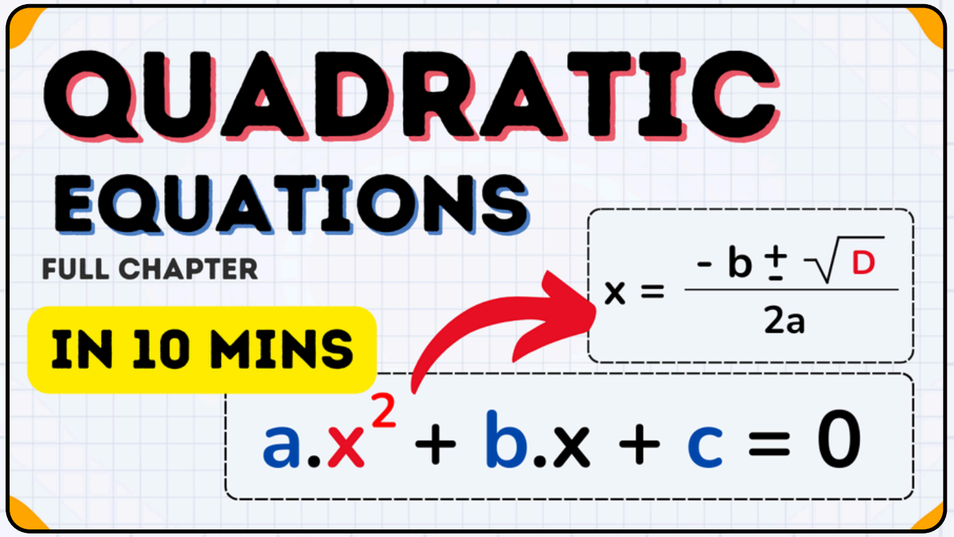
→ Multiply ‘a’ & ‘c’ and find all factors of that value.
Find factors of ‘a x c’

→ Find 2 factors ‘m’ & ‘n’ such that,
m + n = b

→ Put value in the following format and take common

$$ax^2 + mx + nx + c = 0$$

This method is converted to **6 simple steps**
Watch below video for more clarity or see next pages for solved example



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Step 1

Compare equation with general form and find values of a, b & c.

$x^2 - 5x + 6 = 0$

Compare with the standard form.....

$a.x^2 + b.x + c = 0$

- a = +1
- b = -5
- c = +6

Step 2

Multiply a & c and find the factors of that value.

a = +1 b = -5 c = +6

*Find a*c*

a * c = (+1)*(+6)

a * c = +6

Find all factors of '+6'

+6

- 1, 2, 3, 6, -6, -3, -2, -1

Step 3

Find the 2 factors such that their addition is equal to 'b'.

b = -5

Assume 'm' & 'n' as 2 factors

Find $m + n = b$

+6

- 1, 2, 3, 6, -6, -3, -2, -1

-3 & -2 sums up as -5

m = -3 n = -2

Step 4

Put the values of factors into the equation

Put Values of m & n in following equation

$a.x^2 + m.x + n.x + c = 0$

We have values of all constants with us

$a = +1$ $\quad c = +6$

$m = -3$ $\quad n = -2$

Thus Equation Becomes

$1.x^2 - 3.x - 2.x + 6 = 0$

Step 5

Take out 3 common pairs from the equation

$1.x^2 - 3.x - 2.x + 6 = 0$

We need to take 3 common pairs

$1.x^2 - 3.x$ - $2.x + 6 = 0$ *1st Common pair*

$x.(x - 3)$ - $2.x + 6 = 0$ *2nd Common Pair*

$x.(x - 3)$ - $2.(x - 3) = 0$ *3rd Common Pair*

$(x - 3) * (x - 2) = 0$

Step 6

Solve the pairs independently to find roots.

$(x - 3) * (x - 2) = 0$

$(x - 3) = 0$ $\quad (x - 2) = 0$

$x - 3 = 0$ $\quad x - 2 = 0$

$x = +3$ $\quad x = +2$

Roots of Our Equations are

$x = +3$ & $+2$

DEAR STUDENT

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