# 6. QUADRATIC EQUATIONS

## Quadratic Equation

An equation of the form

$ax^2 + bx + c = 0$ ........(i)

where a, b, c $\in$ R and a $\neq$ 0 is called a quadratic equation. The numbers a, b, c are called the coefficients of this quation.

### A root of the quadratic Equation

Discriminant $D = b^2 - 4ac$

The roots of Eq (i) are given by the formula

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

### Properties of Quardratic Equations

- A quadratic equation has two and only two roots.
- A quadratic equation cannot have more than two different roots.
- If $\alpha$ be a root of the quadratic equation $ax^2 + bx + c = 0$, then $(x - \alpha)$ is a factor of $ax^2 + bx + c = 0$.

### Sum and Product of the roots of a Quadratic Equation

Leat $\alpha, \beta$ be the roots of a quadratic equation $ax^2 + bx + c = 0$, a $\neq 0$, then

$$\alpha + \beta = \frac{-b}{a} = -\left(\frac{\text{coefficient of } x}{\text{coefficient of } x^2}\right)$$

and $$\alpha.\beta = \frac{c}{a} = \left(\frac{\text{constant term}}{\text{coefficient of } x^2}\right)$$

Therefore,

- If the two roots $\alpha$ and $\beta$ be reciprocal to each other, then a = c.
- If the two roots $\alpha$ and $\beta$ be equal in magnitude and opposite in sign b = 0.

### Sign of the Roots

| **Sign of $(\alpha + \beta)$** | **Sign of $(\alpha\beta)$** | **Sign of the $\alpha, \beta$** |
|---|---|---|
| +ve | +ve | $\alpha$ and $\beta$ are positive |
| –ve | +ve | $\alpha$ and $\beta$ are negative |
| +ve | –ve | $\alpha$ is positive and $\beta$ is negative if $\alpha > \beta$ |
| –ve | –ve | $\alpha$ is negative and $\beta$ is positive if $\alpha < \beta$ |

## Nature of Roots

For a quadratic equation $ax^2 + bx + c = 0$ where $a, b, c \in R$ and $a \neq 0$ and $D = b^2 - 4ac$

(i) If $D < 0$, roots are imaginary (ii) If $D \geq 0$ roots are real.

- $D < 0$: roots are complex with non-zero imaginary part
- $D = 0$: roots are rational and equal
- $D > 0$:
  - D is a perfect square → roots are rational and unequal
  - D is not a perfect square → roots are irrational and conjugate pairs

- If $a, b, c \in R$ and $p + iq$ is one root of quadratic equation (where $q \neq 0$) then the other root must be conjugate $p - iq$ and vice-versa. ($p, q \in R$ and $i = \sqrt{-1}$)
- If $a, b, c \in Q$ and $p + \sqrt{q}$ is one root of the quadratic equation, then the other root must be the conjugate $p - \sqrt{q}$ and vice-versa (where p is a rational and $\sqrt{q}$ is a surd).
- If $a = 1$ and $b, c \in I$ and the roots of quadratic equation are rational numbers, then these roots must be integers.

## Condition for Common Roots

Consider two quadratic equations

$ax^2 + bx + c = 0$ .............(i) $a \neq 0$

and $a'x^2 + b'x + c' = 0$ .............(ii) $d \neq 0$

(i) If one root is common then,

$(ab' - a'b)(bc' - b'c) = (ca' - c'a)^2$

(ii) If two roots are common then,

$$\frac{a}{a'} = \frac{b}{b'} = \frac{c}{c'}$$

## Condition that $ax^2 + bx + c = 0$, is Factorizable into two Linear Factors

When $D \geq 0$, then the equation $ax^2 + bx + c = 0$ is factorizable into two linear factors.

i.e., $ax^2 + bx + c \Rightarrow (x - a)(x - b) = 0$, where $\alpha$ and $\beta$ are the roots of quadratic equation.

## Formation of a Quadratic Equation

Let $\alpha, \beta$ be the two roots then we can form a quadratic equation as folllows

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

i.e., $x^2 - (\alpha + \beta)x + (\alpha\beta) = 0$

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

## ■ Formation of a New Quadratic Equation by Changing the roots of a given Quadratic Equation

Let $\alpha, \beta$ be the roots of a quadratic equation $ax^2 + bx + c = 0$, then we can form a new quadratic equation as per the following rules.

- A quadratic equation whose roots are p more than the roots of the equation $ax^2 + bx + c = 0$ (i.e., the roots are $\alpha + p$ and $\beta + p$).

  The required equation is

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

- A quadratic equation whose roots are less by p than the roots of the equation $ax^2 + bx + c = 0$, (i.e., the roots are $\alpha - p$ and $\beta - p$)

  The required equation is

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

- A quadratic equation whose roots are p times the roots of the equation $ax^2 + bx + c = 0$(i.e., the roots are $\frac{\alpha}{p}$ and $\frac{\beta}{p}$) The required equation is $a(px)^2+b(px)+c=0$

- A quadratic equation whose roots are the reciprocal of the roots of equation $ax^2+bx+c=0$ (i.e. the roots are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$). The required equation is $a\left(\frac{1}{x}\right)^2 + b\left(\frac{1}{x}\right) + c = 0$

  $\Rightarrow \quad cx^2 + bx + a = 0$

- A quadratic equation whose roots are 1/p times the roots of the equation $ax^2 + bx + c = 0$ (i.e., the roots are $1/\alpha$ and $1/\beta$).

  The required equation is $a\left(\frac{x}{p}\right)^2 + n\left(\frac{x}{p}\right) + c = 0$

- A quadratic equation whose roots are the negative of the roots of the equation $ax^2 + bx + c = 0$ (i.e., the roots are $-\alpha$ and $-\beta$)

  The required equation is $a(-x)^2 + b(-x) + c = 0$

  $\Rightarrow \quad ax^2 - bx + c = 0$

- A quadratic equation whose roots are the square of the roots of the equation $ax^2 + bx + c = 0$ (i.e., the roots are $\alpha^2$ and $\beta^2$)

  The required equation is $a(\sqrt{x})^2 + b(\sqrt{x}) + c = 0$

  $\Rightarrow \quad ax + b\sqrt{x} + c = 0$

- A quadratic equation whose roots are the cubes of the roots of the equation $ax^2 + bx + c = 0$ (i.e., the roots are $\alpha^3$ and $\beta^3$)

  The required equation is $a(x^{1/3})^2 + b(x^{1/3}) + c = 0$

  $\Rightarrow \quad ax^{2/3} + bx^{1/3} + c = 0$

## Maximum or Minimum value of a Quadratic Equation

At $x = \frac{-b}{2a}$ we get the maximum or minimum value of the quadratic expression.

- When $a > 0$ (in the equation $ax^2 + bx + c$) the expression gives minimum value, $y = \frac{4ac - b^2}{4a}$

- When $a < 0$ (in the equation $ax^2 + bx + c$) the expression gives maximum value, $y = \frac{4ac - b^2}{4a}$.

## Sign of Quadratic Expression $ax^2 + bx + c$

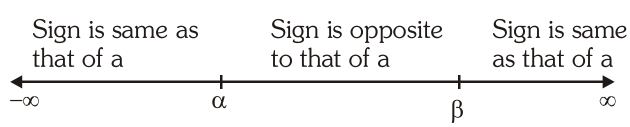
- If $\alpha$, $\beta$ are the roots of the corresponding quadratic equation, then for $x = \alpha$ and $x = \beta$, the value of the expression is equal to zero. i.e., $f(x) = ax^2 + bx + c = 0$.
- But for other real values of x (i.e., except $\alpha$ and $\beta$) the expression is either less than zero or greater than zero, i.e., $f(x) < 0$ or $f(x) > 0$.
- But for other real values of x (i.e., except $\alpha$ and $\beta$) the expression is either less than zero or greater than zero, i.e., $f(x) < 0$ or $f(x) < 0$.
- Thus the sign of $ax^2 + bx + c$, $x \in R$, is determined by the following rules:
  - If $D < 0$ i.e., $\alpha$ and $\beta$ are imaginary, then

    $ax^2 + bx + c > 0$, if $a > 0$

    and $ax^2 + bx + c < 0$, if $a < 0$
  - If $D = 0$ i.e., $\alpha$ and $\beta$ are real and equal, then

    $ax^2 + bx + c \geq 0$, if $a > 0$

    and $ax^2 + bx + c \leq 0$, if $a < 0$
  - If $D > 0$ i.e., $\alpha$ and $\beta$ are real unequal ($\alpha < \beta$), then the sign of the expression $ax^2 + bx + c$, $x \in R$ is determined as follows :




## Relation between roots and coefficients

- For quadratic equation $ax^2 + bx + c = 0$, having the roots $\alpha$ and $\beta$, then

$$\alpha + \beta = \frac{-b}{a} \qquad \text{and} \qquad \alpha\beta = \frac{c}{a}$$

- For cubic equation $ax^3 + bx^2 + cx + d = 0$, having roots $\alpha$, $\beta$ and $\gamma$, then

$$\alpha+\beta+\gamma = \frac{-b}{a}, \qquad \alpha\beta + \beta\gamma + \gamma\alpha = (-1)^2 \frac{c}{a} = \frac{c}{a}$$

and $$\alpha\beta\gamma = (-1)^3 \frac{d}{a} = \frac{-d}{a}$$

**1.** If the roots, $x_1$ and $x_2$, of the quadratic equation $x^2 - 2x + c = 0$ also satisfy the equation $7x_2 - 4x_1 = 47$, then which of the following is true ?

(1) $c = -15$ (2) $x_1 = 5, x_2 = 3$

(3) $x_1 = 4.5, x_2 = -2.5$ (4) None of these

**2.** The integral values of k for which the equation $(k-2)x^2 + 8x + k + 4 = 0$ has both the roots real, distinct and negative is :

(1) 0 (2) 2 (3) 3 (4) – 4

**3.** If the roots of the equation $\frac{x^2 - bx}{ax - c} = \frac{m-1}{m+1}$ are equal and of opposite sign, then the value of m will be :

(1) $\frac{a-b}{a+b}$ (2) $\frac{b-a}{a+b}$ (3) $\frac{a+b}{a-b}$ (4) $\frac{b+a}{b-a}$

**4.** If $\alpha, \beta$ are the roots of the equation $x^2 + 2x + 4 = 0$, then $\frac{1}{\alpha^3} + \frac{1}{\beta^3}$ is equal to :

(1) $-\frac{1}{2}$ (2) $\frac{1}{4}$ (3) 32 (4) $\frac{1}{32}$

**5.** If $\alpha, \beta$ are the roots of the equation $x^2 + 7x + 12 = 0$, then the equation whose roots are $(\alpha + \beta)^2$ and $(\alpha - \beta)^2$ is :

(1) $x^2 + 50x + 49 = 0$ (2) $x^2 - 50x + 49 = 0$

(3) $x^2 - 50x - 49 = 0$ (4) $x^2 + 12x + 7 = 0$

**6.** The value of k (k > 0) for which the equations $x^2 + kx + 64 = 0$ and $x^2 - 8x + k = 0$ both will have real roots is :

(1) 8 (2) 16 (3) – 64 (4) None

**7.** If $\alpha, \beta$ are roots of the quadratic equation $x^2 + bx - c = 0$, then the equation whose roots are b and c is

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

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

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

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

**8.** Solve for x : $x^6 - 26x^3 - 27 = 0$

(1) – 1, 3 (2) 1, 3

(3) 1, – 3 (4) –1, –3

**9.** Solve : $\sqrt{2x+9} + x = 13$ :

(1) 4, 16 (2) 8, 20

(3) 2, 8 (4) None of these

**10.** Solve : $\sqrt{2x+9} - \sqrt{x-4} = 3$

(1) 4, 16 (2) 8, 20 (3) 2, 8 (4) None

**11.** Solve for x : $2\left[x^2 + \frac{1}{x^2}\right] - 9\left[x + \frac{1}{x}\right] + 14 = 0$ :

(1) $\frac{1}{2}$, 1, 2 (2) 2, 4, $\frac{1}{3}$ (3) $\frac{1}{3}$, 4, 1 (4) None

**12.** Solve for x : $\sqrt{x^2 + x - 6} - x + 2 = \sqrt{x^2 - 7x + 10}$, $x \in R$ :

(1) 2, 6, $-\frac{10}{3}$ (2) 2, 6

(3) –2, –6 (4) None of these

**13.** The number of real solutions of $x - \frac{1}{x^2 - 4} = 2 - \frac{1}{x^2 - 4}$ is :

(1) 0 (2) 1 (3) 2 (4) Infinite

**14.** The equation $\sqrt{x+1} - \sqrt{x-1} = \sqrt{4x-1}$ has :

(1) No solution

(2) One solution

(3) Two solutions

(4) More than two solutions

**15.** The number of real roots of the equation $(x-1)^2 + (x-2)^2 + (x-3)^2 = 0$ :

(1) 0 (2) 2 (3) 3 (4) 6

**16.** If the equation $(3x)^2 + (27 \times 3^{1/k} - 15)x + 4 = 0$ has equal roots, then k =

(1) – 2 (2) $-\frac{1}{2}$ (3) $\frac{1}{2}$ (4) 0

**17.** Equation $ax^2 + 2x + 1$ has one double root if :

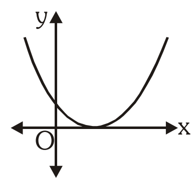
(1) a = 0 (2) a = – 1 (3) a = 1 (4) a = 2

**18.** Solve for x : $(x+2)(x-5)(x-6)(x+1) = 144$

(1) –1, –2, –3 (2) 7, – 3, 2

(3) 2, – 3, 5 (4) None of these

**19.** What does the following graph represent?




(1) Quadratic polynomial has just one root.

(2) Quadratic polynomial has equal roots.

(3) Quadratic polynomial has no root.

(4) Quadratic polynomial has equal roots and constant term is non-zero.

**20.** Consider a polynomial $ax^2 + bx + c$ such that zero is one of it's roots then

(1) $c = 0, x = \frac{-b}{a}$ satisfies the polynomial equation

(2) $c \neq 0, x = \frac{-a}{b}$ satisfies the polynomial equation

(3) $x = \frac{-b}{a}$ satisfies the polynomial equation.

(4) Polynomial has equal roots.

**21.** Consider a quadratic polynomial $f(x)=ax^2-x+c$ such that $ac > 1$ and it's graph lies below x-axis then:

(1) $a < 0, c > 0$ (2) $a < 0, c < 0$

(3) $a > 0, c > 0$ (4) $a > 0, c < 0$

**22.** If $\alpha,\beta$ are the roots of a quadratic equation $x^2 - 3x + 5 = 0$ then the equation whose roots are $(\alpha^2 - 3\alpha + 7)$ and $(\beta^2 - 3\beta + 7)$ is :

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

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

**23.** The expression $a^2x^2 + bx + 1$ will be positive for all $x \in R$ if :

(1) $b^2 > 4a^2$ (2) $b^2 < 4a^2$

(3) $4b^2 > a^2$ (4) $4b^2 < a^2$

**24.** For what value of a the curve $y = x^2 + ax + 25$ touches the x-axis :

(1) 0 (2) $\pm 5$

(3) $\pm 10$ (4) None

**25.** The value of the expression $x^2 + 2bx + c$ will be positive for all real x if :

(1) $b^2 - 4c > 0$ (2) $b^2 - 4c < 0$

(3) $c^2 < b$ (4) $b^2 < c$

**26.** If the roots of the quadratic equation $ax^2 + bx + c = 0$ are imaginary then for all values of a, b, c and $x \in R$, the expression $a^2x^2 + abx + ac$ is

(1) Positive

(2) Non-negative

(3) Negative

(4) May be positive, zero or negative

**27.** The value of k, so that the equations $2x^2 + kx - 5 = 0$ and $x^2 - 3x - 4 = 0$ have one root in common is :

(1) $-2, -3$ (2) $-3, -\frac{27}{4}$

(3) $-5, -6$ (4) None of these

**28.** If the expression $x^2 - 11x + a$ and $x^2 - 14x + 2a$ must have a common factor and $a \neq 0$, then the common factor is :

(1) $(x - 3)$ (2) $(x - 6)$ (3) $(x - 8)$ (4) None

**29.** The value of m for which one of the roots of $x^2 - 3x + 2m = 0$ is double of one of the roots of $x^2 - x + m = 0$ is :

(1) 0, 2 (2) 0, $-2$ (3) 2, $-2$ (4) None

**30.** If the equations $x^2 + bx + c = 0$ and $x^2 + cx + b = 0$, $(b \neq c)$ have a common root then :

(1) $b + c = 0$ (2) $b + c = 1$

(3) $b + c + 1 = 0$ (4) None of these

**31.** If both the roots of the equations

$k(6x^2 + 3) + rx + 2x^2 - 1 = 0$ and

$6k(2x^2 + 1) + px + 4x^2 - 2 = 0$ are common, then $2r - p$ is equal to :

(1) 1 (2) $-1$

(3) 2 (4) 0

**32.** If $x^2 - ax - 21 = 0$ and $x^2 - 3ax + 35 = 0$ ; $a > 0$ have a common root, then a is equal to :

(1) 1 (2) 2

(3) 4 (4) 5

**33.** The values of a for which the quadratic equation $(1 - 2a)x^2 - 6ax - 1 = 0$ and $ax^2 - x + 1 = 0$ have at least one root in common are :

(1) $\frac{1}{2}, \frac{2}{9}$ (2) $0, \frac{1}{2}$

(3) $\frac{2}{9}$ (4) $0, \frac{1}{2}, \frac{2}{9}$

**34.** If the quadratic equation $2x^2 + ax + b = 0$ and $2x^2 + bx + a = 0$ $(a \neq b)$ have a common root, the value of $a + b$ is :

(1) – 3 (2) – 2 (3) – 1 (4) 0

**35.** If the equation $x^2 + bx + ca = 0$ and $x^2 + cx + ab = 0$ have a common root and $b \neq c$, then their other roots will satisfy the equation :

(1) $x^2 - (b + c)x + bc = 0$

(2) $x^2 - ax + bc = 0$

(3) $x^2 + ax + bc = 0$

(4) None of these

**36.** If both the roots of the equations $x^2 + mx + 1 = 0$ and $(b - c)x^2 + (c - a)x + (a - b) = 0$ are common, then :

(1) $m = -2$ (2) $m = -1$ (3) $m = 0$ (4) $m = 1$

**37.** For the equation $3x^2 + px + 3 = 0$, $p > 0$, if one of the roots is square of the other, then p =

(1) $\frac{1}{3}$ (2) 1

(3) 3 (4) $\frac{2}{3}$

**38.** The roots of the equation $|x^2 - x - 6| = x + 2$ are

(1) – 2, 1, 4 (2) 0, 2, 4

(3) 0, 1, 4 (4) –2, 2, 4

**39.** The equation $x - \frac{2}{x-1} = 1 - \frac{2}{x-1}$ has

(1) Two roots

(2) Infinitely many roots

(3) Only one root

(4) No root

**40.** The value of x which satisfy the expression :

$$(5 + 2\sqrt{6})^{x^2-3} + (5 - 2\sqrt{6})^{x^2-3} = 10$$

(1) $\pm 2, \pm\sqrt{3}$ (2) $\pm\sqrt{2}, \pm 4$

(3) $\pm 2, \pm\sqrt{2}$ (4) $2, \sqrt{2}, \sqrt{3}$

**41.** Find all the integral values of a for which the quadratic equation $(x - a)(x - 10) + 1 = 0$ has integral roots :

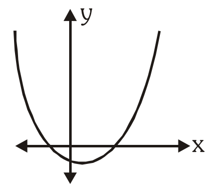
(1) 12, 8 (2) 4, 6

(3) 2, 0 (4) None

**42.** Graph of $y = ax^2 + bx + c$ is given adjacently. What conclusions can be drawn from the graph?

(i) $a > 0$ (ii) $b < 0$

(iii) $c < 0$ (iv) $b^2 - 4ac > 0$



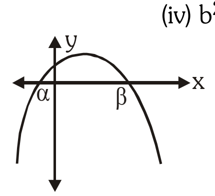

(1) (i) and (iv) (2) (ii) and (iii)

(3) (i), (ii) & (iv (4) (i), (ii), (iii) & (iv)

**43.** The adjoining figure shows the graph of $y = ax^2 + bx + c$. Then which of the following is correct :

(i) $a > 0$ (ii) $b > 0$

(iii) $c > 0$ (iv) $b^2 < 4ac$




(1) (i) and (iv) (2) (ii) and (iii)

(3) (iii) & (iv) (4) None of these

**44.** If $x^2 - (a + b)x + ab = 0$, then the value of $(x - a)^2 + (x - b)^2$ is

(1) $a^2+b^2$ (2) $(a+b)^2$ (3) $(a-b)^2$ (4) $a^2-b^2$

**45.** The sum of the roots of $\frac{1}{x+a} + \frac{1}{x+b} = \frac{1}{c}$ is zero. The product of the roots is

(1) 0 (2) $\frac{1}{2}(a+b)$

(3) $-\frac{1}{2}(a^2+b^2)$ (4) $2(a^2 + b^2)$

**46.** If the roots of the equations

$(c^2-ab)x^2-2(a^2-bc)x+(b^2-ac)=0$

for $a \neq 0$ are real and equal, then the value of $a^3+b^3+c^3$ is

(1) abc (2) 3abc

(3) zero (4) None of these

**47.** If, $\alpha$, $\beta$ are the roots of $X^2 - 8X+P=0$ and $\alpha^2+\beta^2 = 40$. then the value of P is

(1) 8 (2) 10 (3) 12 (4) 14

**48.** If, $\ell$, m, n are real and $\ell$=m, then the roots of the equations

$(\ell - m)x^2 - 5(\ell + m)x - 2(\ell - m) = 0$ are

(1) Real and Equal

(2) Complex

(3) Real and Unequal

(4) None of these

**49.** In a family, eleven times the number of children is greater than twice the square of the number of children by 12. How many children are there ?

(1) 3 (2) 4

(3) 2 (4) 5

**50.** The sum of all the real roots of the equation

$|x-2|^2 + |x-2| - 2 = 0$ is

(1) 2 (2) 3

(3) 4 (4) None of these

**51.** If the ratio between the roots of the equation $\ell x^2 + mx + n = 0$ is p:q, then the value of $\sqrt{\frac{p}{q}} + \sqrt{\frac{q}{p}} + \sqrt{\frac{n}{\ell}}$ is

(1) 4 (2) 3

(3) 0 (4) –1

**52.** Find the root of the quadratic equation $bx^2 - 2ax + a = 0$

(1) $\frac{\sqrt{b}}{\sqrt{b} \pm \sqrt{a-b}}$ (2) $\frac{\sqrt{a}}{\sqrt{b} \pm \sqrt{a-b}}$

(3) $\frac{\sqrt{a}}{\sqrt{a} \pm \sqrt{a-b}}$ (4) $\frac{\sqrt{a}}{\sqrt{a} \pm \sqrt{a+b}}$

**53.** If 4 is a solution of the equation $x^2 + 3x + k = 10$, where k is a constant, what is the other solution ?

(1) –18 (2) –7

(3) –28 (4) None of these

**54.** The coefficient of x in the equation $x^2 + px + p = 0$ was wrongly written as 17 in place of 13 and the roots thus found were –2 and –15. The roots of the correct equation would be

(1) –4, –9 (2) –3, –10

(3) –3, –9 (4) –4, –10

**55.** If $\alpha$ and $\beta$ are the roots of the quadratic equation $ax^2 + bx + c = 0$, then the value of $\frac{\alpha^2}{\beta} + \frac{\beta^2}{\alpha}$ is

(1) $\frac{2bc - a^3}{b^2c}$ (2) $\frac{3abc - b^3}{a^2c}$

(3) $\frac{3abc - b^2}{a^3c}$ (4) $\frac{ab - b^2c}{2b^2c}$

## ANSWER KEY

| **Que.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **1** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ans.** | 1 | 3 | 1 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | |
| **Que.** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| **Ans.** | 2 | 3 | 2 | 4 | 1 | 2 | 2 | 2 | 3 | 4 | 1 | 2 | 3 | 2 | |
| **Que.** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** | **41** | **42** | **43** | **44** | **45** |
| **Ans.** | 4 | 3 | 3 | 2 | 1 | 1 | 3 | 4 | 4 | 3 | 1 | 4 | 2 | 3 | |
| **Que.** | **46** | **47** | **48** | **49** | **50** | **51** | **52** | **53** | **54** | **55** | | | | | |
| **Ans.** | 2 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | | | | | |