Chapter 1
Quadratic Equations

1.1 Equation:

An equation is a statement of equality '=' between two expression for particular values of the variable. For example

$5x + 6 = 2$, x is the variable (unknown)

The equations can be divided into the following two kinds:

Conditional Equation:

It is an equation in which two algebraic expressions are equal for particular value/s of the variable e.g.,

a) $2x = 3$ is true only for $x = 3/2$

b) $x^2 + x - 6 = 0$ is true only for $x = 2, -3$

Note: for simplicity a conditional equation is called an equation.

Identity:

It is an equation which holds good for all value of the variable e.g;

a) $(a + b)\, x \equiv ax + bx$ is an identity and its two sides are equal for all values of x.

b) $(x + 3)(x + 4) \equiv x^2 + 7x + 12$ is also an identity which is true for all values of x.

For convenience, the symbol '=' shall be used both for equation and identity.

1.2 Degree of an Equation:

The degree of an equation is the highest sum of powers of the variables in one of the term of the equation. For example

$2x + 5 = 0$	1st degree equation in single variable
$3x + 7y = 8$	1st degree equation in two variables
$2x^2 - 7x + 8 = 0$	2nd degree equation in single variable
$2xy - 7x + 3y = 2$	2nd degree equation in two variables
$x^3 - 2x^2 + 7x + 4 = 0$	3rd degree equation in single variable
$x^2y + xy + x = 2$	3rd degree equation in two variables

1.3 Polynomial Equation of Degree n:

An equation of the form

$$a_nx^n + a_{n-1}x^{n-1} + \text{----------------} + a_3x^3 + a_2x^2 + a_1x + a_0 = 0 \text{--------------}(1)$$

Where n is a non-negative integer and a_n, a_{n-1}, -------------, a_3, a_2, a_1, a_0 are real constants, is called polynomial equation of degree n. Note that the degree of the equation in the single variable is the highest power of x which appear in the equation. Thus

$3x^4 + 2x^3 + 7 = 0$

$x^4 + x^3 + x^2 + x + 1 = 0$, $x^4 = 0$

are all fourth-degree polynomial equations.

By the techniques of higher mathematics, it may be shown that nth degree equation of the form (1) has exactly n solutions (roots). These roots may be real, complex or a mixture of both. Further it may be shown that if such an equation has complex roots, they occur in pairs of conjugates complex numbers. In other words it cannot have an odd number of complex roots.

A number of the roots may be equal. Thus all four roots of $x^4 = 0$ are equal which are zero, and the four roots of $x^4 - 2x^2 + 1 = 0$

Comprise two pairs of equal roots (1, 1, -1, -1).

1.4 Linear and Cubic Equation:

The equation of first degree is **called linear equation.**

For example,

i) $x + 5 = 1$ (in single variable)

ii) $x + y = 4$ (in two variables)

The equation of third degree is **called cubic equation.**

For example,

i) $a_3x^3 + a_2x^2 + a_1x + a0 = 0$ (in single variable)

ii) $9x^3 + 5x^2 + 3x = 0$ (in single variable)

iii) $x^2y + xy + y = 8$ (in two variables)

1.5 Quadratic Equation:

The equation of second degree is called quadratic equation. The word quadratic comes from the Latin for “square”, since the highest power of the unknown that appears in the equation is square. For example

$2x^2 – 3x + 7 = 0$ (in single variable)

$xy – 2x + y = 9$ (in two variable)

Standard form of quadratic equation

The standard form of the quadratic equation is $ax^2 + bx + c = 0$, where a, b and c are constants with $a \neq 0$.

If $b \neq 0$ then this equation is called **complete quadratic equation** in x.

If $b = 0$ then it is called a **pure or incomplete quadratic equation** in x.

For example, $5 x^2 + 6 x + 2 = 0$ is a complete quadratic equation is x.

and $3x^2 – 4 = 0$ is a pure or incomplete quadratic equation.

1.6 Roots of the Equation:

The value of the variable which satisfies the equation is called the root of the equation. A quadratic equation has two roots and hence there will be two values of the variable which satisfy the quadratic equation. For example the roots of $x^2 + x – 6 = 0$ are 2 and -3.

1.7 Methods of Solving Quadratic Equation:

There are three methods for solving a quadratic equation:

i) By factorization

ii) By completing the square

iii) By using quadratic formula

i) Solution by Factorization:

Method:

Step I: Write the equation in standard form.

Step II: Factorize the quadratic equation on the left hand side if possible.

Step III: The left hand side will be the product of two linear factors. Then equate each of the linear factor to zero and solve for values of x. These values of x give the solution of the equation.

Example 1:

Solve the equation $3x^2 + 5x = 2$

Solution:

$3x^2 + 5x = 2$

Write in standard form $3x^2 + 5x – 2 = 0$

Factorize the left hand side $3x^2 + 6x - x - 2 = 0$

$3x(x + 2) - 1(x + 2) = 0$

$(3x - 1)(x + 2) = 0$

Equate each of the linear factor to zero.

$3x - 1 = 0$ or $x + 2 = 0$

$3x = 1$ or $x = -2$

$x = \frac{1}{3}$

$x = \frac{1}{3}, -2$ are the roots of the Equation.

Solution Set = $\{\frac{1}{3}, -2\}$

Example 2:

Solve the equation $6x^2 - 5x = 4$

Solution:

$6x^2 - 5x = 4$

$6x^2 - 5x - 4 = 0$

$6x^2 - 8x + 3x - 4 = 0$

$2x(3x - 4) + 1(3x - 4) = 0$

$(2x + 1)(3x - 4) = 0$

$\therefore$ Either $2x + 1 = 0$ or $3x - 4 = 0$

Which gives $2x = -1$ which gives $3x = 4$

$\Rightarrow x = -\frac{1}{2}$ $\Rightarrow x = \frac{4}{3}$

$\therefore$ Required Solution Set = $\left\{-\frac{1}{2}, \frac{4}{3}\right\}$

ii) Solution of quadratic equation by Completing the Square

Method:

Step I: Write the quadratic equation is standard form.

Step II: Divide both sides of the equation by the co-efficient of x^2 if it is not already 1.

Step III: Shift the constant term to the R.H.S.

Step IV: Add the square of one-half of the co-efficient of x to both side.

Step V: Write the L.H.S as complete square and simplify the R.H.S.

Step VI: Take the square root on both sides and solve for x.

Example 3:

Solve the equation $3x^2 = 15 - 4x$ by completing the square.

Solution: $3x^2 = 15 - 4x$

Step I Write in standard form: $3x^2 + 4x - 15 = 0$

Step II Dividing by 3 to both sides: $x^2 + \frac{4}{3}x - 5 = 0$

Step III Shift constant term to R.H.S: $x^2 + \frac{4}{3}x = 5$

Step IV Adding the square of one half of the co-efficient of x. i.e., $\left(\frac{4}{6}\right)^2$ on both sides:

$$x^2 + \frac{4}{3}x + \left(\frac{4}{6}\right)^2 = 5 + \left(\frac{4}{6}\right)^2$$

Step V: Write the L.H.S. as complete square and simplify the R.H.S. :

$$\left(x + \frac{4}{6}\right)^2 = 5 + \frac{16}{36}$$

$$= \frac{180 + 16}{36}$$

$$\left(x + \frac{4}{6}\right)^2 = \frac{196}{36}$$

Step VI: Taking square root of both sides and Solve for x

$$\sqrt{\left(x + \frac{4}{6}\right)^2} = \sqrt{\frac{196}{36}}$$

$$x + \frac{4}{6} = \pm\frac{14}{6}$$

$$x + \frac{4}{6} = \pm\frac{7}{3}$$

$$x + \frac{4}{6} = \frac{7}{3}, \qquad x + \frac{4}{6} = -\frac{7}{3}$$

$$\Rightarrow \quad x = \frac{7}{3} - \frac{4}{6} \qquad \Rightarrow \quad x = -\frac{7}{3} - \frac{4}{6}$$

$$x = \frac{10}{6}, \qquad x = \frac{-18}{6}$$

$$x = \frac{5}{3}, \qquad x = -3$$

Hence, the solution set = $\left\{-3, \frac{5}{3}\right\}$

Example 4:

Solve the equation $a^2 x^2 = ab\,x + 2b^2$ by completing the square.

Solution:

$$a^2 x^2 = ab\,x + 2b^2$$

$$a^2 x^2 - ab\,x - 2b^2 = 0$$

Dividing both sides by a^2, we have

$$x^2 - \frac{bx}{a} - \frac{2b^2}{a^2} = 0$$

$$x^2 - \frac{bx}{a} = \frac{2b^2}{a^2}$$

Adding the square of one half of the co-efficient of x i.e., $\left(-\frac{b}{2a}\right)^2$ on both sides.

$$x^2 - \frac{bx}{a} + \left(-\frac{b}{2a}\right)^2 = \frac{2b^2}{a^2} + \left(-\frac{b}{2a}\right)^2$$

$$\left(x - \frac{b}{2a}\right)^2 = \frac{2b^2}{a^2} + \frac{b^2}{4a^2}$$

$$\left(x - \frac{b}{2a}\right)^2 = \frac{8b^2 + b^2}{4a^2}$$

$$\left(x - \frac{b}{2a}\right)^2 = \frac{9b^2}{4a^2}$$

Taking square root on both sides

$$x - \frac{b}{2a} = \pm\frac{3b}{2a}$$

$$x - \frac{b}{2a} = \frac{3b}{2a}$$

$$\Rightarrow \quad x = \frac{b}{2a} + \frac{3b}{2a}$$

$$\Rightarrow \quad x = \frac{b + 3b}{2a}$$

$$\Rightarrow \quad x = \frac{4b}{2a}$$

$$\Rightarrow \quad x = \frac{2b}{a}$$

$$x - \frac{b}{2a} = \frac{3b}{2a}$$

$$\Rightarrow \quad x = \frac{b}{2a} - \frac{3b}{2a}$$

$$\Rightarrow \quad x = \frac{b - 3b}{2a}$$

$$\Rightarrow \quad x = -\frac{2b}{2a}$$

$$\Rightarrow \quad x = -\frac{b}{a}$$

Solution Set = $\left\{\frac{2b}{a}, -\frac{b}{a}\right\}$

iii) Derivation of Quadratic formula

Consider the standard form of quadratic equation $ax^2 + b x + c = 0$.
Solve this equation by completing the square.

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

Dividing both sides by a

$$x^2 + \frac{b}{a}\,x + \frac{c}{a} = o$$

Take the constant term to the R.H.S

$$x^2 + \frac{b}{a}\,x = -\frac{c}{a}$$

To complete the square on L.H.S. add $\left(\frac{b}{2a}\right)^2$ to both sides.

$$X^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a}$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$

Taking square root of both sides

$$x + \frac{b}{2a} = \pm\frac{\sqrt{b^2 - 4ac}}{2a}$$

$$x = -\frac{b}{2a} \pm\sqrt{\frac{b^2 - 4ac}{4a^2}}$$

$$x = -\frac{b}{2a} \pm\frac{\sqrt{b^2 - 4ac}}{2a}$$

$$\boxed{x = \frac{-b \pm\sqrt{b^2 - 4ac}}{2a}}$$

which is called the **Quadratic formula.**

Where, a = co-efficient of x^2 , b = coefficient of x , c = constant term

Actually, the Quadratic formula is the general solution of the quadratic equation $ax^2 + bx + c = 0$

Note: $\frac{-b \pm\sqrt{b^2 - 4ac}}{2a}$, $\frac{-b - \sqrt{b^2 - 4ac}}{2a}$ are also called roots of the quadratic equation

Method:

To solve the quadratic equation by Using Quadratic formula:

Step I: Write the Quadratic Equation in Standard form.

Step II: By comparing this equation with standard form $ax^2 + bx + c = 0$ to identify the values of a , b , c.

Step III: Putting these values of a, b, c in Quadratic formula

$$x = \frac{-b \pm\sqrt{b^2 - 4ac}}{2a}$$ and solve for x.

Example 5:

Solve the equation $3x^2 + 5x = 2$

Solution:

$$3x^2 + 5x = 2$$
$$3x^2 + 5x - 2 = 0$$

Composing with the standard form $ax^2 + bx + c = 0$, we have a = 3 , b = 5, c = -2.

Putting these values in Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-5 \pm \sqrt{(5)^2 - 4(3)(-2)}}{2(3)}$$

$$= \frac{-5 \pm \sqrt{25 + 24}}{6}$$

$$x = \frac{-5 \pm 7}{6}$$

$$x = \frac{-5 + 7}{6} \quad \text{or} \quad x = \frac{-5 - 7}{6}$$

$$x = \frac{2}{6} \quad \text{or} \quad x = \frac{-12}{6}$$

$$x = \frac{1}{3} \quad \text{or} \quad x = -2$$

$$\text{Sol. Set} = \left\{\frac{1}{3},\ 2\right\}$$

Example 6:

Solve the equation $15x^2 - 2ax - a^2 = 0$ by using Quadratic formula:

Solution:

$$15x^2 - 2ax - a^2 = 0$$

Comparing this equation with General Quadratic Equation

Here, $a = 15$, $b = -2a$, $c = -a^2$

Putting these values in Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-2a) \pm \sqrt{(-2a)^2 - 4(15)(-a^2)}}{2(15)}$$

$$= \frac{-(-2a) \pm \sqrt{4a^2 + 60a^2}}{30}$$

$$= \frac{2a \pm 8a}{30}$$

$$x = \frac{2a + 8a}{30} \quad \text{or} \quad x = \frac{2a - 8a}{30}$$

$$x = \frac{10a}{30} \quad \text{or} \quad x = \frac{-6a}{30}$$

$$x = \frac{a}{3} \quad \text{or} \quad x = -\frac{a}{5}$$

$$\text{Sol. Set} = \left\{\frac{a}{3},\ -\frac{a}{5}\right\}$$

Example 7:

Solve the equation $\dfrac{1}{2x - 5} + \dfrac{5}{2x - 1} = 2$ by using Quadratic formula.

Solution:

$$\frac{1}{2x - 5} + \frac{5}{2x - 1} = 2$$

Multiplying throughout by (2x – 5)(2x – 1), we get

$$(2x - 1) + 5(2x - 5) = 2(2x - 5)(2x - 1)$$
$$2x - 1 + 10x - 25 = 8x^2 - 24x + 10$$
$$8x^2 - 36x + 36 = 0$$
$$2x^2 - 9x + 9 = 0$$

Comparing this equation with General Quadratic Equation

Here, $a = 2$, $b = -9$, $c = 9$

Putting these values in the Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{(-9) \pm \sqrt{(-9)^2 - 4(2)(9)}}{2(2)}$$
$$= \frac{9 \pm \sqrt{81 - 72}}{4}$$
$$= \frac{9 \pm 3}{4}$$

$x = \dfrac{9 + 3}{4}$ or $x = \dfrac{9 - 3}{4}$

$x = \dfrac{12}{4}$ or $x = \dfrac{6}{4}$

$x = 3$ or $x = -\dfrac{3}{2}$

Sol. Set $\left\{3, -\dfrac{3}{2}\right\}$

Exercise 1.1

Q.1. Solve the following equations by factorization.

(i). $x^2 + 7x = 8$

(ii). $3x^2 + 7x + 4 = 0$

(iii). $x^2 - 3x = 2x - 6$

(iv). $3x^2 - 1 = \dfrac{1}{5}(1 - x)$

(v). $(2x + 3)(x + 1) = 1$

(vi). $\dfrac{1}{2x - 5} + \dfrac{5}{2x - 1} = 2$

(vii). $\frac{4}{x-1} - \frac{5}{x+2} = \frac{3}{x}$ (viii). $\frac{1}{a+b+x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x}$

(ix). $abx^2 + (b^2 - ac)x - bc = 0$ (x). $(a+b)x^2 + (a+2b+c)x + (b+c) = 0$

(xi). $\frac{a}{ax-1} + \frac{b}{bx-1} = a + b$ (xii). $\frac{x+2}{x-1} + 2\frac{2}{3} = \frac{x+3}{x-2}$

Q.2. Solve the following equations by the method of completing the square.

(i). $x^2 - 6x + 8 = 0$ (ii). $32 - 3x^2 = 10x$

(iii). $(x-2)(x+3) = 2(x+11)$ (iv). $x^2 + (a+b)x + ab = 0$

(v). $x + \frac{1}{x} = \frac{10}{3}$ (vi). $\frac{10}{x-5} + \frac{10}{x+5} = \frac{5}{6}$

(vii). $2x^2 - 5bx = 3b^2$ (viii). $x^2 - 2ax + a^2 - b^2 = 0$

Q.3 Solve the following equations by using quadratic formula.

(i). $2x^2 + 3x - 9 = 0$ (ii). $(x+1)^2 = 3x + 14$

(iii). $\frac{1}{x+1} + \frac{1}{x+2} + \frac{1}{x+3} = \frac{3}{x}$ (iv). $x^2 - 3\left(x + \frac{25}{4}\right) = 9x - \frac{25}{2}$

(v). $x^2 + (m-n)x - 2(m-n)^2 = 0$ (vi) $mx^2 + (1+m)x + 1 = 0$

(vii) $abx^2 + (2b-3a)x - 6 = 0$ (viii). $x^2 + (b-a)x - ab = 0$

(ix) $\frac{x}{x+1} + \frac{x+1}{x+2} + \frac{x+2}{x+3} = 3$

Q.4 The sum of a number and its square is 56 . Find the number.

Q.5 A projectile is fired vertically into the air. The distance (in meter) above the ground as a function of time (in seconds) is given by $s = 300 - 100t - 16t^2$. When will the projectile hit the ground?

Q.6 The hypotenuse of a right triangle is 18 meters. If one side is 4 meters longer than the other side, what is the length of the shorter side ?

Answers 1.1

Q.1. (i). $\{1, -8\}$ (ii). $\left\{-1, \frac{-4}{3}\right\}$ (iii). $\{2, 3\}$

(iv). $\{\frac{3}{5}, -\frac{2}{3}\}$ (v). $\left\{-2, -\frac{1}{2}\right\}$ (vi). $\left\{-\frac{3}{2}, 3\right\}$

(vii). $\left\{-\frac{1}{2}, 3\right\}$ (viii). {-a, -b} (ix). $\{-\frac{b}{a}, \frac{c}{b}\}$

(x). $\{-1, -\frac{b+c}{a+b}\}$ (xi). $\{\frac{a+b}{ab}, \frac{2}{a+b}\}$ (xii). $\{\frac{13}{4}, \frac{1}{2}\}$

Q.2. (i). {2, 4} (ii). $\{2, -\frac{16}{3}\}$ (iii). $\{\frac{1 \pm \sqrt{113}}{2}\}$

(iv). {– a, – b} (v). $\{3, \frac{1}{3}\}$ (vi). {-1, 25}

(vii). $\{3b, -\frac{b}{2}\}$ (viii) { (a + b), (a – b)}

Q.3. (i). $\{\frac{3}{2}, -3\}$ (ii). $\{\frac{1 \pm \sqrt{53}}{2}\}$ (iii). $\{\frac{-11 \pm \sqrt{13}}{6}\}$

(iv). $\{\frac{25}{2}, -\frac{1}{2}\}$ (v). $\{m-n, -2(m-n)\}$ (vi) $\left\{-1, \frac{-1}{m}\right\}$

(vii). $\{-\frac{2}{a}, \frac{3}{b}\}$ (viii). $\{-b, a\}$ (ix) $\left\{\frac{-6+\sqrt{3}}{3}, \frac{-6-\sqrt{3}}{3}\right\}$

Q.4. 7 , - 8 Q.5. 8.465 seconds Q.6. 10.6 m

1.8 Classification of Numbers

1. The Set N of Natural Numbers:

Whose elements are the counting, or natural numbers:

N = {1, 2, 3, - - - - - - - - }

2. The Set Z of Integers:

Whose elements are the positive and negative whole numbers and zero:

Z = {- - - - - - , -2, -1, 0, 1, 2, - - - - - - }

3. The Set Q of Rational Numbers: Whose elements are all those numbers that can be represented as the quotient of two integers $\frac{a}{b}$, where b ≠ 0. Among the elements of Q are such numbers as $-\frac{3}{4}, \frac{18}{27}, \frac{5}{1}, -\frac{9}{1}$. In symbol

$$Q = \left\{\frac{a}{b} \mid a, b \in Z, b \neq 0\right\}$$

Equivalently, rational numbers are numbers with terminating or repeating decimal representation, such as

1.125, 1.52222, 1.56666, 0.3333

4. The Set Q′ of Irrational Numbers:

Whose elements are the numbers with decimal representations that are non-terminating and non-repeating. Among the elements of this set are such numbers as $\sqrt{2},\ -\sqrt{7},\ \pi$.

An irrational number cannot be represented in the form $\frac{a}{b}$, where $a, b \in Z$. In symbols,

$Q' = \{\text{irrational numbers}\}$

5. The Set R of Real Numbers:

Which is the set of all rational and irrational numbers:

$$R = \{x \mid x \in Q \cup Q'\}$$

6. The set I of Imaginary Numbers:

Whose numbers can be represented in the form x + yi, where x and y are real numbers, $y \neq 0$ and $i = \sqrt{-1}$

$$I = \{x + yi \mid x, y \in R, y \neq 0, i = \sqrt{-1}\}$$

If x = 0, then the imaginary number is called a pure imaginary number.

An imaginary number is defined as, a number whose square is a negative i.e, $\sqrt{-1},\ \sqrt{-3},\ \sqrt{-5}$

7. The set C of Complex Numbers:

Whose members can be represented in the form x + y i, where x and y real numbers and $i = \sqrt{-1}$:

$$C = \{x + yi \mid x, y \in R, i = \sqrt{-1}\}$$

With this familiar identification, the foregoing sets of numbers are related as indicated in Fig. 1.

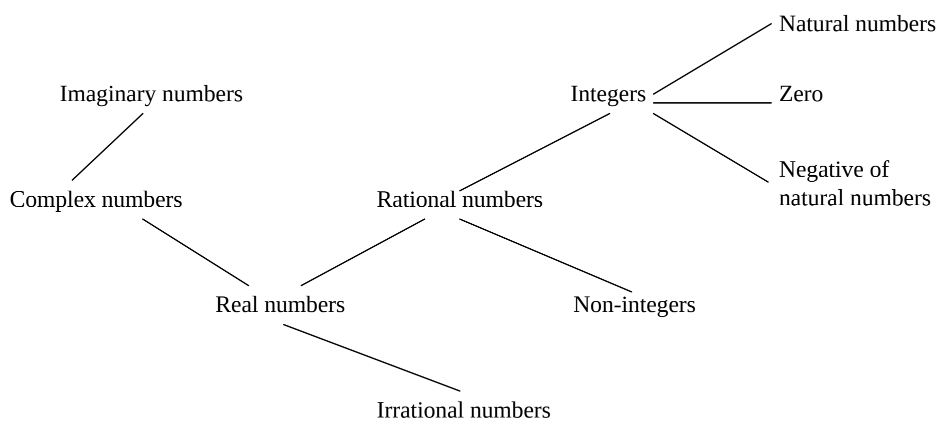

Fig. 1

Hence, it is clear that $N \subseteq Z \subseteq Q \subseteq R \subseteq C$

1.9 Nature of the roots of the Equation $ax^2 + bx + c = 0$

The two roots of the Quadratic equation $ax^2 + bx + c = 0$ are:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The expression $b^2 - 4ac$ which appear under radical sign is called the Discriminant (Disc.) of the quadratic equation. i.e., Disc = $b^2 - 4ac$

The expression $b^2 - 4ac$ discriminates the nature of the roots, whether they are real, rational, irrational or imaginary. There are three possibilities.

(i) $b^2 - 4ac < 0$ (ii) $b^2 - 4ac = 0$ (iii) $b^2 - 4ac > 0$

(i) If $b^2 - 4ac < 0$, then roots will be imaginary and unequal.

(ii) If $b^2 - 4ac = 0$, then roots will be real, equal and rational.
(This means the left hand side of the equation is a perfect square).

(iii) If $b^2 - 4ac > 0$, then two cases arises:

(a) $b^2 - 4ac$ is a perfect square, the roots are real, rational and unequal.
(This mean the equation can be solved by the factorization).

(b) $b^2 - 4ac$ is not a perfect square, then roots are real, irrational and unequal.

Example 1:

Find the nature of the roots of the given equation

$$9x^2 + 6x + 1 = 0$$

Solution:

$$9x^2 + 6x + 1 = 0$$

Here $a = 9$, $b = 6$, $c = 1$

Therefore , Discriminant $= b^2 - 4ac$
$= (6)^2 - 4(9)(1)$
$= 36 - 36$
$= 0$

Because $b^2 - 4ac = 0$

$\therefore$ roots are equal, real and rational.

Example 2:

Find the nature of the roots of the Equation

$$3x^2 - 13x + 9 = 0$$

Solution:

$$3x^2 - 13x + 9 = 0$$

Here $a = 3$, $b = -13$, $c = 9$

Discriminant $= b^2 - 4ac$
$= (-13)^2 - 4(3)(9)$
$= 169 - 108 = 61$

Disc = $b^2 - 4ac = 61$ which is positive

Hence the roots are real, unequal and irrational.

Example 3:

For what value of "K" the roots of $Kx^2 + 4x + (K - 3) = 0$ are equal.

Solution:

$$Kx^2 + 4x + (K - 3) = 0$$

Here $a = K$, $b = 4$, $c = K - 3$

Disc $= b^2 - 4ac$

$= (4)^2 - 4(K)(K - 3)$
$= 16 - 4K^2 + 12K$

The roots are equal if $b^2 - 4ac = 0$

i.e. $16 - 4K^2 + 12K = 0$
$4K^2 - 3K - 4 = 0$
$K^2 - 4K + K - 4 = 0$
$K(K - 4) + 1(K - 4) = 0$

Or $K = 4, -1$

Hence roots will be equal if $K = 4, -1$

Example 4:

Show that the roots of the equation
$2(a + b)x^2 - 2(a + b + c)x + c = 0$ are real

Solution: $2(a + b)x^2 - 2(a + b + c)x + c = 0$

Here, $a = 2(a + b)$, $b = -2(a + b + c)$, $c = c$

Discriminant $= b^2 - 4ac$
$= [-2(a + b + c)]^2 - 4[2(a + b) c]$
$= 4(a^2 + b^2 + c^2 + 2ab + 2bc + 2ac) - 8(ac + bc)$
$= 4(a^2 + b^2 + c^2 + 2ab + \cancel{2bc} + \cancel{2ac} - \cancel{2ac} - \cancel{2bc})$
$= 4(a^2 + b^2 + c^2 + 2ab)$
$= 4[(a^2 + b^2 + 2ab) + c^2]$
$= 4[(a + b)^2 + c^2]$

Since each term is positive, hence
Disc > 0 Hence , the roots are real.

Example 5:

For what value of K the roots of equation $2x^2 + 5x + k = 0$ will be rational.

Solution:

$2x^2 + 5x + k = 0$

Here, $a = 2$, $b = 5$, $c = k$

The roots of the equation are rational if

Disc $= b^2 - 4ac = 0$

So, $5^2 - 4(2)k = 0$
$25 - 8k = 0$
$k = \frac{25}{8}$ Ans

Exercise 1.2

Q1. Find the nature of the roots of the following equations

(i) $2x^2 + 3x + 1 = 0$ (ii) $6x^2 = 7x + 5$

(iii) $3x^2 + 7x - 2 = 0$ (iv) $\sqrt{2}\, x^2 + 3x - \sqrt{8} = 0$

Q2. For what value of K the roots of the given equations are equal.

(i) $x^2 + 3(K + 1)x + 4K + 5 = 0$ (ii) $x^2 + 2(K - 2)x - 8k = 0$

(iii) $(3K + 6)x^2 + 6x + K = 0$ (iv) $(K + 2)x^2 - 2Kx + K - 1 = 0$

Q3. Show that the roots of the equations

(i) $a^2(mx + c)^2 + b^2x^2 = a^2 b^2$ will be equal if $c^2 = b^2 + a^2m^2$

(ii) $(mx + c)^2 = 4ax$ will be equal if $c = \frac{a}{m}$

(iii) $x^2 + (mx + c)^2 = a^2$ has equal roots if $c^2 = a^2 (1 + m^2)$.

Q4. If the roots of $(c^2 – ab)x^2 – 2(a^2 – bc)x + (b^2 – ac) = 0$ are equal then prove that $a^3 + b^3 + c^3 = 3abc$

Q5. Show that the roots of the following equations are real

(i) $x^2 – 2 (m+\frac{1}{m})x + 3 = 0$

(ii) $x^2 – 2ax + a^2 = b^2 + c^2$

(iii) $(b^2 – 4ac)x^2 + 4(a + c)x – 4 = 0$

Q6. Show that the roots of the following equations are rational

(i) $a(b – c)x^2 + b(c – a)x + c(a – b) = 0$

(ii) $(a + 2b)x^2 + 2(a + b + c)x + (a + 2c) = 0$

(iii) $(a + b)x^2 – ax – b) = 0$

(iv) $p x^2 - (p – q) x – q = 0$

Q7. For what value of 'K' the equation $(4–k) x^2 + 2(k+2) x + 8k + 1 = 0$ will be a perfect square.
(Hint : The equation will be perfect square if Disc. $b^2 – 4ac = 0$)

Answers 1.2

Q1. (i) Real, rational, unequal (ii) unequal, real and rational
(iii) ir-rational, unequal, real (iv) Real, unequal, ir-rational

Q2. (i) $1, \frac{-11}{9}$ (ii) - 2 (iii) 1, -3 (iv) 2

Q7. 0, 3

1.10 Sum and Product of the Roots

(Relation between the roots and Co-efficient of $ax^2 + b x + c = 0$)
The roots of the equation $ax^2 + bx + c = 0$ are

$$\propto = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$\beta = \frac{-b-\sqrt{b^2-4ac}}{2a}$$

Sum of roots:

Add the two roots

$$\propto + \beta = \frac{-b+\sqrt{b^2-4ac}}{2a} + \frac{-b-\sqrt{b^2-4ac}}{2a}$$

$$= \frac{-b+\sqrt{b^2-4ac}-b-\sqrt{b^2-4ac}}{2a}$$

$$= \frac{-b \ -b}{2a}$$

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

Hence, sum of roots = $\propto + \beta = \dfrac{-\text{ Co-efficient of x}}{\text{Co-efficient of } x^2}$

Product of roots:

$$\propto \beta = \left(\frac{-b+\sqrt{b^2-4ac}}{2a}\right) x \left(\frac{-b-\sqrt{b^2-4ac}}{2a}\right) \qquad =$$

$$= \frac{(-b)^2 - (\sqrt{b^2 - 4ac} \ \ )^2}{2\ a^2}$$

$$= \frac{b^2-b^2+4ac}{4a^2}$$

$$= \frac{4ac}{4a^2}$$

$$a\beta = \frac{c}{a}$$

i.e. product of roots = $\propto \beta = \dfrac{-\text{ Constant term}}{\text{Co-efficient of } x^2}$

Example 1:

Find the sum and the Product of the roots in the Equation $2x^2 + 4 = 7x$

Solution:

$2x^2 + 4 = 7x$

$2x^2 - 7x + 4 = 0$

Here a = 2, b = -7, c = 4

Sum of the roots = $-\dfrac{b}{a} = -\left(-\dfrac{7}{2}\right) = \dfrac{7}{2}$

Product of roots = $\dfrac{c}{a} \quad = \dfrac{4}{2} = 2$

Example 2:

Find the value of “K” if sum of roots of

$(2k - 1)x^2 + (4K - 1)x + (K + 3) = 0$ is $\frac{5}{2}$

Solution:

$(2k - 1)x^2 + (4K - 1)x + (K + 3) = 0$

Here $a = (2k - 1)$, $b = 4K - 1$, $c = K + 3$

Sum of roots $= -\frac{b}{a}$

$\frac{5}{2} = -\frac{(4K - 1)}{(2K - 1)}$ $\quad\because$ Sum of roots $= \frac{5}{2}$

$5(2K - 1) = -2(4K - 1)$

$10K - 5 = -8K + 2$

$10K + 8K = 5 + 5$

$18K = 7$

$K = \frac{7}{18}$

Example 3:

If one root of $4x^2 - 3x + K = 0$ is 3 times the other, find the value of "K".

Solution:

Given Equation is $4x^2 - 3x + K = 0$

Let one root be α, then other will be 3α.

Sum of roots $= -\frac{a}{b}$

$\alpha + 3\alpha = -\frac{(-3)}{4}$

$4\alpha = \frac{3}{4}$

$\alpha = \frac{3}{16}$

Product of roots $= \frac{c}{a}$

$\alpha(3\alpha) = \frac{K}{4}$

$3\alpha^2 = \frac{K}{4}$

$K = 12\alpha^2$

Putting the value of $\alpha = \frac{3}{16}$ we have

$K = 12\left(\frac{3}{16}\right)^2$

$= \frac{12x9}{256} = \frac{27}{64}$

Exercise 1.3

Q1. Without solving, find the sum and the product of the roots of the following equations.

(i) $x^2 - x + 1 = 0$ (ii) $2y^2 + 5y - 1 = 0$
(iii) $x^2 - 9 = 0$ (iv) $2x^2 + 4 = 7x$
(v) $5x^2 + x - 7 = 0$

Q2. Find the value of k, given that

(i) The product of the roots of the equation $(k + 1)x^2 + (4k + 3)x + (k - 1) = 0$ is $\frac{7}{2}$

(ii) The sum of the roots of the equation $3x^2 + k x + 5 = 0$ will be equal to the product of its roots.

(iii) The sum of the roots of the equation $4 x^2 + k x - 7 = 0$ is 3.

Q3. (i)If the difference of the roots of $x^2 - 7x + k - 4 = 0$ is 5, find the value of k and the roots.

(ii) If the difference of the roots of $6x^2 - 23x + c = 0$ is $\frac{5}{6}$, find the value of k and the roots.

Q4. If α, β are the roots of $ax^2 + bx + c = 0$ find the value of

(i) $\alpha^3 + \beta^3$ (ii) $\frac{1}{\propto^2}+\frac{1}{\beta^2}$ (iii) $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} = 0$

(iv) $\frac{\alpha^2}{\beta}+\frac{\beta^2}{\alpha}$ (v) $\frac{\alpha}{\beta}-\frac{\beta}{\alpha}$
(v)

Q5. If p, q are the roots of $2x^2 - 6x + 3 = 0$ find the value of
$(p^3 + q^3) - 3pq\,(p^2 + q^2) - 3pq\,(p + q)$

Q6. The roots of the equation $px^2 + qx + q = 0$ are α and β,
Prove that $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}} + \sqrt{\frac{q}{p}} = 0$

Q7. Find the condition that one root of the equation $px^2 + qx + r = 0$ is square of the other.

Q8. Find the value of k given that if one root of $9x^2 - 15x + k = 0$ exceeds the other by 3. Also find the roots.

Q9. If α, β are the roots of the equation $px^2 + qx + r = 0$ then find the values of

(i) $\alpha^2 + \beta^2$ (ii) $(\alpha - \beta)^2$ (iii) $\alpha^3\beta + \alpha\beta^3$

Answers 1.3

Q1.(i) 1, 1 (ii) $-\frac{5}{2}, -\frac{1}{2}$ (iii) 0, - 9 (iv) $\frac{7}{2}$, 2 (v) $-\frac{1}{5}, -\frac{7}{5}$

Q2.(i) $\frac{7}{18}$ (ii) $-\frac{9}{5}$ (iii) - 12

Q3.(i) K =10, roots = 6, 1 (ii) $\alpha = \frac{7}{3},\ \beta = \frac{3}{2};$ c = 21

Q4. (i) $\frac{-b^3+3abc}{a^3}$ (ii) $\frac{b^2-2ac}{c^2}$ (iii) $-\frac{b}{\sqrt{ac}}$ (iv) $\frac{3abc-b^3}{a^2c}$ (v) $\frac{-b\sqrt{b^2-4ac}}{ac}$

Q5. - 27 **Q7.** $Pr(p+r)+q^3 = 3pqr$ **Q8.** K = - 14, roots are $-\frac{2}{3},\ \frac{7}{3}$

Q9. (i) $\frac{q^2-2pr}{p^2}$ (ii) $\frac{q^2-4pr}{p^2}$ (iii) $\frac{r(q^2-2pr)}{p^3}$

1.11 Formation of Quadratic Equation from the given roots :

Let α, β be the roots of the Equation $ax^2 + bx + c = 0$

The sum of roots $= \alpha + \beta = -\frac{b}{a}$ ……… (I)

Product of roots $= \alpha . \beta = \frac{c}{a}$ ……… (II)

The equation is $ax^2 + bx + c = 0$

Divide this equation by a $\Rightarrow x^2 + \frac{b}{a}x + \frac{c}{a} = 0$

Or $x^2 - \left(-\frac{b}{a}\right)x + \frac{c}{a} = 0$

From I and II this equation becomes

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

Or x^2 – (Sum of roots) x + Product of roots = 0

Or $x^2 - (S)x + (P) = 0$

is the required equation, where $S = \alpha + \beta$ and $P = \alpha\beta$

Alternate method:-

Let α, β be the roots of the equation $a x^2 + b x + c = 0$

i.e., $x = \alpha$ and $x = \beta$

$\Rightarrow$ $x - \alpha = 0$ and $x - \beta = 0$

$\Rightarrow$ $(x - \alpha)(x - \beta) = 0$

$$x^2 - \alpha x - \beta x + \alpha\beta = 0$$

$x^2 - (\alpha + \beta)x + \alpha\beta = 0$

Or x^2 – (Sum of roots) x + Product of roots = 0

Or $x^2 - Sx + P = 0$

is the required equation, where $S = \alpha + \beta$ and $P = \alpha\beta$

Example 4:

Form a quadratic Equation whose roots are $3\sqrt{5}, -3\sqrt{5}$

Solution:

Roots of the required Equation are $3\sqrt{5}$ and $-3\sqrt{5}$

Therefore S = Sum of roots = $3\sqrt{5} - 3\sqrt{5}$

$S = 0$

P = Product of roots = $(3\sqrt{5})(-3\sqrt{5}) = -9(5)$

$P = -45$

Required equation is

x^2 – (Sum of roots) x + (Product of roots) = 0

Or $x^2 - Sx + P = 0$

$x^2 - 0(x) + (-45) = 0$

$x^2 - 0 - 45 = 0$

$x^2 - 45 = 0$

Example 5:

If α, β are the roots of the equation $ax^2 + bx + c = 0$, find the equation whose **roots are** $\frac{\alpha}{\beta}, \frac{\beta}{\alpha}$**.**

Solution:

Because α, β are the roots of the Equation $ax^2 + bx + c = 0$

The sum of roots = $\alpha + \beta = -\frac{b}{a}$

Product of roots = $\alpha\beta = \frac{b}{a}$

Roots of the required equation are $\frac{\alpha}{\beta}, \frac{\beta}{\alpha}$

Therefore ,

S = sum of roots of required equation = $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$

$$= \frac{\alpha^2 + \beta^2}{\alpha\beta} \because (\alpha + \beta)^2 = \alpha^2 + \beta^2 + 2\alpha\beta$$

$$= \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta} = \frac{\left(-\frac{b}{a}\right)^2 - 2\frac{c}{a}}{\alpha\beta}$$

$$= \frac{\frac{b^2}{a^2} - \frac{2c}{a}}{\frac{c}{a}} = \frac{b^2 - 2ac}{a^2} \text{ x } \frac{a}{c}$$

$$S = \frac{b^2 - 2ac}{ac}$$

P = Product of roots of required equation $= \frac{\alpha}{\beta} \cdot \frac{\beta}{\alpha} = \frac{\alpha\beta}{\beta\alpha}$

P = 1

Required equation is: $x^2 - Sx + P = 0$

$$x^2 + \left(\frac{b^2 - 2ac}{ac}\right) x + 1 = 0$$

$$acx^2 - (b^2 - 2ac)x + ac = 0$$

Exercise 1.4

Q1. Form quadratic equations with the following given numbers as its roots.

(i) 2, - 3 (ii) $3 + i$, $3 - i$ (iii) $2+\sqrt{3},\ 2-\sqrt{3}$

(iv) $-3+\sqrt{5},\ -3-\sqrt{5}$ (v) $4 + 5i$, $4 - 5i$

Q2. Find the quadratic equation with roots

(i)Equal numerically but opposite in sign to those of the roots of the equation $3x^2 + 5x - 7 = 0$

(ii)Twice the roots of the equation $5x^2 + 3x + 2 = 0$

(iii)Exceeding by '2' than those of the roots of $4x^2 + 5x + 6 = 0$

Q3. Form the quadratic equation whose roots are less by '1' than those of $3x^2 - 4x - 1 = 0$

Q4. Form the quadratic equation whose roots are the square of the roots of the equation $2x^2 - 3x - 5 = 0$

Q5. Find the equation whose roots are reciprocal of the roots of the equation $px^2 - qx + r = 0$

Q6. If $\propto, \beta$ are the roots of the equation $x^2 - 4x + 2 = 0$ find the equation whose roots are

(i) α^2 , β^2 (ii) α^3 , β^3 (iii) $\propto + \frac{1}{\propto}, \beta + \frac{1}{\beta}$

(iv) $\alpha + 2$, $\beta + 2$

Q7. If α , β are the roots of $ax^2 + bx + c = 0$ form an equation whose roots are

(i) $\frac{\alpha}{\beta}, \frac{\beta}{\alpha}$ (ii) $\frac{\alpha^2}{\beta}, \frac{\beta^2}{\alpha}$ (iii) $\frac{\alpha+1}{\alpha}, \frac{\beta+1}{\beta}$

Answers 1.4

Q1. (i) $x^2 + x - 6 = 0$ (ii) $x^2 - 6x + 10 = 0$
(iii) $x^2 - 4x + 1 = 0$ (iv) $x^2 + 6x + 4 = 0$ (v) $x^2 - 5x + 41 = 0$

Q2. (i) $3x^2 - 5x - 7 = 0$ (ii) $5x^2 - 6x + 8 = 0$
(iii) $4x^2 - 11x + 12 = 0$

Q3. $3x^2 + 2x - 2 = 0$ **Q4 .** $4x^2 - 29x + 25 = 0$

Q5. $rx^2 - qx + p = 0$ **Q6.** (i) $x^2 - 12x + 4 = 0$ (ii) $x^2 - 40x + 8 = 0$
(iii) $2x^2 - 12x + 17 = 0$ (iv) $x^2 - 8x + 14 = 0$

Q7. (i) $acx^2 - (b^2 - 2ac)x + ac = 0$ (ii) $a^2cx^2 + (b^3 - 3abc)x + ac^2 = 0$
(iii) $cx^2 - (2c - b)x + (a - b + c) = 0$

Summary

Quadratic Equation:

An equation of the form $ax^2 + bx + c = 0$, $a \neq 0$, where a, b , c $\in$ R and x is a variable, is called a quadratic equation.

If α, β are its roots then

$$\alpha = \frac{-b+\sqrt{b^2-4ac}}{2a}, \ \beta = \frac{-b-\sqrt{b^2-4ac}}{2a}$$

Nature of Roots:

(i) If $b^2 - 4ac > 0$ the roots are real and distinct.
(ii) If $b^2 - 4ac = 0$ the roots are real and equal.
(iii) If $b^2 - 4ac < 0$ the roots are imaginary.
(iv) If $b^2 - 4ac$ is a perfect square, roots will be rational, otherwise irrational.

Relation between Roots and Co-efficients

If α and β be the roots of the equation $ax^2 + bx + c = 0$

Then sum of roots = $\alpha + \beta = \frac{-b}{a}$

Product of roots = $\alpha\beta = \frac{c}{a}$

Formation of Equation

If α and β be the roots of the equation $ax^2 + bx + c = 0$ then we have

x^2 – (sum of roots)x + (product of roots) = 0

Short Questions

Write Short answers of the following questions:

Solve the following quadratic equations by factorization

Q.1 $x^2 + 7x + 12 = 0$

Q2. $x^2 - x = 2$

Q3. $x(x + 7) = (2x - 1)(x + 4)$

Q4. $6x^2 - 5x = 4$

Q5. $3x^2 + 5x = 2$

Q6. $2x^2 + x = 1$

Q7. $m x^2 + (1 + m) x + 1 = 0$

Solve the following equations by completing the square:

Q8. $x^2 - 2x - 899 = 0$

Q9. $2x^2 + 12x - 110 = 0$

Q10. $x^2 + 5x - 6 = 0$

Q11. $x^2 - 6x + 8 = 0$

Solve the following equations by quadratic formula :

Q12. $4x^2 + 7x - 1 = 0$

Q13. $9x^2 - x - 8 = 0$

Q14. $X^2 - 3x - 18 = 0$

Q15. $X^2 - 3x = 2x - 6$

Q16. $3x^2 - 5x - 2 = 0$

Q17. $16x^2 + 8x + 1 = 0$

Q18 Define discriminant

Discuss the nature of the roots of the equation:

Q19 $2x^2 - 7x + 3 = 0$

Q20. $x^2 - 5x - 2 = 0$

Q21. $x^2 + x + 1 = 0$

Q22. $x^2 - 2\sqrt{2}\,x + 2 = 0$

Q23. $9x^2 + 6x + 1 = 0$

Q24. $3x^2 - 13x + 9 = 0$

For what value of K the roots of the following equations are equal:

Q25 $Kx^2 + 4x + 3 = 0$

Q26. $2x^2 + 5x + K = 0$

Q27 Prove that the roots of the equation

$(a + b)x^2 - ax - b = 0$ are rational

Q28 Write relation between the roots and the coefficients of the quadratic equation

$ax^2 + bx + c = 0$

Q.29 If the sum of the roots of $4x^2 + kx - 7 = 0$ is 3, Find the value of k.

Q.30 Find the value of K if the sum of the roots of equation

$(2k - 1)x^2 + (4k - 1)x + (K + 3) = 0$ is 5/2

Find the sum and product of the roots of following equations:

Q31 $7x^2 - 5x + 4 = 0$

Q32. $x^2 - 9 = 0$

Q33. $9x^2 + 6x + 1 = 0$

Q34. For what value of k the sum of roots of equation $3x^2 + kx + 5 = 0$

may be equal to the product of roots?

Q35. If α , β are the roots of $x^2 - px - p - c = 0$ then prove that $(1+\alpha)(1+\beta) = 1 - c$

Write the quadratic equation for the following equations whose roots are :

Q.36 -2, -3

Q37. $i\sqrt{3}$, $-i\sqrt{3}$

Q38. $-2+\sqrt{3}$, $-2-\sqrt{3}$

Q.39 Form the quadratic equation whose roots are equal numerically but opposite in sign to those of $3x^2 - 7x - 6 = 0$

If α, β are the roots of the equation $x^2 - 4x + 2 = 0$ find equation whose roots are:

Q40. $\frac{1}{\alpha}, \frac{1}{\beta}$

Q41 $-\alpha$, $-\beta$

Answers

Q1. {- 3 , - 4} **Q2** {- 1 , 2} **Q3** { 2 , -2} **Q4** {4/3 , - ½} **Q5** {1 , -6}

Q6 {-1 , ½} **Q7** { -1 , - 1/m} **Q8** {-29 , 31} **Q9** {-11 , 5} **Q10**{1 , – 6}

Q11 {2 , 4} **Q12.** {1 , -6} **Q13** $\{\frac{-7-\sqrt{65}}{8}, \frac{-7+\sqrt{65}}{8}\}$ **Q14** {-8/9 , 1}

Q15 {6 , -3} **Q16** {2 , 3} **Q17** {2 , -1/3} **Q18** {-1/4 }

Q19. Roots are rational , real and unequal

Q20 Roots are irrational , real and unequal

Q21 Roots are imaginary **Q22** Roots are equal and real

Q23 Roots are equal and real **Q24** Roots are unequal , real and irrational

Q25. K = 4/3 **Q26.** K = 5 **Q29** K = -12 **Q30.** K = 7/18

Q31 S = 5/7 , P = 4/7 **Q32** S = 0 , P = - 9 **Q33** S = -2/3 , 1/9

Q34 K = - 5 **Q36** $x^2 + 5x + 6 = 0$ **Q37** $x^2 + 3 = 0$ **Q38** $x^2 + 4x + 1 = 0$

Q39 $3x^2 + 7x - 2 = 0$ **Q40** $2x^2 - 4x + 1 = 0$ **Q41** $x^2 + 4x + 2 = 0$

Objective Type Questions

Q1. Each question has four possible answers .Choose the correct answer and encircle it .

__1. The standard form of a quadratic equation is:

(a) $ax^2 + bx = 0$ (b) $ax^2 = 0$

(c) $ax^2 + bx + c = 0$ (d) $ax^2 + c = 0$

__2. The roots of the equation $x^2 + 4x - 21 = 0$ are:

(a) (7, 3) (b) (–7, 3)

(c) (–7, –3) (d) (7, –3)

__3. To make $x^2 - 5x$ a complete square we should add:

(a) 25 (b) $\frac{25}{4}$ (c) $\frac{25}{9}$ (d) $\frac{25}{16}$

__4. The factors of $x^2 - 7x + 12 = 0$ are:

(a) $(x - 4)(x + 3)$ (b) $(x - 4)(x - 3)$

(c) $(x + 4)(x + 3)$ (d) $(x + 4)(x - 3)$

__5. The quadratic formula is:

(a) $\frac{b \pm \sqrt{b^2 - 4ac}}{2a}$ (b) $\frac{-b \pm \sqrt{b^2 + 4ac}}{2a}$

(c) $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ (d) $\frac{-b \pm \sqrt{b^2 + 4ac}}{2a}$

__6. A second degree equation is known as:

(a) Linear (b) Quadratic

(c) Cubic (e) None of these

__7. Factors of $x^3 - 1$ are:

(a) $(x - 1)(x^2 - x - 1)$ (b) $(x - 1)(x^2 + x + 1)$

(c) $(x - 1)(x^2 + x - 1)$ (d) $(x - 1)(x^2 - x + 1)$

__8. To make $49x^2 + 5x$ a complete square we must add:

(a) $\left(\frac{5}{14}\right)^2$ (b) $\left(\frac{14}{5}\right)^2$

(c) $\left(\frac{5}{7}\right)^2$ (d) $\left(\frac{7}{5}\right)^2$

__9. $lx^2 + mx + n = 0$ will be a pure quadratic equation if:

(a) $l = 0$ (b) $m = 0$

(c) $n = 0$ (d) Both l, $m = 0$

__10. If the discrimnant $b^2 - 4ac$ is negative, the roots are:

(a) Real (b) Rational

(c) Irrational (d) Imaginary

__11. If the discriminant $b^2 - 4ac$ is a perfect square, its roots will be:

(a) Imaginary (b) Rational

(c) Equal (d) Irrational

__12. The product of roots of $2x^2 - 3x - 5 = 0$ is:

(a) $-\frac{5}{2}$ (b) $\frac{5}{2}$

(c) $\frac{2}{5}$ (d) $-\frac{2}{5}$

__13. The sum of roots of $2x^2 - 3x - 5 = 0$ is:

(a) $-\frac{3}{2}$ (b) $\frac{3}{2}$

(c) $\frac{2}{3}$ (d) $-\frac{2}{3}$

__14. If 2 and – 5 are the roots of the equation, then the equations is:

(a) $x^2 + 3x + 10 = 0$ (b) $x^2 - 3x - 10 = 0$

(c) $x^2 + 3x - 10 = 0$ (d) $2x^2 - 5x + 1 = 0$

__15. If ± 3 are the roots of the equation, then the equation is:

(a) $x^2 - 3 = 0$ (b) $x^2 - 9 = 0$

(c) $x^2 + 3 = 0$ (d) $x^2 + 9 = 0$

__16. If 'S' is the sum and 'P' is the product of roots, then equation is:

(a) $x^2 + Sx + P = 0$ (b) $x^2 + Sx - P = 0$

(c) $x^2 - Sx + P = 0$ (d) $x^2 - Sx - P = 0$

__17. Roots of the equation $x^2 + x - 1 = 0$ are:

(a) Equal (b) Irrational

(c) Imaginary (d) Rational

__18. If the discriminant of an equation is zero, then the roots will be:

(a) Imaginary (b) Real

(c) Equal (d) Irrational

__19. Sum of the roots of $ax^2 - bx + c = 0$ is:

(a) $-\frac{c}{a}$ (b) $\frac{c}{a}$

(c) $-\frac{b}{a}$ (d) $\frac{b}{a}$

__20. Product of roots of ax2 + bx – c = 0 is:

(a) $\frac{c}{a}$ (b) $-\frac{c}{a}$ (c) $\frac{a}{b}$ (d) $-\frac{a}{b}$

Answers

1.	c	2.	b	3.	b	4.	b	5.	c
6.	b	7.	b	8.	a	9.	b	10.	d
11.	b	12.	a	13.	b	14.	c	15.	b
16.	c	17.	b	18.	c	19.	d	20.	b