

# QUADRATIC EQUATIONS

## 1.Introduction:

In this chapter, you will study quadratic equations, and various ways of finding their roots. You will also see some applications of quadratic equations in daily life situations.

## 2.Notes:

- A quadratic equation in the variable  $x$  is of the form  $ax^2 + bx + c = 0$ , where  $a, b, c$  are real numbers and  $a \neq 0$ .
- A real number  $\alpha$  is said to be a root of the quadratic equation  $ax^2 + bx + c = 0$ , if  $a\alpha^2 + b\alpha + c = 0$ . The zeroes of the quadratic polynomial  $ax^2 + bx + c$  and the roots of the quadratic equation  $ax^2 + bx + c = 0$  are the same.
- If we can factorise  $ax^2 + bx + c$ ,  $a \neq 0$ , into a product of two linear factors, then the roots of the quadratic equation  $ax^2 + bx + c = 0$  can be found by equating each factor to zero.
- A quadratic equation can also be solved by the method of completing the square.
- Quadratic formula: The roots of a quadratic equation  $ax^2 + bx + c = 0$  are given by  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  – provided  $b^2 - 4ac \geq 0$ .
- A quadratic equation  $ax^2 + bx + c = 0$  has (i) two distinct real roots, if  $b^2 - 4ac > 0$ , (ii) two equal roots (i.e., coincident roots), if  $b^2 - 4ac = 0$ , and (iii) no real roots, if  $b^2 - 4ac < 0$ .

## 3.Example Sums:

\*Check whether the following are quadratic equations: (i)  $(x - 2)^2 + 1 = 2x - 3$

Solution:  $\text{LHS} = (x - 2)^2 + 1 = x^2 - 4x + 4 + 1 = x^2 - 4x + 5$  Therefore,  $(x - 2)^2 + 1 = 2x - 3$  can be rewritten as  $x^2 - 4x + 5 = 2x - 3$  i.e.,  $x^2 - 6x + 8 = 0$  It is of the form  $ax^2 + bx + c = 0$ . Therefore, the given equation is a quadratic equation.

\*Find the roots of the following quadratic equations, if they exist, using the quadratic formula: (i)  $3x^2 - 5x + 2 = 0$ .

SOLUTION:  $3x^2 - 5x + 2 = 0$ . Here,  $a = 3$ ,  $b = -5$ ,  $c = 2$ . So,  $b^2 - 4ac = 25 - 24 = 1 > 0$ . Therefore,  $x = \frac{5 \pm \sqrt{1}}{6} = \frac{5 \pm 1}{6}$ , i.e.,  $x = 1$  or  $x = \frac{2}{3}$  So, the roots are  $\frac{2}{3}$  and 1.

#### 4.Practice Sums:

\*Find the roots of the following quadratic equations, if they exist, using the quadratic formula:

$$x^2 + 4x + 5 = 0.$$

\*Find the roots of the equation  $5x^2 - 6x - 2 = 0$  by the method of completing the square.