■ CLASS 10 MATHEMATICS

QUADRATIC EQUATIONS

Complete Notes • Formulae • Examples • Practice Questions

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**Chapter 4: Quadratic Equations **

4.1 Introduction

Key Concepts

- A **quadratic equation** is an equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$.
- It is a **second-degree polynomial equation** in one variable (x).
- Quadratic equations arise in real-life scenarios like calculating areas, projectile motion, and profit/loss problems.

Important Points

- The **degree** of a quadratic equation is **2**, which is the highest power of the variable.
- The equation is called **quadratic** because "quad" means square (from Latin *quadratus*).

Exam Tips

- Understand the **standard form** of a quadratic equation.
- Recognize that quadratic equations are used to model real-world problems.

4.2 Quadratic Equations

Definition and Standard Form

- A **quadratic equation** in one variable **x** is an equation that can be written as:
  $ax^2 + bx + c = 0$, where:
  - **a**, **b**, and **c** are constants ($a \neq 0$).
  - **x** is the variable.
  - **a** is the **coefficient of x^2**, **b** is the **coefficient of x**, and **c** is the **constant term.**

Examples

- $x^2 + 5x + 6 = 0 \rightarrow a = 1, b = 5, c = 6$
- $3x^2 - 2x + 1 = 0 \rightarrow a = 3, b = -2, c = 1$

Exam Tips

- Identify the coefficients **a**, **b**, and **c** from a given equation.
- Remember that **$a \neq 0$** is a critical condition for an equation to be quadratic.

4.3 Solution of a Quadratic Equation by Factorisation

Steps to Solve by Factorisation

1. **Write the equation in standard form** ($ax^2 + bx + c = 0$).
2. **Split the middle term** (bx) into two terms such that the product of the coefficients equals **$a \times c$**.
3. **Factor by grouping** the terms into two binomials.
4. **Set each factor equal to zero** and solve for **x**.

Example

Solve $x^2 + 5x + 6 = 0$:

1. Split the middle term: $x^2 + 2x + 3x + 6 = 0$
2. Group: $(x^2 + 2x) + (3x + 6) = 0$
3. Factor: $x(x + 2) + 3(x + 2) = 0$
4. Combine: $(x + 2)(x + 3) = 0$
5. Solutions: $x = -2$ or $x = -3$

Important Notes

- Factorisation works only if the quadratic can be expressed as a product of two binomials with integer coefficients.
- If factorisation is not possible, use the **quadratic formula** or **completing the square** method.

Exam Tips

- Practice factorisation with equations where the product $a \times c$ is easy to split.
- Check your solutions by substituting them back into the original equation.

4.4 Nature of Roots

Discriminant and Its Role

- The **discriminant** of a quadratic equation $ax^2 + bx + c = 0$ is given by:
  $D = b^2 - 4ac$.
- The **nature of the roots** depends on the value of D:
  - $D > 0$: Two **distinct real roots.**
  - $D = 0$: One **real root** (repeated root).
  - $D < 0$: No **real roots** (roots are **imaginary**).

Examples

1. $x^2 - 4x + 4 = 0 \rightarrow D = (-4)^2 - 4(1)(4) = 16 - 16 = 0 \rightarrow$ One real root ($x = 2$).
2. $x^2 + 2x + 5 = 0 \rightarrow D = (2)^2 - 4(1)(5) = 4 - 20 = -16 \rightarrow$ No real roots.

Exam Tips

- Memorize the **discriminant formula** ($D = b^2 - 4ac$).
- Use the discriminant to determine the nature of roots without solving the equation.
- If **D is a perfect square**, the roots are **rational**; otherwise, they are **irrational**.

4.5 Summary

- A quadratic equation is of the form $ax^2 + bx + c = 0$ ($a \neq 0$).
- **Factorisation** is a method to solve quadratic equations when possible.
- The **discriminant** ($D = b^2 - 4ac$) determines the nature of the roots:
  - $D > 0$: Two distinct real roots.
  - $D = 0$: One real root (repeated).
  - $D < 0$: No real roots.
- Always verify solutions by substitution.

Important Formulas to Remember

- **Standard form:** $ax^2 + bx + c = 0$
- **Discriminant:** $D = b^2 - 4ac$
- **Roots:** $x = \frac{-b \pm \sqrt{D}}{2a}$ (derived from quadratic formula)

Exam Preparation Checklist

- Practice solving equations by factorisation.
- Solve problems on the nature of roots using the discriminant.
- Memorize the standard form and discriminant formula.
- Focus on identifying coefficients **a**, **b**, and **c** in given equations.