QUADRATIC EQUATIONS

CLASS X (BASIC & STANDARD)

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i) Quadratic equation: A quadratic equation in the variable x is of the form $ax^2 + bx + c = 0$ *where a, b, c are real numbers and* $a \neq 0$.

ii) Roots of a quadratic equation: A real number α is said to be a root of the quadratic equation $ax^2 + bx + c = 0$ *, if* $a\alpha^2 + b\alpha + c = 0$.

iii) The roots of the quadratic equation $ax^2 + bx + c = 0$ *are the same as the zeroes of the quadratic polynomial* $ax^2 + bx + c$

iv) Quadratic Formula: If $b^2 - 4ac \geq 0$ *, then the real roots of the quadratic equation*

$ax^2 + bx + c = 0$ *are given by* $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

The expression $b^2 - 4ac$ *is called the discriminant of the quadratic equation.*

v) A quadratic equation $ax^2 + bx + c = 0$ *has*

i) two distinct real roots if $b^2 - 4ac > 0$

ii) two equal real roots if $b^2 - 4ac = 0$

iii) no real roots if $b^2 - 4ac < 0$. *(Complex numbers)*

iv) Rational roots if $b^2 - 4ac$ is a perfect square.

PART -1

1. If the roots of the equation $ax^2 = bx + c = 0$, $a \neq 0$ are real and equal, which of the following relation is true? (CBSE 2024)

   (A) $a = \frac{b^2}{c}$ (B) $b^2 = ac$ (C) $ac = \frac{b^2}{4}$ (D) $c = \frac{b^2}{a}$

2. The discriminant of the quadratic equation $2x^2 - 5x - 3 = 0$ is _____ (CBSE 2023)

   (A) 1 (B) 19 (C) 49 (D) 7

3. Which of the following equations is a quadratic equation? (CBSE 2025)

   (A) $x^2 + 1 = (x - 1)^2$ (B) $\left(x + \sqrt{x}\right)^2 = 2x\sqrt{x}$

   (C) $x^3 + 3x^2 = (x + 1)^3$ (D) $(x + 1)(x - 1) = (x + 1)^2$

4. If $x^2 + bx + b = 0$ has two real and distinct roots, then the value of b can be (CBSE 2025)

   (A) 0 (B) 4 (C) 3 (D) -3

5. The quadratic equation $4x^2 + 6x + 3 = 0$ has _____

   (A) two distinct real roots (B) two equal real roots

   (C) no real roots (D) more than 2 real roots

6. For what value of *k*, are the roots of the quadratic equation $3x^2 + 2kx + 27 = 0$ real and equal?

   (A) ± 9 (B) 9 (C) 3 (D) 12

7. If the roots of $ax^2 + bx + c = 0$ are equal in magnitude but opposite in sign, then_____

   (A) a = 0 (B) b = 0 (C) c = 0 (D) none of these

8. If the difference of the roots of the equation $x^2 - bx + c = 0$ be 1, then_____

   (A) $b^2 - 4c + 1 = 0$ (B) $b^2 + 4c = 0$ (C) $b^2 - 4c - 1 = 0$ (D) $b^2 - 4c = 0$

9. Write the nature of roots of quadratic equation $4x^2 + 4\sqrt{3}x + 3 = 0$.

   (A). Distinct non real roots (B) real and unequal roots (C) real and equal roots (D) none

10. Which one of the following equations has no real roots?

    (A) $x^2 - 4x + 3\sqrt{2}$ (B) $x^2 + 4x - 3\sqrt{2}$ (C) $x^2 - 4x - 3\sqrt{2}$ (D) $3x^2 + 4\sqrt{3}x + 4$

11. Find the value of k for which the equation $x^2 - 4x + k = 0$ has equal roots.

(A) -4 (B) 1 (C) 4 (D) 16

12. The nature of roots of the quadratic equation $4x^2 + 4\sqrt{3}x + 3 = 0$ is _____.
(A) real and equal roots (B) real and distinct roots
(C) no real roots (D) none of these

13. The discriminant (D) of the quadratic equation $\sqrt{3}x^2 + 2\sqrt{2}x - 2\sqrt{3}$ is _____
(A) -32 (B) 4 (C) $\sqrt{32}$ (D) 32

14. Write the nature of roots of the quadratic equation $9x^2 - 6x - 2 = 0$.
(A) Distinct non real roots (B) real and unequal roots (C) real and equal roots (D) none

15. The roots of $ax^2 + bx + c = 0, a \neq 0$ are real and unequal. What is value of D?
(A) $D > 0$ (B) $D < 0$ (C) $D \leq 0$ (D) $D \geq 0$

16. If arithmetic mean of two numbers *a* and *b* is 8 and *ab* = 9, find a quadratic equation whose roots are *a* and *(B)*
(A) $x^2 + 16x + 9 = 0$ (B) $x^2 - 16x + 9 = 0$ (C) $x^2 - 16x - 9 = 0$ (D) $x^2 - 9x + 16 = 0$

17. If $2x^2 - (2 + k)x + k = 0$ where *k* is a real number, find the roots of the equation.
(A) $1, \frac{1}{2}$ (B) $1, \frac{k}{2}$ (C) $k, \frac{k}{2}$ (D) $\frac{k}{2}, \frac{k}{2}$

18. If 2 is a root of the equation $x^2 + bx + 12 = 0$, find the value of *(B)*
(A) 8 (B) – 4 (C) 14 (D) – 8

19. If $3x^2 - 2kx + m = 0$, find k when $x = 2$ and $m = 3$.
(A) 15 (B) $\frac{15}{4}$ (C) 14 (D) $\frac{4}{15}$

20. Find the discriminant of the quadratic equation: $3\sqrt{3}x^2 + 10x + \sqrt{3} = 0$.
(A) 8 (B) ± 8 (C) 64 (D) $\sqrt{3}$

21. For what value of *k* does $(k - 12)x^2 + 2(k - 12)x + 2 = 0$ have equal roots?
(A) $k = 14$. (B) $k = 14, 12$ (C) $k = 12$ (D) $k = \pm 14$

22. If the roots of quadratic equation $ax^2 + bx + c = 0$ are equal in magnitude but opposite in sign then find the value of *(B)*
(A) $b = 2$ (B) $b = 1$ (C) $b = 0$ (D) $b = \pm 1$

23. If two roots of $2x^2 + bx + c = 0$ are reciprocal of each other then find the value of c
(A) ± 2 (B) 4 (C) $c = \pm 1$ (D) $c = 2$

24. Which one of the following equations has 2 as a root?
A) $x^2 - 4x + 5 = 0$ B) $x^2 + 3x - 12 = 0$ C) $2x^2 - 7x + 6 = 0$ D) $3x^2 - 6x - 2 = 0$

25. If the roots of the equation $ax^2 + 2bx + c = 0$ are α and β, find the value of $\sqrt{\frac{\alpha}{\beta}} + \sqrt{\frac{\beta}{\alpha}}$
A) $\frac{-2b}{\sqrt{ac}}$ B) $\frac{-2c}{\sqrt{ab}}$ C) $\frac{-2}{\sqrt{ac}}$ D) $\frac{-b}{\sqrt{ac}}$

26. If $\frac{1}{2}$ is a root of the equation $x^2 + kx - \frac{5}{4} = 0$ then the value of *k* is
A) 2 B) – 2 C) $\frac{1}{2}$ D) $\frac{1}{4}$

27. Which of the following equations has the sum of its roots as 3?
A) $2x^2 - 3x + 6 = 0$ B) $-x^2 + 3x - 3 = 0$ C) $\sqrt{2}x^2 - \frac{3}{\sqrt{2}}x + 6 = 0$ D) $3x^2 - 3x + 3 = 0$

28. Value (s) of k for which the quadratic equation $2x^2 - kx + k = 0$ has equal roots is
A) 0 only B) 4 C) 8 only D) 0, 8

29. The quadratic equation $2x^2 - \sqrt{5}\,x + 1 = 0$ has
A) two distinct real roots (B) two equal real roots (C) no real roots (D) more than 2 real roots

30. Find the least positive value of k for which $x^2 + kx + 16 = 0$ has real roots.
A) 4 B) 8 C) $\frac{1}{2}$ D) 1

31. Find the value of p for which the roots of the equation $px^2 - 2\sqrt{5}px + 15 = 0$ has two equal roots.
A) p = 3 B) p = 8 C) p = -2 D) p = 0, 3

32. If (1 – b) is a root of quadratic equation $x^2 + bx + (1 - b) = 0$, then its roots are _____
(A) 0, 1 (B) 0, –1 (C) –1, 1 (D) 0, 2

33. If $3x^2 - 2kx + m = 0$, find k when $x = 2$ *and* $m = 3$.
A) 2 B) $-\frac{5}{4}$ C) $-\frac{15}{4}$ D) $\frac{15}{4}$

34. If the quadratic equation $mx^2 + 2x + m = 0$ has two equal roots, then the values of m are _____ and _____ .
A) 0 and –1 B) 1 and –2 C) 2 and –1 D) 1 and –1

35. Write the nature of roots of the quadratic equation $9x^2 – 6x – 2 = 0$.
A) two unequal real roots B) equal and real roots
C) no real roots D) none of these

36. The hypotenuse of a right triangle is 1 m more than twice the shortest side. If the third side is 7 m more than the shortest side, find the longest side of the triangle.
A) 12 B) 15 C) 16 D) 17

37. Find the discriminant (D) of quadratic equation $4x^2 – 2x – 5 = 0$
A) 82 B) 84 C) -84 D) 80

38. For what value of k , *if* $x = \sqrt{2}$ is a solution of the equation $kx^2 + \sqrt{2}x - 4 = 0$?
A) 1 B) 2 C) 3 D) 4

39. Which are the following quadratic equations:
A) $(x – 2)(x + 5) = (x – 3)(x + 4) + x^2$ B) $x^2 – 3x + 5 = (x + 5)^2$
C) $x^3 – 3x^2 + 5x = (x – 2)^3$ D) $(x – 7)\,x = 3x^2 – 5$

40. If the difference of the roots of the equation $x^2 - bx + c = 0$ be 1, then____
(A) $b^2 – 4c + 1 = 0$ (B) $b^2 + 4c = 0$ (C) $b^2 – 4c – 1 = 0$ (D) $b^2 – 4c = 0$

41. Which of the following is a solution of the equation $x^2 – 6x + 5 = 0$?
A) 2 B) 5 C) -5 D) 3

42. Find the value (s) of p for which the quadratic equation given as $(p + 4)x^2 - (p + 1)x + 1 = 0$ has real and equal roots. Also , find the roots of the equation(s) so obtained

ANS: $(p+4)x^2-(p+1)x+1=0$ -------(i)
For equal roots, D = 0 $\Rightarrow$ $b^2 - 4ac = 0$
$(-(p+1))^2-4\times(p+4)=0$
$p^2+1+2p-4p-16=0$
$p^2-2p-15=0 \Rightarrow (p-5)(p+3)=0$
$p=-3,5$
Substitute in (i) $p=-3$ then $x^2-2x+1=0 \Rightarrow (x-1)^2=0 \Rightarrow x=1,1$
Substitute in (i) $p=5$ then $9x^2-6x+1=0 \Rightarrow (3x-1)^2=0 \Rightarrow x=\frac{1}{3},\frac{1}{3}$
roots of the equations are $1,\frac{1}{3}$.

43. If x = 2 is a solution of the equation $x^2 - 5x + 6k = 0$, the value of k is _____.

ANS: Substituting x = 2, we have
$(2)^2 - 5 \times 2 + 6k = 0$
$\Rightarrow 4 - 10 + 6k = 0 \Rightarrow k = 1$

44. The least positive value of k, for which the equation $2x^2+kx-4=0$ has rational roots , is __
(A) $\pm 2\sqrt{2}$ (B) 2 (C) ± 2 (D) $\sqrt{2}$
ANS: D = $b^2-4ac = k^2-4\times 2(-4) = k^2+32$
x = $\frac{-b\pm\sqrt{D}}{2a}$ To get rational roots $D\ is\ perfect\ square.\ x^2+32$ is perfect square when $k^2=4$
ie: least positive value of k = 2

45. If (1 – p) is a root of the equation $x^2 + px + 1 - p = 0$, then roots are_____

ANS: (c) (1 – p) is a root
$\therefore (1-p)^2 + p(1-p) + 1 - p = 0$
$\Rightarrow (1-p)[1-p+p+1] = 0$
$\Rightarrow (1-p)(2) = 0 \Rightarrow p = 1$
$x^2 + x = 0$
One root = 0 and another root = – 1
$\therefore$ roots are 0 and –1.

46. If α, β are roots of the equation $x^2 + 5x + 5 = 0$, then equation whose roots are α + 1 and β + 1 is
(a) $x^2 + 5x - 5 = 0$ (b) $x^2 + 3x + 5 = 0$ (c) $x^2 + 3x + 1 = 0$ (d) $x^2 - 3x + 1 = 0$
ANS: (c) $\alpha+\beta = -5$, $\alpha\beta = 5$.
Required equation is
$x^2 - (\alpha+1+\beta+1)x + (\alpha+1)(\beta+1) = 0$
$\Rightarrow x^2 - (\alpha+\beta+2)x + (\alpha\beta+\alpha+\beta+1) = 0$
$\Rightarrow x^2 - (-5+2)x + (5-5+1) = 0$
$\Rightarrow x^2 + 3x + 1 = 0$

47. Which of the following equations has no real roots ?
(a) $x^2 - 4x + 3\sqrt{2} = 0$ (b) $x^2 + 4x - 3\sqrt{2} = 0$
(c) $x^2 - 4x - 3\sqrt{2} = 0$ (d) $3x^2 + 4\sqrt{3}x + 4 = 0$
ANS: (a) D < 0

48. If α, β are roots of $x^2 + 5x + a = 0$ and $2\alpha + 5\beta = -1$, then a is equal to _____.

ANS: Here $\alpha+\beta = -5$ ...(i)
and $2\alpha + 5\beta = -1$ ...(ii)
Multiplying (i) by 2, we get

$\Rightarrow 2\alpha + 2\beta = -10$ ...(iii)
Solving (ii) and (iii), we get $\alpha = -8$, $\beta = 3$
Now $\alpha\beta = -\frac{24}{1} \Rightarrow a = -24$

49. α, β are roots of the equation $(a + 1)x^2 + (2a + 3)x + (3a + 4) = 0$. If $\alpha \cdot \beta = 2$, then $\alpha + \beta =$ _____.

$$\because \alpha\beta = \frac{3a+4}{a+1} \Rightarrow 2 = \frac{3a+4}{a+1} \Rightarrow 2a + 2 = 3a + 4$$

$$\Rightarrow \quad a = -2$$

$$\text{and } \alpha + \beta = -\left(\frac{2a+3}{a+1}\right)$$

$$\Rightarrow \quad \alpha + \beta = -\left(\frac{2(-2)+3}{-2+1}\right) - \left(\frac{-1}{-1}\right) = -1$$

50. If the difference of the roots of the equation $x^2 - bx + c = 0$ be 1, then
(a) $b^2 - 4c + 1 = 0$ (b) $b^2 + 4c = 0$
(c) $b^2 - 4c - 1 = 0$ (d) $b^2 - 4c = 0$

ANS: (c) Let roots are α and β
$\Rightarrow \alpha - \beta = 1, \alpha + \beta = b \ , \alpha\beta = c$
$\because (\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$
$\Rightarrow 1 = b^2 - 4c \Rightarrow b^2 - 4c - 1 = 0$

51. If the roots of $ax^2 + bx + c = 0$ are equal in magnitude but opposite in sign, then
(a) $a = 0$ (b) $b = 0$ (c) $c = 0$ (d) none of these
ANS: (b) $\because$ sum of roots = 0
$\Rightarrow -\frac{b}{a} = 0 \Rightarrow b = 0$

52. If $\alpha + \beta = 4$ and $\alpha^3 + \beta^3 = 44$, then α, β are the roots of the equation
(a) $2x^2 - 7x - 7 = 0$ (b) $3x^2 + 8x + 12 = 0$
(c) $3x^2 - 12x + 5 = 0$ (d) none of these

ANS: (c) $\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$
$\Rightarrow 44 = (4)^3 - 3\alpha\beta \times 4$
$\Rightarrow 44 - 64 = -12\alpha\beta$
$\Rightarrow \alpha\beta = \frac{20}{12} = \frac{5}{3}$
$\therefore$ quadratic equation is
$x^2 - (\alpha + \beta)x + \alpha\beta = 0$
$\Rightarrow x^2 - 4x + \frac{5}{3} = 0 \qquad \Rightarrow 3x^2 - 12x + 5 = 0$

53. If the roots of equation $3x^2 + 2x + (p + 2)(p - 1) = 0$ are of opposite sign then which of the following cannot be the value of p?
(a) 0 (b) -1 (c) $\frac{1}{2}$ (d) -3
ANS: (d) $\because$ roots are of opposite sign
$\therefore$ product of the roots is negative

$\Rightarrow (p + 2)(p - 1)$ should be negative.

Clearly when p = – 3, (p + 2) (p – 1) is not negative.

54. The value of k for which the equation $x^2 + 2(k + 1)x + k^2 = 0$ has equal roots is

ANS: (b) For equal roots, D = 0
$\Rightarrow [2(k + 1)]^2 - 4 \times k^2 = 0$
$\Rightarrow 4(k + 1)^2 - 4k^2 = 0$
$\Rightarrow 4(k^2 + 2k + 1) - 4k^2 = 0$
$\Rightarrow 8k + 4 = 0 \Rightarrow k = -\frac{1}{2}$

55. If the equation $x^2 - (2 + m)x + (-m^2 - 4m - 4) = 0$ has coincident roots, then
(a) m = 0, m = 1 (b) m = 2, m = 2 (c) m = –2, m = –2 (d) m = 6, m = 1

ANS: (c) For coincident roots, D = 0
$\Rightarrow [-(2 + m)]^2 - 4 \times 1 \times (-m^2 - 4m - 4) = 0$
$\Rightarrow (2 + m)^2 + 4(m^2 + 4m + 4) = 0$
$\Rightarrow (2 + m)^2 + 4(m + 2)^2 = 0$
$\Rightarrow 5(2 + m)^2 = 0$
$\Rightarrow (2 + m)^2 = 0 \Rightarrow m = -2.$

56. If the roots of the equation $12x^2 + mx + 5 = 0$ are in the ratio 3 : 2, then m equals _____.

ANS: Let roots are 3α and 2α
Sum of roots = $3\alpha + 2\alpha = 5\alpha = -\frac{m}{12} \Rightarrow \alpha = -\frac{m}{60}$ … ...(i)
Product of roots = $3\alpha \cdot 2\alpha = 6\alpha^2 = \frac{5}{12} \Rightarrow \alpha^2 = \frac{5}{72}$ ……....(ii)
From (i) and (ii), $\frac{m^2}{3600} = \frac{5}{72} \Rightarrow m^2 = 5 \times 50$
$\Rightarrow m^2 = 5 \times 5 \times 10 \Rightarrow m = 5\sqrt{10}$

57. Is $x = -2$ a solution of the equation $x^2 - 2x + 8 = 0$?

ANS: $x^2 - 2x + 8 = 0$
When $x = -2$, LHS = $(-2)^2 - 2(-2) + 8 = 4 + 4 + 8 = 16 \neq 0$
$x = -2$ is not a solution of the given equation

58. Find the roots/solution of the quadratic equation by factorisation: $x^2 - 9x + 20 = 0$

ANS: Given equation is $x^2 - 9x + 20 = 0 \Rightarrow x^2 - 5x - 4x + 20 = 0$
$x(x - 5) - 4(x - 5) = 0 \Rightarrow (x - 5)(x - 4) = 0$
$\Rightarrow$ either $x - 5 = 0$ or $x - 4 = 0 \Rightarrow x = 5$ or $x = 4$
$x = 4$ or 5 are the roots/solution of the given quadratic equation.

59. Solve the following quadratic equation by factorisation: $\sqrt{3}\,x^2 + 10x + 7\sqrt{3} = 0$

ANS: $\sqrt{3}\,x^2 + 10x + 7\sqrt{3} = 0 \Rightarrow \sqrt{3}\,x^2 + 7x + 3x + 7\sqrt{3} = 0$
$\Rightarrow x(\sqrt{3}\,x + 7) + \sqrt{3}(\sqrt{3}\,x + 7) = 0 \Rightarrow (\sqrt{3}\,x + 7)(x + \sqrt{3}) = 0$
$x = \sqrt{3}, \quad x = -\frac{7}{\sqrt{3}}$

60. Write the nature of roots of quadratic equation : $4x^2 + 4\sqrt{3}\,x + 3 = 0.$

ANS: Given equation is $4x^2 + 4\sqrt{3}\,x + 3 = 0$. , Here $a = 4$, $b = 4\sqrt{3}$, $c = 3$
$D = b^2 - 4ac = 48 - 48 = 0$
As D = 0, the equation has real and equal roots.

61. Write the nature of roots of the quadratic equation $9x^2 - 6x - 2 = 0$.

ANS: Given quadratic equation is $9x^2 - 6x - 2 = 0$
Here $a = 9$, $b = -6$, $c = -2$
$D = b^2 - 4ac \Rightarrow D = (-6)^2 - 4 \times 9 \times (-2) = 36 + 72 = 108 > 0$
Given quadratic has two unequal real roots.

62. Write the nature of roots of quadratic equation : $4x^2 + 6x + 3 = 0$

ANS: Given quadratic equation is $4x^2 + 6x + 3 = 0$. Here, $a = 4$, $b = 6$, $c = 3$
$D = b^2 - 4ac \Rightarrow D = (6)^2 - 4 \times 4 \times 3 = 36 - 48 = -12 < 0$
given quadratic equation has no real roots.

63. If $2x^2 - (2 + k)x + k = 0$ where k is a real number, find the roots of the equation.

ANS: Given quadratic equation is $2x^2 - (2 + k)x + k = 0$. Here, $a = 2$, $b = -(2 + k)$, $c = k$
Now, $a + b + c = 2 + [-(2 + k)] + k = 0$
roots are 1 and $\frac{k}{2}$.
(If $a + b + c = 0$, then roots of the quadratic equation are 1 and $\frac{c}{a}$)

64. Is $x = -4$ a solution of the equation $2x^2 + 5x - 12 = 0$.

ANS: LHS $= 2x^2 + 5x - 12$
When $x = -4$,
$LHS = 2(-4)^2 + 5(-4) - 12 = 32 - 20 - 12 = 0 = RHS$
$x = -4$ is a solution of the given equation.

65. If 2 is a root of the equation $x^2 + bx + 12 = 0$, find the value of b.

ANS: Since 2 is a root of the given equation.
$(2)^2 + b(2) + 12 = 0 \text{—} 16 + 2b = 0 \text{—} b = -8$

66. If $3x^2 - 2kx + m = 0$, find k when $x = 2$ and $m = 3$.

ANS: The given quadratic equation is
$3x^2 - 2kx + m = 0$ ...(i)
when $x = 2$ and $m = 3$ eq. (i) becomes
$3(2)^2 - 2k(2) + 3 = 0$
$\Rightarrow 12 - 4k + 3 = 0 \quad \Rightarrow \quad k = \frac{15}{4}$

67. Find discriminant of the quadratic equation: $4x^2 - 2x^2 + 3 = 0$.

ANS: Given equation is $4x - 2x^2 + 3 = 0$
$-2x^2 + 4x + 3 = 0$
Here $a = -2$, $b = 4$, $c = 3$
$D = b^2 - 4ac = (4)^2 - 4 \times (-2) \times 3 = 16 + 24 = 40$

68. Find discriminant of the quadratic equation: $4x^2 - 12x + 9 = 0$.

ANS: Given equation is $4x^2 - 12x + 9 = 0$
Here $a = 4$, $b = -12$, $c = 9$
$D = b^2 - 4ac = (-12)^2 - 4 \times 4 \times 9 = 144 - 144 = 0$

69. Find discriminant of the quadratic equation: $5x^2 + 5x + 6 = 0$.

ANS: Given equation is $5x^2 + 5x + 6 = 0$
Here $a = 5$, $b = 5$, $c = 6$
$D = b^2 - 4ac = (5)^2 - 4 \times 5 \times 6 = -95$

70. For what value of k does $(k - 12)\,x^2 + 2(k - 12)x + 2 = 0$ have equal roots?

ANS: $D = [2(k - 12)]^2 - 4(k - 12) \times 2$
$= 4(k - 12)^2 - 8(k - 12)$
For equal and real roots, $D = 0$
$\Rightarrow\ 4(k - 12)^2 - 8(k - 12) = 0$
$\Rightarrow\ 4(k - 12)\,(k - 12 - 2) = 0$
$\Rightarrow\ 4(k - 12)\,(k - 14) = 0$
$\Rightarrow\ k = 12$ or $k = 14$
$a \neq 0\ \Rightarrow\ k \neq 12;\quad k = 14.$

71. A quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$ has equal roots. What is the value of D?

ANS: For equal roots, $D = 0$

72. If two roots of $2x^2 + bx + c = 0$ are reciprocal of each other then find the value of c.

ANS: Let one roots be α other root be $\frac{1}{\alpha}$.
Now, product of roots $= \frac{c}{a}\quad \Rightarrow \alpha \times \frac{1}{\alpha} = \frac{c}{2}\quad \Rightarrow c = 2$

73. Two numbers differ by 3 and their product is 504. Find the numbers.

ANS: Let one number be x
other number be $x + 3$
ATQ $x(x + 3) = 504$
$\Rightarrow\ x^2 + 3x - 504 = 0 \Rightarrow\ x^2 + 24x - 21x - 504 = 0$
$\Rightarrow\ (x + 24)\,(x - 21) = 0 \Rightarrow x + 24 = 0$ or $x - 21 = 0$
$\Rightarrow\ x = -24$ or $x = 21$
When $x = -24$, numbers are -24 and $-24 + 3 = -21$
When $x = 21$, numbers are 21 and $21 + 3 = 24$.

74. Solve the following equation using by quadratic formula: $x^2 + 5x + 5 = 0$.

ANS: Given equation is $x^2 + 5x + 5 = 0$
Here $a = 1$, $b = 5$, $c = 5$.
$D = b^2 - 4\,ac \Rightarrow\ D = (5)^2 - 4 \times 1 \times 5 \Rightarrow\ D = 5 > 0$
solution is given by
$x = \frac{-b \pm \sqrt{D}}{2a} = \frac{-5 \pm \sqrt{5}}{2}$ are solutions.

75. Solve the following equation by using quadratic formula: $9x^2 - 12x + 4 = 0$.

ANS: Given equation is $9x^2 - 12x + 4 = 0$

Here $a = 9$, $b = -12$, $c = 4$

$D = b^2 - 4ac \Rightarrow D = (-12)^2 - 4 \times 9 \times 4 \Rightarrow D = 144 - 144 = 0$

$D = 0$

Equation has equal roots given by $x = \frac{-b \pm \sqrt{D}}{2a}$

$x = \frac{-(-12) \pm \sqrt{0}}{2 \times 9} = \frac{12}{18} = \frac{2}{3}$ $x = \frac{2}{3}$ is the required solution.

76. Find the value of p so that the quadratic equation $p\,x(x - 3) + 9 = 0$ has two equal roots.

ANS: $p\,x(x - 3) + 9 = 0 \Rightarrow px^2 - 3px + 9 = 0$. Here, $a = p$, $b = -3p$, $c = 9$

For equal roots $D = 0 \Rightarrow D = b^2 - 4ac$

$\Rightarrow (-3p)^2 - 4 \times p \times 9 = 0 \Rightarrow 9p^2 - 36p = 0$

$\Rightarrow 9p(p - 4) = 0 \Rightarrow 9p = 0$ or $p - 4 = 0 \Rightarrow p = 0$ or $p = 4$

but $p \neq 0$ [In quadratic equation $a \neq 0$]

77. If the roots of quadratic equation $ax^2 + bx + c = 0$ are equal in magnitude but opposite in sign then find the value of b.

ANS: Let one root be α

other roots be $-\alpha$

Now, sum of roots = $-\frac{b}{a} \Rightarrow \alpha + (-\alpha) = 0$

78. Write the discriminant of the following quadratic equation : (i) $2x^2 - 5x + 3 = 0$

ANS: Given equation,

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

It is in the form of a $x^2 + bx + c = 0$

Where, a = 2, b = -5 and c = 3

So, the discriminant is given by $D = b^2 - 4ac$

$D = (-5)^2 - 4 \times 2 \times 3$

$D = 25 - 24 = 1$

Hence, the discriminant of the given quadratic equation is 1.

79. Write the discriminant of the following quadratic equation (ii) $x^2 + 2x + 4 = 0$

ANS:

Given equation,

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

It is in the form of a $x^2 + bx + c = 0$

Where, a = 1, b = 2 and c = 4

So, the discriminant is given by $D = b^2 - 4ac$

$D = (2)^2 - 4 \times 1 \times 4$

$D = 4 - 16 = -12$

Hence, the discriminant of the given quadratic equation is - 12

80. Write the discriminant of iii) $(x - 1)(2x - 1) = 0$

ANS:

Given equation,

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

On expanding it, we get

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

It is in the form of a $x^2 + bx + c = 0$

Where, a = 2, b = -3, c = 1
So, the discriminant is given by D = b^2 - 4ac
D = (- 3^2) - 4 x 2 x 1
D = 9 - 8 = 1
Hence, the discriminant of the given quadratic equation is 1.

81. Write the discriminant of (iv) x^2 – 5x + 1 = 0

ANS: It is in the form of a x^2 + bx + c = 0
Where, a = 1, b = -5 and c = 1
So, the discriminant is given by D = b^2 - 4ac
D = $(-5)^2$– 4 x 1 x 1
D = 25 – 4 = 21
Hence, the discriminant of the given quadratic equation is 21

82. Using quadratic formula solve the following quadratic equations:
(i) $2x^2 – 2x + 1 = 0$
(ii) $2x^2 – 11x + 9 = 0$
(iii) $5x^2 – 9x – 14 = 0$

ANS:
(i) $2x^2 – 2x + 1 = 0$
Here, $a = 2$, $b = –2$, $c = 1$,

D = $b^2 – 4ac = (–2)^2 – 4 \times 2 \times 1 = 8 – 8 = 0$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{-(2\sqrt{2})}{2\times 2} = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$$

(ii) $2x^2 – 11x + 9 = 0$
ANS: $2x^2 – 11x + 9 = 0$
Here, $a = 2$, $b = –11$, $c = 9$
D = $(–11)^2 – 4 \times 2 \times 9 = 121 – 72 = 49 > 0$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{11 \pm 7}{4}$$

$$x = \frac{11+7}{4}, \frac{11-7}{4}$$

$$x = \frac{9}{2}, 1$$

iii) $5x^2 – 9x – 14 = 0$
Here $a = 5$, $b = –9$, $c = –14$
D = $(–9)^2 – 4 \times 5 \times (–14) = 81 + 280 = 361 > 0$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{9+19}{10}, \frac{9-19}{10} \quad x = \frac{14}{5}, -1$$

83. Using quadratic formula solve the following quadratic equation:
i) $5x^2 – 18x – 8 = 0$ ii) $13x^2 + 9(x + 1) – (2x + 3)(x + 2) = 6$ iii) $x^2 + 3x – 28 = 0$
TRY YOURSELF…… First find D (……?)
Apply $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
ANS: $x = 4$ or $x = -\frac{2}{5}$
TRY YOURSELF……
Eqn : $11x^2 + 2x – 3 = 0$

D = $(2)^2 - 4 \times 11 \times (-3) = 4 + 132 = 136 > 0$

ANS: $\frac{-1 \pm \sqrt{34}}{11}$

TRY YOURSELF……

ANS: $x = -7 \quad x = 4$

iv) $2x^2 + 5x + 3 = 0$

TRY YOURSELF……

$x = -1, -\frac{3}{2}$

84. Determine the nature of the roots of the following quadratic equations:

(i) $2x^2$ -3x + 5 = 0 (ii) 2 x^2 -6x + 3 = 0 (iii) (3/5)x^2 – (2/3) + 1 = 0

(iv) $3x^2$ - 4√3x + 4 = 0

(i) $2x^2$ -3x + 5 =0

Solution:

Here, a = 2, b = -3, c = 5

D = $\boldsymbol{x^2} - 4ac = (-\mathbf{3})^{\mathbf{2}}$ -4(2)(5)

= 9 – 40 = -31<0

D < 0 and hence, the given equation does not have any real roots.

(ii) 2 x^2 -6x + 3=0

Solution:

Here, a= 2, b= -6, c= 3

D = (- $\mathbf{6^2}$) -4(2)(3)

= 36 – 24

= 12 > 0

D > 0 and hence, the given equation have real and distinct roots.

(iii) (3/5)x^2 – (2/3) + 1 = 0

Solution:

Here, a= 3/5, b= -2/3, c= 1

D = $\left(-\frac{2}{3}\right)^2$ - 4(3/5)(1)

= 4/9 – 12/5

= -88/45<0

It's seen that D<0 and hence, the given equation does not have any real roots.

(iv) $3x^2$ - 4√3x + 4 = 0

Solution:

Here, a= 3, b= - 4√3, c= 4

D = $\left(-4\sqrt{3}\right)^2$ -4(3)(4)

= 48 – 48

= 0

It's seen that D = 0 and hence, the given equation has only 1 real and equal root.

85. Find the values of k for which the roots are real and equal in each of the following equations:

(i) kx^2 + 4x + 1 = 0 (ii) kx^2 - 2√5x + 4 = 0 (iii) 4x^2- 3kx + 1 = 0

iv) x^2 - 2(5 + 2k)x + 3(7 + 10k) = 0

ANS: **(i) kx^2 + 4x + 1 = 0**

The given equation k x^2 + 4x + 1 = 0 is in the form of ax^2 + bx + c = 0

Where a = k, b = 4, c = 1

For the equation to have real and equal roots, the condition is

D = b^2 - 4ac = 0

$\Rightarrow 4^2 - 4(k)(1) = 0$
$\Rightarrow 16 - 4k = 0$
$\Rightarrow k = 4$
The value of k is 4.
(ii) $kx^2 - 2\sqrt{5}x + 4 = 0$
Solution:
The given equation $k\,\boldsymbol{x^2} - 2\sqrt{5}x + 4 = 0$ is in the form of $a\,\boldsymbol{x^2} + bx + c = 0$
Where a = k, b = $-2\sqrt{5}$, c = 4
For the equation to have real and equal roots, the condition is
$D = b^2 - 4ac = 0$
$\Rightarrow (-2\sqrt{5})^2 - 4(k)(4) = 0$
$\Rightarrow 20 - 16k = 0$
$\Rightarrow k = 5/4$
The value of k is 5/4.
(iii) $4x^2 - 3kx + 1 = 0$
Solution:
The given equation $4\boldsymbol{x^2} - 3kx + 1 = 0$ is in the form of $a\boldsymbol{x^2} + bx + c = 0$
Where a = 4, b = -3k, c = 1
For the equation to have real and equal roots, the condition is
$D = \boldsymbol{b^2} - 4ac = 0$
$\Rightarrow (-3k)^2 - 4(4)(1) = 0$
$\Rightarrow 9k^2 - 16 = 0$
$\Rightarrow k = \pm 4/3$
The value of k is ± 4/3.
iv) $x^2 - 2(5 + 2k)x + 3(7 + 10k) = 0$
Solution:
The given equation $x^2 - 2(5 + 2k)x + 3(7 + 10k) = 0$ is in the form of $a\,\boldsymbol{x^2} + bx + c = 0$
Where a = 1, b = -2(5 + 2k), c = 3(7 + 10k)
For the equation to have real and equal roots, the condition is
$D = \boldsymbol{b^2} - 4ac = 0$
$\Rightarrow (-2(5 + 2k))2 - 4(1)(3(7 + 10k)) = 0$
$\Rightarrow 4(5 + 2k)2 - 12(7 + 10k) = 0$
$\Rightarrow 25 + 4k2 + 20k - 21 - 30k = 0$
$\Rightarrow 4k2 - 10k + 4 = 0$
$\Rightarrow 2k2 - 5k + 2 = 0$ [dividing by 2]
Now, solving for k by factorization we have
$\Rightarrow 2k2 - 4k - k + 2 = 0$
$\Rightarrow 2k(k - 2) - 1(k - 2) = 0$
$\Rightarrow (k - 2)(2k - 1) = 0,$
k = 2 and k = 1/2,
So, the value of k can either be 2 or 1/2

86. In the following, determine the set of values of k for which the given quadratic equation has real roots:
(i) $2x^2 + 3x + k = 0$ **(**ii) $2x^2 + x + k = 0$
(i) $2x^2 + 3x + k = 0$
Solution:
Given,
$2x^2 + 3x + k = 0$
It's of the form of $a\,x^2 + bx + c = 0$

Where, a = 2, b = 3, c = k

For the given quadratic equation to have real roots D = b^2 - 4ac ≥ 0

D = 9 - 4(2)(k) ≥ 0

⇒ 9 - 8k ≥ 0

⇒ k ≤ 9/8

The value of k should not exceed 9/8 to have real roots

(ii) 2 x^2 + x + k = 0

Solution:

Given,

2 x^2 + x + k = 0

It's of the form of a x^2 + bx + c = 0

Where, a = 2, b = 1, c = k

For the given quadratic equation to have real roots D = b^2 - 4ac ≥ 0

D = 12 - 4(2)(k) ≥ 0

⇒ 1 – 8k ≥ 0

⇒ k ≤ 1/8

The value of k should not exceed 1/8 to have real roots.

87. Find the values of k for which the following equations have real and equal roots

(i) x^2– 2(k + 1)x + k^2 = 0 (ii) k^2 x^2 – 2 (2k - 1)x + 4 = 0

Solution:

Given,

x^2 – 2(k + 1)x + k^2 = 0

It's of the form of ax2 + bx + c = 0

Where, a =1, b = -2(k + 1), c = k^2

For the given quadratic equation to have real roots D = b^2 - 4ac = 0

D = $\left(-2(k\ +\ 1)\right)^2$ - 4(1)(k^2) = 0

⇒ 4 k^2 + 8k + 4 - 4 k^2 = 0

⇒ 8k + 4 = 0

⇒ k = -4/8

⇒ k = -1/2

The value of k should -1/2 to have real and equal roots.

(ii) k^2 x^2 – 2 (2k - 1)x + 4 = 0

Solution:

Given,

k^2x^2 – 2 (2k - 1)x + 4 = 0

It's of the form of a x^2 + bx + c = 0

Where, a = k^2 , b = –2 (2k - 1), c = 4

For the given quadratic equation to have real roots D = b^2 - 4ac = 0

D = $\left(-2(2k\ -\ 1)\right)^2$ - 4(4)(k^2) = 0

⇒ 4 k^2 - 4k + 1 - 4 k^2 = 0 [dividing by 4 both sides]

⇒ -4k + 1 = 0

⇒ k = 1/4

The value of k should 1/4 to have real and equal roots.

88. Find the values of k for which the given quadratic equation has real and distinct roots.

(i) k x^2 + 2x + 1 = 0 ii) k x^2 + 6x + 1 = 0

Solution:
Given,

$$k x^2 + 2x + 1 = 0$$

It's of the form of $a x^2 + bx + c = 0$
Where, a =k, b = 2, c = 1
For the given quadratic equation to have real roots
$D = b^2 - 4ac > 0$
$D = 2^2 - 4(1)(k) > 0$
$\Rightarrow 4 - 4k > 0$
$\Rightarrow 4k < 4$
$\Rightarrow k < 1$
The value of k should be lesser than 1 to have real and distinct roots.
ii) $k x^2 + 6x + 1 = 0$
Solution:
Given,
$k x^2 + 6x + 1 = 0$
It's of the form of $a x^2 + bx + c = 0$
Where, a =k, b = 6, c = 1
For the given quadratic equation to have real roots $D = b^2 - 4ac > 0$
$D = 6^2 - 4(1)(k) > 0$
$\Rightarrow 36 - 4k > 0$
$\Rightarrow 4k < 36$
$\Rightarrow k < 9$
The value of k should be lesser than 9 to have real and distinct roots.