# Quadratic Equations (Further Mathematics)

## 1. Introduction to Quadratic Equations

Definition: A quadratic equation is a polynomial equation of degree 2.

Standard form: ax² + bx + c = 0

Identifying coefficients: a, b, and c

### Example:

Identify the coefficients of the quadratic equation 3x² - 5x + 2 = 0.

Solution: a = 3, b = -5, c = 2

### Try This:

Find the coefficients for: 2x² + 7x - 4 = 0.

## 2. Methods of Solving Quadratic Equations

### Factorization Method:

Solve: x² - 5x + 6 = 0

Solution: (x-2)(x-3) = 0 → x = 2 or x = 3

### Completing the Square Method:

Solve: x² + 4x + 1 = 0

Solution: (x+2)² - 3 = 0 → (x+2)² = 3 → x = -2 ± √3

### Using the Quadratic Formula:

The quadratic formula is x = [-b ± √(b²-4ac)] / 2a

Solve: 2x² + 3x - 2 = 0

Solution: a=2, b=3, c=-2

x = [-3 ± √(3²-4(2)(-2))]/(2×2) = [-3 ± √(9+16)]/4 = [-3 ± √25]/4

x = (-3 + 5)/4 = 2/4 = 0.5 or x = (-3 - 5)/4 = -8/4 = -2

### Try This:

Solve x² - 2x - 8 = 0 by factorization.

## 3. Nature of Roots of Quadratic Equations

Discriminant D = b² - 4ac

Interpretation:

• D > 0 → Two distinct real roots

• D = 0 → Two equal real roots

• D < 0 → Complex roots

### Example:

Find the nature of roots for x² + 2x + 5 = 0.

D = (2)² - 4(1)(5) = 4 - 20 = -16 → Complex roots

### Try This:

Find the nature of roots for x² - 6x + 9 = 0.

## 4. Relationship Between Roots and Coefficients

Sum of roots = -b/a, Product of roots = c/a

### Example:

Find the sum and product of roots for 2x² - 4x + 1 = 0.

Sum = -(-4)/2 = 2, Product = 1/2

### Try This:

Find sum and product of roots for x² + 3x + 2 = 0.

## 5. Formation of Quadratic Equations from Given Roots

If roots are α and β, equation is (x-α)(x-β) = 0

### Example:

Form the quadratic equation with roots 2 and 5.

Solution: (x-2)(x-5) = x² -7x + 10 = 0

### Try This:

Form the quadratic equation with roots -3 and 4.

## 6. Graphical Method

Plot y = ax² + bx + c using a table of values.

Roots are where graph cuts x-axis.

## 7. Solving Quadratic Inequalities

Solve inequalities like ax² + bx + c > 0 or < 0.

Solution sets are represented on number lines.

## 8. Application Problems (Word Problems)

Formulate and solve quadratic equations from real-life situations like area, motion, revenue, etc.

## Past Questions:

1. Solve 2x² - 3x - 2 = 0 (WAEC 2020)

2. Find the nature of the roots of x² + 4x + 5 = 0 (NECO 2019)

3. Form a quadratic equation whose roots are 1/2 and -3 (WAEC 2018)