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Exercise 4A

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Question 1: Which of the following are quadratic equations in x?

(i) $x^2 – x + 3 = 0$
(ii) $2x^2 + 5/2\ x - \sqrt{3} = 0$
(iii) $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$
(iv) $1/3x^2 + 1/5x – 2 = 0$
(v) $x^2 - 3x - \sqrt{x} + 4 = 0$
(vi) $x – 6/x = 3$
(vii) $x + 2/x = x^2$
(viii) $x^2 – 1/x^2 = 5$
(ix) $(x + 2)^3 = x^3 - 8$
(x) $(2x + 3)(3x + 2) = 6(x – 1)(x – 2)$
(xi) $(x + 1/x)^2 = 2)x + 1/x) + 3$

Solution:

A quadratic equation is an equation of the second degree.

(i)$x^2 – x + 3 = 0$

Highest Degree: 2

Quadratic equation.

(ii) $2x^2 + 5/2x - \sqrt{3} = 0$

Highest Degree: 2

Quadratic equation.

(iii) $\sqrt{2}x^2+7x+5\sqrt{2}=0$

Highest Degree: 2

Quadratic equation.

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(iv) $1/3x^2 + 1/5x – 2 = 0$

Above equation can be simplify as: $5x^2 + 3x – 2 = 0$

Highest Degree: 2

Quadratic equation.

(v) $x^2 - 3x - \sqrt{x} + 4 = 0$

Equation has a fractional power.

Not a quadratic equation.

(vi) $x – 6/x = 3$

Simply as $x^2 - 3x - 6 = 0$

Degree : 2
Quadratic equation.

(vii) $x + 2/x = x^2$

Simplify above equation:

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

Degree: 3

Not a quadratic equation.

(viii) x^2 – 1/x^2 = 5

Simplify above equation

$x^4 - 1 = 5 x^2$

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or $x^4-5x^2-1 =0$

Degree: 4

Not a quadratic equation.

(ix) (x + 2)^3 = x^3 – 8

x^3 + 8 + 6x^2 + 12x = x^3 – 8

-6x^2 + 12x + 16 = 0

Degree = 2

A quadratic equation.

(x)(2x + 3)(3x + 2) = 6(x – 1)(x – 2)

Simplify above equation:

6x^2 + 4x + 9x + 6 = 6x^2 – 12x – 6x + 12

31x – 6 = 0

Degree : 1

Not a quadratic equation

(xi)(x + 1/x)^2 = 2)x + 1/x) + 3

Simplify above equation:

(x^4 + 2x^2 + 1) / x^2 = (2x^2 + 2) / x + 3

(x^4 + 2x^2 + 1)x = x^2(2x^2 + 2) + 3

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Not a quadratic equation.

Answer: (i), (ii), (iii), (iv), (vi) and (ix) are only quadratic equations.

Question 2:
Which of the following are the roots of $3x^2 + 2x – 1=0$?
(i) -1
(ii) 1/3
(iii) -1/2

Solution:
Simplify given equation:
$3x^2 + 2x – 1 = 3x^2 + 3x – x – 1$

$= 3x (x + 1) – 1 (x + 1)$

$= (x + 1) (3x – 1)$

To find roots, put $3x^2 + 2x – 1 = 0$

Either, $x + 1 = 0$ or $3x – 1 =0$

$x = -1$ or $x = 1/3$

Therefore, (-1) and 1/3 are the required roots.

Question 3:
(i) Find the value of k for which x = 1 is a root of the equation $x^2 + kx + 3 = 0$. Also, find the other root.
(ii) Find the values of a and 6 for which x = 3/4 and x = -2 are the roots of the equation $ax^2 + bx – 6 = 0$.

Solution:

(i) x = 1 is a solution of x^2+kx+3=0, which means it must satisfy the equation.

(1)^2 + k(1) + 3 = 0

k = -4

Hence the required value of k = -4

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Find other root:

We have equation, x^2 - 4x + 3 = 0

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

x(x - 1) - 3(x - 1) = 0

(x - 1)(x - 3) = 0

either x - 1 = 0 or x - 3 = 3

x = 1 or x = 3

Other root is 3.

(ii) given equation is $ax^2 + bx - 6 = 0$

As ¾ is its root, then must satisfy the equation

$a(3/4)^2 + b(3/4) - 6 = 0$

$9a + 12b - 96 = 0$ ….(1)

Again, x = -2 is its root

$a(-2)^2 + b(-2) - 6 = 0$

$4a - 2b - 6 = 0$ …(2)

Solving (1) and (2), we get

a = 4 and b = 5

Question 4: Show that x = -bc/ad is a solution of the quadratic equation

$$ad^2\left(\frac{ax}{b}+\frac{2c}{d}\right)x + bc^2 = 0$$

Solution:

$$ad^2\left(\frac{ax}{b}+\frac{2c}{d}\right)x + bc^2 = 0$$

……(1)

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x = -bc/ad is solution of equation (1), if it satisfy the equation.

$$ad^2\left(\frac{-bc}{bd}+\frac{2c}{d}\right)\frac{b^2c^2}{a^2d^2}+bc^2=0$$

$$\left(\frac{-bcd+2bcd}{bd^2}\right)\times\frac{b^2c^2}{a}+bc^2=0$$

$$\frac{bcd}{bd^2}\times\frac{b^2c^2}{a}+bc^2=0$$

$$\frac{b^2c^3}{a}+bc^2=0$$

Which is not true.

So x = -bc/ad is not a solution of given quadratic equation.

Solve each of the following quadratic equations.

Question 5:
(2x – 3)(3x + 1) = 0

Solution:
(2x – 3)(3x + 1) = 0

Either 2x – 3 = 0 or 3x + 1 = 0

x = 3/2 or x = -1/3

Question 6:
$4x^2 + 5x = 0$

Solution:

$4x^2 + 5x = 0$

Or x (4x + 5) = 0

Either x = 0 or 4x + 5 = 0, then

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x = -5/4 or 0

Question 7: $3x^2 – 243 = 0$

Solution:

$3x^2 – 243 = 0$

or $x^2 – 81 = 0$

$(x)^2 – (9)^2 = 0$
$(x + 9) (x – 9) = 0$

Either, x + 9 = 0 or x – 9 = 0

x = -9 or 9

Question 8:
$2x^2 + x – 6 = 0$

Solution:

$2x^2 + x - 6 = 0$

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

$2x\ (x + 2) - 3(x + 2) = 0$
$(x + 2)(2x - 3) = 0$
Either $x + 2 = 0$ or $2x - 3 = 0$

x = -2 or 3/2

Question 9:
$x^2 + 6x + 5 = 0$

Solution:
x^2 + 6x + 5 = 0

x^2 + x + 5x + 5 = 0

x(x + 1) + 5(x + 1) = 0

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(x + 5)(x + 1) = 0

either x +5 = 0 or x + 1 = 0

x = -5 or -1

Question 10:
$9x^2 – 3x – 2 = 0$
Solution:
9x^2 – 3x – 2 = 0

9x^2 – 6x + 3x – 2 = 0

3x(3x -2) + (3x – 2) = 0

(3x +1)(3x – 2) = 0

either (3x +1) = 0 or (3x – 2) = 0

x = -1/3 or 2/3

Question 11:
$x^2 + 12x + 35 = 0$
Solution:

$x^2 + 12x + 35 = 0$

$x^2 + 7x + 5x + 35 = 0$

x(x + 7) + 5((x + 7) = 0

(x + 5)(x + 7) = 0

either (x + 5) = 0 or (x + 7) = 0

x = -5 or -7

Question 12:
$x^2 = 18x – 77$

Solution:

x^2 - 18x + 77 = 0

x^2 - 7x - 11x + 77 = 0

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x (x - 7) - 11(x - 7)
= 0

(x - 11)(x - 7) = 0

either (x - 11) = 0 or (x - 7) = 0

x = 11 or 7

Question 13:
$6x^2 + 11x + 3 = 0$
Solution:
6x^2 + 11x + 3 = 0

6x^2 + 2x + 9x + 3 = 0

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

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

either (2x + 3) = o or (3x + 1) = 0

x = -1/3 or -3/2

Question 14:
$6x^2 + x - 12 = 0$
Solution:

$6x^2 + x - 12 = 0$
$6x^2 + 9x - 8x - 12 = 0$

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

Either, $2x + 3 = 0$, then $2x = -3 \Rightarrow x = \frac{-3}{2}$

or $3x - 4 = 0$, then $3x = 4 \Rightarrow x = \frac{4}{3}$

$x = \frac{-3}{2}$ or $\frac{4}{3}$

Question 15:
$3x^2 - 2x - 1 = 0$

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Solution:

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

$3x(x - 1) + 1(x - 1) = 0$
$(x - 1)(3x + 1) = 0$
Either, $x - 1 = 0$, then $x = 1$
or $3x + 1 = 0$, then $x = \frac{-1}{3}$

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

Question 16:
$4x^2 - 9x = 100$

Solution:

$4x^2 - 9x = 100$
$4x^2 - 9x - 100 = 0$

$4x^2 - 25x + 16x - 100 = 0$

$x(4x - 25) + 4(4x - 25) = 0$
$(4x - 25)(x + 4) = 0$

Either, $4x - 25 = 0$, then $x = \frac{25}{4}$

or $x + 4 = 0$, then $x = -4$

$x = -4$ or $\frac{25}{4}$

Question 17:
$15x^2 - 28 = x$
Solution:

$15x^2 - 28 = x$

$15x^2 - x - 28 = 0$

$15x^2 - (21x - 20x) - 28 = 0$

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$15x^2 - 21x + 20x - 28 = 0$

$3x(5x - 7) + 4(5x - 7) = 0$

$(3x + 4)(5x - 7) = 0$

$3x + 4 = 0$ or $5x - 7 = 0$

x = -4/3 or 7/5

Question 18:

$4 - 11x = 3x^2$

Solution:

$4 - 11x = 3x^2$

$3x^2 + 11x - 4 = 0$

$3x^2 + 12x - x - 4 = 0$

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

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

Either $x + 4 = 0$ *or* $3x - 1 = 0$

x = -4 or 1/3

Question 19:
$48x^2 - 13x - 1 = 0$

Solution:

$48x^2 - 13x - 1 = 0$

$48x^2 - (16x - 3x) - 1 = 0$

$48x^2 - 16x + 3x - 1 = 0$

$16x(3x - 1) + 1(3x - 1) = 0$

$(16x + 1)(3x - 1) = 0$

Either $16x + 1 = 0$ *or* $3x - 1 = 0$

x = -1/16 or 1/3

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Question 20:
$x^2 + 2\sqrt{2}x - 6 = 0$

Solution:

$x^2 + 2\sqrt{2}x - 6 = 0$

$x^2 + 3\sqrt{2}x - \sqrt{2}x - 6 = 0$

$x(x + 3\sqrt{2}) - \sqrt{2}(x + 3\sqrt{2}) = 0$

$(x + 3\sqrt{2})(x - \sqrt{2}) = 0$

Either, $(x + 3\sqrt{2}) = 0$, then $x = -3\sqrt{2}$

or $x - \sqrt{2} = 0$, then $x = \sqrt{2}$

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

Question 21;
$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$

Solution:
$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$

$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$

$\sqrt{3}x^2 + 3x + 7x + 7\sqrt{3} = 0$

$\sqrt{3}x(x + \sqrt{3}) + 7(x + \sqrt{3}) = 0$

$(x + \sqrt{3})(\sqrt{3}x + 7) = 0$

either $\sqrt{3}x + 7 = 0$ or $x + \sqrt{3} = 0$

$x = -\sqrt{3}$ or $-7/\sqrt{3}$

Question 22:
$\sqrt{3}x^2 + 11x + 6\sqrt{3} = 0$
Solution:

$\sqrt{3}x^2 + 11x + 6\sqrt{3} = 0$

$\sqrt{3}x^2 + 9x + 2x + 6\sqrt{3} = 0$

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$\sqrt{3}$ x $(x + 3\sqrt{3}) + 2(x + 3\sqrt{3}) = 0$

$(\sqrt{3}x + 2)(x + 3\sqrt{3}) = 0$

either $(\sqrt{3}x + 2) = 0$ or $(x + 3\sqrt{3}) = 0$

$x = -3\sqrt{3}$ or $-2\sqrt{3}/3$

Question 23:

$3\sqrt{7}\,x^2 + 4x + \sqrt{7} = 0$

Solution:

$3\sqrt{7}\,x^2 + 4x - \sqrt{7} = 0$

$3\sqrt{7}\,x^2 + 4x - \sqrt{7} = 0$

$3\sqrt{7}\,x^2 - 3x + 7x - \sqrt{7} = 0$

$3x(\sqrt{7}x - 1) + \sqrt{7}(\sqrt{7}x - 1) = 0$

$(3x + \sqrt{7})(\sqrt{7}x - 1) = 0$

either $(3x + \sqrt{7}) = 0$ or $(\sqrt{7}x - 1) = 0$

$x = -\sqrt{7}/3$ or $1/\sqrt{7}$

Question 24:
$\sqrt{7}\,x^2 - 6x - 13\sqrt{7} = 0$

Solution:

$\sqrt{7}\,x^2 - 6x - 13\sqrt{7} = 0$

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$\sqrt{7}x^2 + 7x - 13x - 13\sqrt{7} = 0$

$\sqrt{7}x(x + \sqrt{7}) - 13(x + \sqrt{7}) = 0$

$(x + \sqrt{7})(\sqrt{7}x - 13) = 0$

Either, $x + \sqrt{7} = 0$, then $x = -\sqrt{7}$

or $\sqrt{7}x - 13 = 0$, then $\sqrt{7}x = 13$

$x = -\sqrt{7}$ or $\frac{13\sqrt{7}}{7}$

Question 25:
$4\sqrt{6}x^2 - 13x - 2\sqrt{6} = 0$

Solution:

$4\sqrt{6}x^2 - 13x - 2\sqrt{6} = 0$

$4\sqrt{6}x^2 - 16x + 3x - 2\sqrt{6} = 0$

$4\sqrt{2}x(\sqrt{3}x - 2\sqrt{2}) + \sqrt{3}(\sqrt{3}x - 2\sqrt{2}) = 0$

$(\sqrt{3}x - 2\sqrt{2})(4\sqrt{2}x + \sqrt{3}) = 0$

Either, $\sqrt{3}x - 2\sqrt{2} = 0$, then $\sqrt{3}x = 2\sqrt{2}$

$x = \frac{2\sqrt{6}}{3}$

and

$4\sqrt{2}x + \sqrt{3} = 0$, then $4\sqrt{2}x = -\sqrt{3}$

$x = \frac{-\sqrt{6}}{8}$

$x = \frac{2\sqrt{2}}{\sqrt{3}}$

$x = \frac{2\sqrt{6}}{3}, \frac{-\sqrt{6}}{8}$

Question 26.

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$3x^2 - 2\sqrt{6}x + 2 = 0$

Solution:

$3x^2 - 2\sqrt{6}x + 2 = 0$

$$3x^2 - \sqrt{6}x - \sqrt{6}x + 2 = 0$$

$$\sqrt{3}x(\sqrt{3}x - \sqrt{2}) - \sqrt{2}(\sqrt{3}x - \sqrt{2}) = 0$$

$$(\sqrt{3}x - \sqrt{2})(\sqrt{3}x - \sqrt{2}) = 0$$

$$\text{Either, } \sqrt{3}x - \sqrt{2} = 0, \text{ then } x = \frac{\sqrt{2}}{\sqrt{3}}$$

$$\text{or } \sqrt{3}x - \sqrt{2} = 0, \text{ then } x = \frac{\sqrt{2}}{\sqrt{3}}$$

$$x = \frac{\sqrt{2}}{\sqrt{3}} \text{ or } \frac{\sqrt{2}}{\sqrt{3}}$$

Question 27:

$\sqrt{3}x^2 - 2\sqrt{2}x - 2\sqrt{3} = 0$

Solution:

$\sqrt{3}x^2 - 2\sqrt{2}x - 2\sqrt{3} = 0$

$\sqrt{3}x^2 - 3\sqrt{2}x + \sqrt{2}x - 2\sqrt{3} = 0$

$\sqrt{3}x(x - \sqrt{6}) + \sqrt{2}(x - \sqrt{6}) = 0$

$(\sqrt{3}x + \sqrt{2})(x - \sqrt{6}) = 0$

either $(\sqrt{3}x + \sqrt{2}) = 0$ or $(x - \sqrt{6}) = 0$

$x = \sqrt{6}$ or $-\sqrt{2}/\sqrt{3}$

Question 28.

$x^2 - 3\sqrt{5}x + 10 = 0$

Solution:

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$x^2 - 3\sqrt{5}x + 10 = 0$

$x^2 - 2\sqrt{5}x - \sqrt{5}x + 10 = 0$

$x(x - 2\sqrt{5}) - \sqrt{5}(x - 2\sqrt{5}) = 0$

$(x - 2\sqrt{5})(x - \sqrt{5}) = 0$

Either, $x - 2\sqrt{5} = 0$, then $x = 2\sqrt{5}$

or $x - \sqrt{5} = 0$, then $x = \sqrt{5}$

Hence, $x = 2\sqrt{5}$ or $\sqrt{5}$

Question 29:

$x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$

Solution:

$x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$

$x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$

$x^2 - \sqrt{3}x - x + \sqrt{3} = 0$

$x(x - \sqrt{3}) - (x - \sqrt{3}) = 0$

$(x - 1)(x - \sqrt{3}) = 0$

either $(x - 1) = 0$ or $(x - \sqrt{3}) = 0$

$x = 1$ or $\sqrt{3}$

Question 30:

$x^2 + 3\sqrt{3}x - 30 = 0$

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Solution:

$x^2 + 3\sqrt{3}\, x - 30 = 0$

$x^2 + 5\sqrt{3}\, x - 2\sqrt{3} - 30 = 0$

$x(x + 5\sqrt{3}) - 2\sqrt{3}\,(x + 5\sqrt{3}) = 0$

$(x - 2\sqrt{3})(x + 5\sqrt{3}) = 0$

either $(x - 2\sqrt{3}) = 0$ or $(x + 5\sqrt{3}) = 0$

$x = -5\sqrt{3}$ or $2\sqrt{3}$

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Exercise 4B

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Solve each of the following equations by using the method of completing the square:
Question 1:
$x^2 - 6x + 3 = 0$

Solution:
$x^2 - 6x + 3 = 0$
x^2 - 6x + 3 = 0

x^2 - 6x = - 3

x^2 - 2(x)3 + 3^2 = -3 + 3^2

(adding 3^2 on both sides)

(x - 3)^2 = - 3 + 9 = 6

Using algebraic identity: a^2 - 2ab + b^2 = (a - b)^2

$x - 3 = \pm\sqrt{6}$

$x = 3 \pm \sqrt{6}$

$x = (3 + \sqrt{6})$ or $(3 - \sqrt{6})$

Question 2:
$x^2 - 4x + 1 = 0$
Solution:

x^2 - 4x + 1 = 0

x^2 - 4x = - 1

x^2 - 2(x)(2) + 2^2 = - 1 + 2^2

(adding 2^2 on both sides)

(x - 2)^2 = 3

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Using algebraic identity: a^2 - 2ab + b^2 = (a - b)^2

$x - 2 = \pm\sqrt{3} \Rightarrow x = 2 \pm \sqrt{3}$

$x = (2 + \sqrt{3})$ or $(2 - \sqrt{3})$

Question 3:
$x^2 + 8x - 2 = 0$
Solution:
x^2 + 8x – 2 = 0

x^2 + 8x = 2

x^2 - 2.x.4 + 42 = 2 + 42

(adding 2^2 on both sides)

(x + 4)^2 = 18

Using algebraic identity: a^2 - 2ab + b^2 = (a - b)^2

$x + 4 = \pm 3\sqrt{2}$

$x = -4 \pm 3\sqrt{2}$

$x = (-4 + 3\sqrt{2})$ or $(-4 - 3\sqrt{2})$

Question 4:
$4x^2 + 4\sqrt{3}x + 3 = 0$
Solution:

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$4x^2 + 4\sqrt{3}\,x + 3 = 0$

$(2x)^2 + 2 \times 2x \times \sqrt{3} = -3$

Adding $(\sqrt{3})^2$ to both sides,

$(2x)^2 + 2 \times 2x \times \sqrt{3} + (\sqrt{3})^2 = -3 + (\sqrt{3})^2$

$(2x + \sqrt{3})^2 = -3 + \sqrt{3} = 0$

$2x + \sqrt{3} = 0 \Rightarrow 2x = -\sqrt{3}$

So,

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

Question 5:
$2x^2 + 5x - 3 = 0$
Solution:
2x^2 + 5x - 3 = 0

4x^2 + 10x - 6 = 0
(multiplying both sides by 2)

4x^2 + 10x = 6

(adding (5/2)^2 on both sides)

(2x + 5/2)^2 = 6 + 25/4 = 49/4

Using algebraic identity: a^2 - 2ab + b^2 = (a - b)^2

Taking square root,

$2x + \frac{5}{2} = \pm\frac{7}{2}$

2x + 5/2 = 7/2 or 2x + 5/2 = -7/2

x = 1/2 or -3

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Question 6:
$3x^2 – x – 2 = 0$
Solution:

3x^2 - x - 2 = 0

9x^2 - 3x - 6 = 0
(multiplying both sides by 3)

9x^2 - 3x = 6

Adding (1/2)^2 on both the sides.

$$(3x)^2 - 2.3x.\frac{1}{2} + \left(\frac{1}{2}\right)^2 = 6 + \left(\frac{1}{2}\right)^2$$

$$\left(3x - \frac{1}{2}\right)^2 = 6 + \frac{1}{4} = \frac{25}{4} = \left(\frac{5}{2}\right)^2$$

3x - 1/2 = 5/2 or 3x - 1/2 = -5/2

x = 1 or x = -2/3

Question 7:
$8x^2 – 14x – 15 = 0$
Solution:

8x^2 - 14x - 15 = 0

16x^2 - 28x - 30 = 0
(multiplying both sides by 2)
Adding (7/2)^2 on both the sides

$$(4x)^2 - 2.4x.\frac{7}{2} + \left(\frac{7}{2}\right)^2 = 30 + \left(\frac{7}{2}\right)^2$$

$$\left(4x - \frac{7}{2}\right)^2 = 30 + \frac{49}{4} = \frac{169}{4} = \left(\frac{13}{2}\right)^2$$

4x - 7/2 = 13/2 or 4x - 7/2 = -13/2

x = 5/2 or x = -3/4

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Question 8:
$7x^2 + 3x - 4 = 0$
Solution:

7x^2 + 3x - 4 = 0

49x^2 + 21x - 28 = 0
(multiplying both sides by 7)

Adding (3/2)^2 on both the sides,

$$(7x)^2 + 2.7x.\frac{3}{2} + \left(\frac{3}{2}\right)^2 = 28 + \left(\frac{3}{2}\right)^2$$

$$\left(7x + \frac{3}{2}\right)^2 = 28 + \frac{9}{4} = \frac{121}{4} = \left(\frac{11}{2}\right)^2$$

7x + 3/2 = 11/2 or 7x + 3/2 = -11/2

x = -1 or x = 4/7

Question 9:
$3x^2 - 2x - 1 = 0$
Solution:

3x^2 - 2x - 1 = 0

9x^2 - 6x = 3

(multiplying both sides by 3)

Adding (1)^2 on both the sides

(3x)^2 - 2.3x.1 + (1)^2 = 3 + (1)^2

(3x - 1)^2 = 2^2

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

x = -1 or x = -1/3

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RS Aggarwal Solutions for Class 10 Maths Chapter 4 Quadratic Equations

Question 10:
$5x^2 - 6x - 2 = 0$
Solution:

5x^2 - 6x - 2 = 0

25x^2 - 30x - 10 = 0
(multiplying both sides by 5)

25x^2 - 30x = 10

Adding (3)^2 both the sides

$$(5x)^2 - 2.5x.3 + (3)^2 = 10 + (3)^2$$

$$(5x - 2)^2 = 10 + 9 = 19$$

5x - 3 = √19 or 5x - 3 = -√19

x = (3 + √19)/5 or x = (3 - √19)/5

Question 11:

2/x^2 - 5/x + 2 = 0
Solution:

2/x^2 - 5/x + 2 = 0

$$\frac{2 - 5x + 2x^2}{x^2} = 0$$

2x^2 - 5x + 2 = 0

4x^2 - 10x = - 4 (multiplying both sides by 2)

Adding (5/2)^2 both the sides

$$(2x)^2 - 2.2x.\frac{5}{2} + \left(\frac{5}{2}\right)^2 = -4 + \left(\frac{5}{2}\right)^2$$

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$$(2x)^2 - 2.2x.\frac{5}{2} + \left(\frac{5}{2}\right)^2 = -4 + \left(\frac{5}{2}\right)^2$$

2x - 5/2 = 3/2 or 2x - 5/2 = -3/2

x = 2 or x = 1/2

Question 12:
$4x^2 + 4bx - (a^2 - b^2) = 0$
Solution:

$$4x^2 + 4bx - (a^2 - b^2) = 0$$

$$x^2 + bx - \frac{a^2 - b^2}{4} = 0$$

(Dividing by 4)

Adding (b/2)^2 both sides,

$$(x)^2 + 2 \times x + \frac{b}{2} + \left(\frac{b}{2}\right)^2$$

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

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

x + b/2 = a/2 or x + b/2 = -a/2

x = (a-b)/2 or x = -(a+b)/2

Question 13:
$x^2 - (\sqrt{2} + 1)x + \sqrt{2} = 0$
Solution:

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$x^2 - (\sqrt{2} + 1)x + \sqrt{2} = 0$

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

Adding, $\left(\frac{\sqrt{2}+1}{2}\right)^2$ to both sides

$x^2 - 2\left(\frac{\sqrt{2}+1}{2}\right)x + \left(\frac{\sqrt{2}+1}{2}\right)^2$

$= -\sqrt{2} + \left(\frac{\sqrt{2}+1}{2}\right)^2$

$\left(x - \frac{\sqrt{2}+1}{2}\right)^2 = \frac{-\sqrt{2}}{1} + \frac{2+1+2\sqrt{2}}{4}$

$= \frac{-4\sqrt{2}+2+1+2\sqrt{2}}{4} = \frac{2+1-2\sqrt{2}}{4}$

$= \left(\pm\frac{\sqrt{2}-1}{2}\right)^2$

$x = \frac{\sqrt{2}+1}{2} \pm \frac{\sqrt{2}-1}{2}$

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$$x = \frac{\sqrt{2}+1}{2} \pm \frac{\sqrt{2}-1}{2}$$

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

$$\text{or } x = \frac{\sqrt{2}+1-\sqrt{2}+1}{2} = \frac{2}{2} = 1$$

$x = 1$ or $\sqrt{2}$

Question 14:
$\sqrt{2}\,x^2 - 3x - 2\sqrt{2} = 0$
Solution:

$\sqrt{2}\,x^2 - 3x - 2\sqrt{2} = 0$

Dividing each side by $\sqrt{2}$

$$x^2 - \frac{3}{\sqrt{2}}x - 2 = 0$$

$$(x)^2 - 2 \times x \times \frac{3}{2\sqrt{2}} = 2$$

Adding, $\left(\frac{3}{2\sqrt{2}}\right)^2$ to both sides,

$$(x)^2 - 2 \times x \times \frac{3}{2\sqrt{2}} + \left(\frac{3}{2\sqrt{2}}\right)^2$$

$$= 2 + \left(\frac{3}{2\sqrt{2}}\right)^2$$

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$$\left(x-\frac{3}{2\sqrt{2}}\right)^2 = 2+\frac{9}{8} = \frac{25}{8} = \left(\pm\frac{5}{2\sqrt{2}}\right)^2$$

$$x-\frac{3}{2\sqrt{2}} = \left(\pm\frac{5}{2\sqrt{2}}\right)$$

$$x = \frac{3}{2\sqrt{2}} \pm \frac{5}{2\sqrt{2}}$$

$$x = \frac{3}{2\sqrt{2}} + \frac{5}{2\sqrt{2}} = \frac{8}{2\sqrt{2}} = \frac{4}{\sqrt{2}}$$

$$= \frac{4\sqrt{2}}{\sqrt{2}\times\sqrt{2}} = 2\sqrt{2}$$

$$\text{or } x = \frac{3}{2\sqrt{2}} - \frac{5}{2\sqrt{2}} = \frac{-2}{2\sqrt{2}} = \frac{-1}{\sqrt{2}} = \frac{\sqrt{2}}{4}$$

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

Question 15:
$\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$
Solution:

$\sqrt{3}x^2 + 10x - 7\sqrt{3} = 0$

Dividing each side by $\sqrt{3}$

$$x^2 + \frac{10}{\sqrt{3}}x + 7 = 0$$

$$(x)^2 + 2\times x \times \frac{5}{\sqrt{3}} = -7$$

Adding, $\left(\frac{5}{\sqrt{3}}\right)^2$ to both sides

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$$(x)^2 + 2 \times x \times \frac{5}{\sqrt{3}} + \left(\frac{5}{\sqrt{3}}\right)^2 = -7 + \left(\frac{5}{\sqrt{3}}\right)^2$$

$$\left(x + \frac{5}{\sqrt{3}}\right)^2 = -7 + \frac{25}{3}$$

$$= \frac{-21 + 25}{3} = \frac{4}{3} = \left(\pm\frac{2}{\sqrt{3}}\right)^2$$

$$x + \frac{5}{\sqrt{3}} = \pm\frac{2}{\sqrt{3}}$$

$$x = \frac{-5}{\sqrt{3}} \pm \frac{2}{\sqrt{3}}$$

$$x = -\sqrt{3} \text{ or } \frac{-7}{\sqrt{3}}$$

Question 16:
By using the method of completing the square, show that the equation $2x^2 + x + 4 = 0$ has no real roots:
Solution:
2x^2 + x + 4 = 0
4x^2 + 2x + 8 = 0
(multiplying both sides by 2)
4x^2 + 2x = - 8
Adding (1/2)^2 both sides

$$(2x)^2 + 2.2x.\frac{1}{2} + \left(\frac{1}{2}\right)^2 = -8 + \left(\frac{1}{2}\right)^2$$

$$\left(2x + \frac{1}{2}\right)^2 = -8 + \frac{1}{4} = -\frac{31}{4} < 0$$

But (2x + 1/2)^2 cannot be negative for any real value of x

The given equation has no real roots.

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Exercise 4C

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Find the discriminant of each of the following equations:

Question 1:
(i) $2x^2 – 7x + 6 = 0$
(ii) $3x^2 – 2x + 8 = 0$
(iii) $2x^2 – 5\sqrt{2}x + 4 = 0$
(iv) $\sqrt{3}x^2 + 2\sqrt{2}x – 2\sqrt{3} = 0$
(v) $(x – 1)(2x – 1) = 0$
(vi) $1 – x = 2x^2$

Solution:
(i) $2x^2 – 7x + 6 = 0$

Compare given equation with the general form of quadratic equation, which is
ax^2 + bx + c = 0

Here, a = 2, b = -7 and c = 6

Discriminant formula: D = b^2 - 4ac

(-7)^2 - 4 x 2 x 6

= 1

(ii) $3x^2 – 2x + 8 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

Here, a = 3, b = – 2, c = 8

Discriminant formula: D = b^2 - 4ac

= (– 2)^2 – 4.3.8

= 4 – 96

= – 92

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(iii) $2x^2 – 5\sqrt{2}x + 4 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

Here, a = 2, b = $– 5\sqrt{2}$, c = 4

Discriminant formula: D = b^2 - 4ac

= $(– 5\sqrt{2})^2 – 4.2.4$

= 50 - 32

= 18

(iv) $\sqrt{3}\ x^2 + 2\sqrt{2}\ x – 2\sqrt{3} = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

Here, a = $\sqrt{3}$, b = $2\sqrt{2}$, c = $– 2\sqrt{3}$

Discriminant formula: D = b^2 - 4ac

= $(2\sqrt{2})^2 – 4(\sqrt{3})(– 2\sqrt{3})$

= 32

(v) (x – 1) (2x – 1) = 0

2x^2 – 3x + 1 = 0

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

Here, a = 2, b = -3, c = –1

Discriminant formula: D = b^2 - 4ac

= (-3)^2 – 4x2x1

= 1

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(vi) $1 – x = 2x^2$

$1 – x = 2x^2$

$2x^2 + x – 1 = 0$

Compare given equation with the general form of quadratic equation, which is $ax^2 + bx + c = 0$

Here, $a = 2, b = 1, c = –1$

Discriminant formula: $D = b^2 - 4ac$

$= (1)^2 – 4x2x-1$

$= 9$

Find the roots of each of the following equations, if they exist, by applying the quadratic formula:

Question 2:
$x^2 – 4x – 1 = 0$

Solution:

$x^2 – 4x – 1 = 0$

Compare given equation with the general form of quadratic equation, which is $ax^2 + bx + c = 0$

Here, $a = 1, b = -4, c = –1$

Find Discriminant:

$D = b^2 - 4ac$

$= (-4)^2 – 4x1x-1$

$= 20 > 0$

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

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$$x = \frac{-(-4)) \pm \sqrt{20}}{2 \times 1}$$

$$= \frac{4 \pm 2\sqrt{5}}{2}$$

$$= 2 \pm \sqrt{5}$$

Therefore, x = 2 + √5 and x = 2 - √5

Question 3:

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

Solution:

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 1, b = -6, c = 4

Find Discriminant:

D = b^2 - 4ac

= (-6)^2 – 4.1.4

= 36 - 16

= 20 > 0

Roots of equation are real.

Find the Roots:

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

$$= \frac{-(-6) \pm \sqrt{20}}{2 \times 1} = \frac{6 \pm 2\sqrt{5}}{2}$$

$$= 3 \pm \sqrt{5}$$

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x = 3 + √5 and x = 3 – √5

Question 4:
$2x^2 + x - 4 = 0$

Solution:

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2, b = 1, c = -4

Find Discriminant:

D = b^2 - 4ac

= (1)^2 – 4.2.-4

= 1 + 32

= 33 > 0

Roots of equation are real.

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

$$= \frac{-1 \pm \sqrt{33}}{4}$$

Root are:

$$x = \frac{(-1 + \sqrt{33})}{4}$$

and

$$x = \frac{(-1 - \sqrt{33})}{4}$$

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Question 5:
$25x^2 + 30x + 7 = 0$

Solution:

$25x^2 + 30x + 7 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 25, b = 30, c = 7

Find Discriminant:

D = b^2 - 4ac

= (30)^2 – 4.25.7

= 900 – 700

= 200 > 0

Roots of equation are real.

Find the Roots:

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

$$x = \frac{-30 \pm \sqrt{200}}{2 \times 25}$$

$$= \frac{-30 \pm 10\sqrt{2}}{50}$$

$$= \frac{-3 \pm \sqrt{2}}{5}$$

Roots of the equations are:

$$x = \frac{-3+\sqrt{2}}{5}$$

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And

$$x = \frac{-3-\sqrt{2}}{5}$$

Question 6:
$16x^2 = 24x + 1$

Solution:
$16x^2 - 24x - 1 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 16 , b = -24, c = -1

Find Discriminant:

D = b^2 - 4ac

= (-24)^2 – 4.16.-1

= 576 + 64

= 640 > 0

Roots of equation are real.

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

$$= \frac{3 \pm \sqrt{10}}{4}$$

Roots are:

$$x = \frac{3+\sqrt{10}}{4} \text{ or } x = \frac{3-\sqrt{10}}{4}$$

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Question 7:
$15x^2 - 28 = x$

Solution:

$15x^2 - x - 28 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 15, b =-1 , c = -28

Find Discriminant:

D = b^2 - 4ac

= (-1)^2 – 4.15.(-28)

= 1 + 1680

= 1681 > 0

Roots of equation are real.

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

$$= \frac{-(-1) \pm \sqrt{1681}}{2 \times 15} = \frac{1 \pm 41}{30}$$

X = 7/5 and x = -4/3

Question 8:
$2x^2 - 2\sqrt{2}x + 1 = 0$

Solution:
$2x^2 - 2\sqrt{2}x + 1 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2, b = $-2\sqrt{2}$, c = 1

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Find Discriminant:

D = b^2 - 4ac

= (– 2√2)^2 – 4.2.1

= 8 - 8

= 0

Equation has equal root.

Find roots:

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

$$= \frac{2\sqrt{2} \pm 0}{4} = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$$

x = 1/√2 and x = 1/√2

Question 9:
√2 x² + 7x + 5√2 = 0

Solution:

√2 x² + 7x + 5√2 = 0

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = √2 , b = 7 , c = 5√2

Find Discriminant:

D = b^2 - 4ac

= (7)^2 – 4. √2 . 5√2

= 49 - 40

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= 9> 0

Roots of equation are real.

Find roots:

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

$$= \frac{-7 \pm \sqrt{9}}{2 \times \sqrt{2}} = \frac{-7 \pm 3}{2\sqrt{2}}$$

Roots are:

x = - √2 and x = -5/√2

Question 10:
√3 x² + 10x – 8√3 = 0

Solution:

√3 x² + 10x – 8√3 = 0

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = √3, b = 10 , c = – 8√3

Find Discriminant:

D = b^2 - 4ac

= (10)^2 – 4. √3 . – 8√3

= 100 + 96

= 196 > 0

Roots of equation are real.

Find roots:

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

$$= \frac{-10 \pm \sqrt{196}}{2 \times \sqrt{3}} = \frac{-10 \pm 14}{2\sqrt{3}}$$

Roots are:

x = 2√3/3 and x = -4√3

Question 11:
√3 x² – 2√2 x – 2√3 = 0

Solution:

√3 x² – 2√2 x – 2√3 = 0

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = √3 , b = – 2√2, c = – 2√3

Find Discriminant:

D = b^2 - 4ac

= (– 2√2)^2 – 4. √3 . – 2√3

= 8 + 24

= 32 > 0

Roots of equation are real.

Find roots:

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

$$= \frac{2\sqrt{2} \pm 4\sqrt{2}}{2\sqrt{3}}$$

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x = √6 and x = -√2/√3

Question 12:
$2x^2 + 6\sqrt{3}x - 60 = 0$

Solution:

$2x^2 + 6\sqrt{3}x - 60 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2, b = 6√3, c = – 60

Find Discriminant:

D = b^2 - 4ac

= (6√3)^2 – 4.2. – 60

= 108 + 480

= 588 > 0

Roots of equation are real.

Find roots:

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

$$= \frac{-6\sqrt{3} \pm \sqrt{196 \times 3}}{2 \times 2}$$

$$= \frac{-3\sqrt{3} \pm 7\sqrt{3}}{2}$$

Roots are:

x = 2√3 and x = -5√3

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Question 13:
$4\sqrt{3}\,x^2 + 5x - 2\sqrt{3} = 0$

Solution:

$4\sqrt{3}\,x^2 + 5x - 2\sqrt{3} = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

$a = 4\sqrt{3}$, b = 5, $c = -2\sqrt{3}$

Find Discriminant:

D = b^2 - 4ac

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

= 25 + 96

= 121 > 0

Roots of equation are real.

Find roots:

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

$$= \frac{-5 \pm \sqrt{121}}{2 \times 4\sqrt{3}} = \frac{-5 \pm 11}{8\sqrt{3}}$$

Roots are:

x = √3/4 and x = -2/√3

Question 14:
$3x^2 - 2\sqrt{6}\,x + 2 = 0$

Solution:

$3x^2 - 2\sqrt{6}\,x + 2 = 0$

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Compare given
equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 3, b = – 2√6 , c = 2

Find Discriminant:

D = b^2 - 4ac

= (– 2√6)^2 – 4. 3 . 2

= 24 - 24

= 0

Roots of equation are equal.

Find roots:

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

$$= \frac{-(-2\sqrt{6}) \pm \sqrt{0}}{2 \times 3}$$

$$= \frac{2\sqrt{6}}{6}$$

Roots are:

x = √2/√3 and x = x = √2/√3

Question 15:
$2\sqrt{3}x^2 - 5x + \sqrt{3} = 0$

Solution:

$2\sqrt{3}x^2 - 5x + \sqrt{3} = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2√3, b = – 5 , c = √3

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Find Discriminant:

D = b^2 - 4ac

= (– 5)^2 – 4. 2√3 . √3

= 25 - 24

= 1 > 0

Roots of equation are real.

Find roots:

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

$$= \frac{-(-5) \pm \sqrt{1}}{2 \times 2\sqrt{3}} = \frac{5 \pm 1}{4\sqrt{3}}$$

Roots are:

x = √3/2 and x = 1/√3

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Exercise 4D

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Question 1:
Find the nature of the roots of the following quadratic equations:
(i) $2x^2 - 8x + 5 = 0$
(ii) $3x^2 - 2\sqrt{6}x + 2 = 0$
(iii) $5x^2 - 4x + 1 = 0$
(iv) $5x(x - 2) + 6 = 0$
(v) $12x^2 - 4\sqrt{15}x + 5 = 0$
(vi) $x^2 - x + 2 = 0$

Solution:

(i)$2x^2 - 8x + 5 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2, b = – 8, c = 5

Using Discriminant Formula:

D = b^2 – 4ac
= (– 8)^2 – 4.2.5
= 64 – 40
= 24 > 0

Hence the roots of equation are real and unequal.

(ii) $3x^2 - 2\sqrt{6}x + 2 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 3, b = – 2√6, c = 2

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Using Discriminant Formula:

D = b^2 – 4ac
= (– 2√6)^2 – 4.3.2
=24 - 24
= 0
Roots of equation are real and equal.

(iii) $5x^2 – 4x + 1 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 5, b = – 4, c = 1

Discriminant:
D = b^2 – 4ac
= (– 4)^2 – 4.5.1
= 16 – 20
= – 4 < 0
Equation has no real roots.

(iv) 5x (x – 2) + 6 = 0
5x^2 – 10x + 6 = 0

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 5, b = – 10, c = 6

Discriminant:
D = b^2 – 4ac
= (– 10)2 – 4.5.6

= 100 – 120

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= – 20 < 0

Equation has no real roots.

(v) $12x^2 – 4\sqrt{15}\,x + 5 = 0$

$12x^2 – 4\sqrt{15}\,x + 5 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 12, b = – 4√15, c = 5

Discriminant:
D = b^2 – 4ac
= (– 4√15)^2 – 4.12.5

= 240 - 240

= 0

Equation has real and equal roots.

(vi) $x^2 – x + 2 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 1, b = – 1, c = 2

Discriminant:
D = b^2 – 4ac
= (– 1)^2 – 4.1.2
= 1 – 8
= – 7 < 0

Equation has no real roots.

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Question 2:
If a and b are distinct real numbers, show that the quadratic equation $2(a^2 + b^2) x^2 + 2 (a + b) x + 1 = 0$ has no real roots:
Solution:
$2(a^2 + b^2) x^2 + 2 (a + b) x + 1 = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 2 (a^2 + b^2), b = 2(a + b), c = 1

Discriminant:
D = b^2 – 4ac

=[2(a + b)]^2 – 4. 2 (a^2 + b^2).1

= 4a^2 + 4b^2 + 8ab – 8a^2 – 8b^2
= – 4a^2 – 4b^2 + 8ab
= – 4(a^2 + b^2 – 2ab)
= – 4(a – b)^2
< 0

Hence the equation has no real roots.

Question 3:
Show that the roots of the equation $x^2 + px – q^2 = 0$ are real for all real values of p and q
Solution:
$x^2 + px – q^2 = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

$a = 1, b = p, c = -q^2$

Using discriminant formula:

$D = b^2 – 4ac$

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$= (p)^2 - 4 \times 1 \times (-q^2)$
$= p^2 + 4q^2$
> 0

Hence roots are real for all real values of p and q.

Question 4:
For what values of k are the roots of the quadratic equation $3x^2 + 2kx + 27 = 0$ real and equal?
Solution:
$3x^2 + 2kx + 27 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 3, b = 2k, c = 27

Find discriminant:

$D = b^2 - 4ac$
$= (2k)^2 - 4 \times 3 \times 27$
$= (2k)^2 - 324$
>0
Roots are real and equal

Find the value of k:

$(2k)^2 - 324 = 0$
$(2k)^2 - (18)^2 = 0$
$(k)^2 - (9)^2 = 0$
$(k + 9)(k - 9) = 0$

Either $k + 9 = 0$ or $k - 9 = 0$

$k = -9$ or $k = 9$

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Hence, the value of k is k = 9 or -9

Question 5:
For what values of k are the roots of the quadratic equation kx (x – 2√5) + 10 = 0 real and equal?
Solution:

kx (x – 2√5) x + 10 = 0

$kx^2 – 2\sqrt{5}\, kx + 10 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = k, b = $-2\sqrt{5}$ k, c = 10

Find discriminant:

$D = b^2 – 4ac$

$= (-2\ k)^2 – 4 \times k \times 10 = 20k^2 – 40k$

Since roots are real and equal (given), put D = 0

$20k^2 – 40k = 0$
$k^2 – 2k = 0$
$k (k – 2) = 0$
Either, k = 0 or k – 2 = 0

Hence k = 0 or k = 2

Question 6:
For what values of p are the roots of the equation $4x^2 + px + 3 = 0$ real-and equal?
Solution:
$4x^2 + px + 3 = 0$

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Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 4, b = p, c = 3

Find discriminant:

$D = b^2 - 4ac$
$= p^2 - 4 \times 4 \times 3$
$= p^2 - 48$
Since roots are real and equal (given)
Put D = 0
$p^2 - 48 = 0$
$p^2 = 48 = (\pm 4\sqrt{3})^2$
$p = \pm 4\sqrt{3}$
Hence $p = 4\sqrt{3}$ or $p = -4\sqrt{3}$

Question 7:
Find the nonzero value of k for which the roots of the quadratic equation $9x^2 - 3kx + k - 0$ are real and equal.
Solution:

$9x^2 - 3kx + k = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0
Here a = 9, b = -3k, c = k

Find discriminant:

$D = b^2 - 4ac$
$= (-3k)^2 - 4 \times 9 \times k$
$= 9k^2 - 36k$
Since roots are real and equal (given)
Put D = 0
$9k^2 - 36k = 0$
$9k(k - 4) = 0$

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Either, k = 0 or k – 4 = 0

As, value of k is non-zero:

So, k = 4

Question 8:
(i) Find the values of k for which the quadratic equation $(3k + 1) x^2 + 2 (k + 1) x + 1 = 0$ has real and equal roots
(ii) Find the value of k for which the equation $x^2 + k (2x + k – 1) + 2 = 0$ has real and equal roots

Solution:

(i) $(3k + 1) x^2 + 2(k + 1) x + 1 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = (3k + 1), b = 2(k + 1), c = 1

Find discriminant:

$D = b^2 – 4 ac$
$= (2(k + 1))^2 – 4(3k + 1) \times 1$
$= 4k^2 + 4 + 8k – 12k – 4$
$= 4k (k – 1)$

Since roots are real and equal (given)
Put D = 0
4k (k – 1) = 0
Either, k = 0 or k – 1 = 0

k = 0, k = 1

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(ii) $x^2 + k(2x + k – 1) + 2 = 0$
Simplify above equation:
$x^2 + 2kx + (k^2 – k + 2) = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

Here, $a = 1$, $b = 2k$, $c = (k^2 – k + 2)$

Find Discriminant:

$D = b^2 – 4ac$
$= (2k)^2 – 4 \times 1 \times (k^2 – k + 2)$
$= 4k^2 – 4k^2 + 4k – 8$
$= 4k – 8$
Since roots are real and equal (given)
Put $D = 0$
$4k – 8 = 0$
$k = 2$
Hence, the value of k is 2.

Question 9:
Find the values of p for which the quadratic equation $(2p + 1) x^2 – (7p + 2) x + (7p – 3) = 0$ has real and equal roots.
Solution:

$(2p + 1) x^2 – (7p + 2) x + (7p – 3) = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

$a = (2p + 1)$, $b = – (7p + 2)$ and $c = (7p – 3)$

Discriminant:
$D = b^2 – 4ac$

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= (– (7p + 2))^2 – 4.(2p + 1).(7p – 3)

= (49p^2 + 28p + 4) – 4(14p^2 + p – 3)

= 49p^2 + 28p + 4 – 56p^2 – 4p + 12

= - 7p2 + 24p + 16

Since roots are real and equal (given)
Put D = 0

7p^2 – 24p – 16 = 0

7p^2 – 28p + 4p – 16 = 0

7p(p – 4) + 4(p – 4) = 0

(7p + 4)(p – 4) = 0

Either (7p + 4) = 0 or (p – 4) = 0

p = -4/7 or p = 4

Question 10:
Find the values of p for which the quadratic equation $(p + 1)x^2 – 6(p + 1)x + 3(p + 9) = 0$, $p \neq -1$ has equal roots: Hence, find the roots of the equation.
Solution:
The given quadratic equation is
$(p + 1)x^2 – 6(p + 1)x + 3(p + 9) = 0$, $p \neq -1$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = (p + 1), b = – 6(p + 1) and c = 3(p + 9)

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Discriminant:
D = b^2 – 4ac

= (-6(p + 1))^2 – 4.(p + 1).3(p + 9)

= 36(p + 1)(p + 1) – 12(p + 1)(p + 9)

= 12(p + 1) (3p + 3 – p – 9)

= 12(p + 1)(2p – 6)

Since roots are real and equal (given)
Put D = 0

12(p + 1)(2p – 6) = 0

either (p + 1) = 0 or (2p – 6) = 0

p = -1 or p = 3

Question 11:
If -5 is a root of the quadratic equation $2x^2 + px – 15 = 0$ and the quadratic equation $p(x^2 + x) + k = 0$ has equal roots, find the value of k.
Solution:

Given: -5 is a root of the quadratic equation $2x^2 + px – 15 = 0$

Substitute the value of x = -5

$2(-5)^2 + p(-5) – 15 = 0$
$50 – 5p – 15 = 0$
$35 – 5p = 0$
$p = 7$

Again,
In quadratic equation $p(x^2 + x) + k = 0$
$7 (x^2 + x) + k = 0$ (put value of p = 7)

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$7x^2 + 7x + k = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 7, b = 7, c = k

Find Discriminant:
$D = b^2 - 4ac$
$= (7)^2 - 4 \times 7 \times k$
$= 49 - 28k$
Since roots are real and equal, put $D = 0$
$49 - 28k = 0$
$28k = 49$
$k = 7 / 4$

The value of k is 7/4

Question 12:
If 3 is a root of the quadratic equation $x^2 - x + k - 0$, find the value of p so that the roots of the equation $x^2 + k (2x + k + 2) + p = 0$ are equal.
Solution:
Given: 3 is a root of equation $x^2 - x + k = 0$

Substitute the value of x = 3
$(3)^2 - (3) + k = 0$
$9 - 3 + k = 0$
$k = -6$

Now, $x^2 + k (2x + k + 2) + p = 0$

$x^2 + (-6)(2x - 6 + 2) + p = 0$
$x^2 - 12x + 36 - 12 + p = 0$
$x^2 - 12x + (24 + p) = 0$

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Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0
a = 1, b = -12, c = 24 + p

Find Discriminant:
$D = b^2 - 4ac$
$= (-12)^2 - 4 \times 1 \times (24 + p)$
$= 144 - 96 - 4p = 48 - 4p$

Since roots are real and equal, put $D = 0$

$48 - 4p = 0$
$4p = 48$
$p = 12$

The value of p is 12.

Question 13:
If -4 is a root of the equation $x^2 + 2x + 4p = 0$, find the value of k for which the quadratic equation $x^2 + px (1 + 3k) + 7 (3 + 2k) = 0$ has equal roots.
Solution:
Given: -4 is a root of the equation $x^2 + 2x + 4p = 0$

Substitute the value of x = -4
$(-4)^2 + 2(-4) + 4p = 0$
$16 - 8 + 4p = 0$
$8 + 4p = 0$
$4p = -8$
or $p = -2$
In the quadratic equation $x^2 + px (1 + 3k) + 7(3 + 2k) = 0$
$x^2 - 2x (1 + 3k) + 7(3 + 2k) = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

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a = 1, b = -2 (1 + 3k), c = 7 (3 + 2k)

Find Discriminant:
$D = b^2 - 4ac$
$= (-2(1 + 3k))^2 - 4 \times 1 \times 7(3 + 2k)$
$= 4(1 + 9k^2 + 6k) - 28(3 + 2k)$
$= 36k^2 - 32k - 80$

Since roots are real and equal, put $D = 0$

$36k^2 - 32k - 80 = 0$
$9k^2 - 8k - 20 = 0$
$9k^2 - 18k + 10k - 20 = 0$
$9k (k - 2) + 10(k - 2) = 0$
$(k - 2) (9k + 10) = 0$
Either, $k - 2 = 0$ or $9k + 10 = 0$

$k = 2$ or $k = -10/9$

Question 14:
If the quadratic equation $(1 + m^2) x^2 + 2mcx + c^2 - a^2 = 0$ has equal roots, prove that $c^2 = a^2 (1 + m^2)$.
Solution:
$(1 + m^2) x^2 + 2mcx + c^2 - a^2 = 0$

Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = (1 + m^2), b = 2mc and c = c^2 – a^2

Since roots are equal, so D = 0

$(2mc)^2 - 4.(1 + m^2)(c^2 - a^2) = 0$

$4 m^2c^2 - 4c^2 + 4a^2 - 4 m^2c^2 + 4 m^2a^2 = 0$

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$a^2 + m^2a^2 = c^2$

or $c^2 = a^2 (1 + m^2)$

Hence Proved

Question 15:
If the roots of the equation $(c^2 – ab) x^2 – 2(a^2 – bc)x + (b^2 – ac) = 0$ are real and equal, show that either a = 0 or $(a^3 + b^3 + c^3) = 3abc$
Solution:
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = (c^2 – ab) b = – 2(a^2 – bc) c = (b^2 – ac)

Since roots are equal, so D = 0

$(– 2(a^2 – bc))^2 – 4(c^2 – ab) (b^2 – ac) = 0$

$4(a^4 – 2a^2bc + b^2c^2) – 4(b^2c^2 – ac^3 – ab3 + a^2bc) = 0$

$a^4 – 3a^2bc + ac^3 + ab^3 = 0$

$a (a^3 – 3abc + c^3 + b^3) = 0$

either a = 0 or $(a^3 – 3abc + c^3 + b^3) = 0$

a = 0 or $a^3 + c^3 + b^3 = 3abc$

Hence Proved.

Question 16:
Find the values of p for which the quadratic equation $2x^2 + px + 8 = 0$ has real roots.
Solution:

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$2x^2 + px + 8 = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0
a = 2, b = p, c = 8

Find D:

$D = b^2 - 4ac$

$= p^2 - 4 \times 2 \times 8$

$= p^2 - 64$
Since roots are real, so $D \geq 0$

$p^2 - 64 \geq 0$
$p^2 \geq 64$
$\geq (\pm 8)^2$

Either $p \geq 8$ or $p \leq -8$

Question 17:
Find the value of a for which the equation $(\alpha - 12)\, x^2 + 2(\alpha - 12)\, x + 2 = 0$ has equal roots.
Solution:

$(\alpha - 12)\, x^2 + 2(\alpha - 12)\, x + 2 = 0$
Roots of given equation are equal (given)
So, D = 0
$4(\alpha - 12)\,(\alpha - 14) = 0$
$\alpha - 14 = 0$ $\{(\alpha - 12) \neq 0\}$
$\alpha = 14$
Hence the value of α is 14

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Question 18:
Find the value of k for which the roots of $9x^2 + 8kx + 16 = 0$ are real and equal.
Solution:
$9x^2 + 8kx + 16 = 0$
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = 9, b = 8k, c = 16

Find D:

$D = b^2 - 4ac$

$= (8k)^2 - 4 \times 9 \times 16$
$= 64k^2 - 576$
Roots of given equation are equal (given)
So, D = 0

$64k^2 - 576 = 0$
$64k^2 = 576$
$k^2 = 9$
$k = \pm 3$

Answer: k = 3, k = -3

Question 19:
Find the values of k for which the given quadratic equation has real and distinct roots.
(i) $kx^2 + 6x + 1 = 0$
(ii) $x^2 - kx + 9 = 0$
(iii) $9x^2 + 3kx + 4 = 0$
(iv) $5x^2 - kx + 1 = 0$
Solution:
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

(i) a = k, b = 6, c = 1

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For real and distinct roots, then D > 0

$6^2 - 4k > 0$

$36 - 4k > 0$

$k < 9$

(ii)

a = 1, b = – k, c = 9

For real and distinct roots, then D > 0

$(-k)^2 - 36 > 0$

k > 6 or k < -6

(iii)
a = 9 ,b = 3k ,c = 4

For real and distinct roots, then D > 0

$(3k)^2 - 144 > 0$

$9k^2 > 144$

$k^2 > 16$

k > 4 or k < – 4

(iv)
a = 5, b = – k, c = 1

For real and distinct roots, then D > 0

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k^2 – 20 > 0

k2 > 20

k > 2√5 or k < –2√5

Question 20:
If a and b are real and a ≠ b then show that the roots of the equation (a – b) x^2 + 5(a + b) x – 2 (a – b) = 0 are real and unequal.
Solution:
Compare given equation with the general form of quadratic equation, which is ax^2 + bx + c = 0

a = (a – b), b = 5(a + b), c = – 2(a – b)

Find Discriminant:

D = b^2 – 4ac

= (5(a + b))^2 – 4(a – b)(– 2(a – b))

= 25(a + b)^2 + 8(a – b)^2

= 17(a + b)^2 + {8(a + b)^2 + 8(a – b)^2 }

= 17(a + b)^2 + 16(a^2 + b^2)
Which is always greater than zero.

Equation has real and unequal roots.