

Ex 14.1

Q1

$$x^2 + 1 = 0$$

$$\Rightarrow x^2 + i^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow (x + i)(x - i) = 0 \quad [a^2 - b^2 = (a + b)(a - b)]$$

$$\Rightarrow x = i, -i$$

Q2

$$9x^2 + 4 = 0$$

$$\Rightarrow (3x)^2 - (2i)^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow (3x + 2i)(3x - 2i) = 0$$

$$\Rightarrow 3x + 2i = 0 \quad \text{or} \quad 3x - 2i = 0$$

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

$$\therefore x = \frac{-2}{3}i, \frac{2}{3}i$$

Q3

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

Now, completing the squares, we get

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

$$\Rightarrow (x + 1)^2 - 2i^2 = 0$$

$$\Rightarrow (x + 1 + 2i)(x + 1 - 2i) = 0$$

$$\Rightarrow (x + 1 + 2i) = 0 \quad \text{or} \quad (x + 1 - 2i) = 0$$

$$\therefore x = -1 - 2i, -1 + 2i$$

Q4

$$4x^2 - 12x + 25 = 0$$

Now, completing the squares, we get

$$\begin{aligned} & (2x - 3)^2 + 16 = 0 \\ \Rightarrow & (2x - 3)^2 - 4i^2 = 0 \\ \Rightarrow & (2x - 3 + 4i)(2x - 3 - 4i) = 0 \\ \Rightarrow & (2x - 3 + 4i) = 0 \quad \text{or} \quad (2x - 3 - 4i) = 0 \\ \therefore x = & \frac{3}{2} + 2i, \quad \frac{3}{2} - 2i \end{aligned}$$

Q5

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

Now, completing the squares, we get

$$\begin{aligned} & \left(x + \frac{1}{2}\right)^2 + \frac{3}{4} = 0 \\ \Rightarrow & \left(x + \frac{1}{2}\right)^2 - \left(\frac{\sqrt{3}}{2}i\right)^2 = 0 \\ \Rightarrow & \left(x + \frac{1}{2} + \frac{\sqrt{3}}{2}i\right)\left(x + \frac{1}{2} - \frac{\sqrt{3}}{2}i\right) = 0 \\ \Rightarrow & \left(x + \frac{1}{2} + \frac{\sqrt{3}}{2}i\right) = 0 \quad \text{or} \quad \left(x + \frac{1}{2} - \frac{\sqrt{3}}{2}i\right) = 0 \\ \therefore x = & -\frac{1}{2} + \frac{\sqrt{3}}{2}i, \quad -\frac{1}{2} - \frac{\sqrt{3}}{2}i \end{aligned}$$

Q6

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

$$\Rightarrow (2x)^2 - i^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow (2x + i)(2x - i) = 0$$

$$\Rightarrow \text{either } 2x + i = 0 \quad \text{or} \quad 2x - i = 0$$

$$\Rightarrow x = \frac{-i}{2} \quad \text{or} \quad x = \frac{i}{2}$$

$$\therefore x = \frac{-i}{2}, \frac{i}{2}$$

Q7

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac = (-4)^2 - 4.1.7 = -12$$

from (A)

$$x = \frac{-(-4) \pm \sqrt{-12}}{2}$$

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

$$= 2 \pm \sqrt{3}i$$

$$\therefore x = 2 + \sqrt{3}i, 2 - \sqrt{3}i$$

Q8

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= 2^2 - 4 \cdot 1 \cdot 2$$

$$= 4 - 8$$

$$= -4$$

from (A)

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

$$= \frac{-2 \pm 2i}{2}$$

$$= -1 \pm i$$

$$\therefore x = -1 + i, \quad -1 - i$$

Q9

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (-6)^2 - 4 \cdot 5 \cdot 2$$

$$= 36 - 40$$

$$= -4$$

from (A)

$$x = \frac{-(-6) \pm \sqrt{-4}}{2 \cdot 5}$$

$$= \frac{6 \pm 2i}{10}$$

$$= \frac{3 \pm i}{5}$$

$$\therefore x = \frac{3}{5} + \frac{i}{5}, \quad \frac{3}{5} - \frac{i}{5}$$

Q10

$$21x^2 + 9x + 1 = 0$$

Comparing the given equation with the general form

$$ax^2 + bx + c = 0, \text{ we get } a = 21, b = 9, c = 1$$

Substituting a and b in,

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

$$\alpha = \frac{-9 + \sqrt{81 - 84}}{42} \quad \text{and} \quad \beta = \frac{-9 - \sqrt{81 - 84}}{42}$$

$$\Rightarrow \alpha = \frac{-9 + \sqrt{-3}}{42} \quad \text{and} \quad \beta = \frac{-9 - \sqrt{-3}}{42}$$

$$\Rightarrow \alpha = \frac{-9 + i\sqrt{3}}{42} \quad \text{and} \quad \beta = \frac{-9 - i\sqrt{3}}{42}$$

$$\text{The roots are } x = \frac{-9}{42} \pm \frac{i\sqrt{3}}{42}$$

Q11

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (-1)^2 - 4.1.1$$

$$= 1 - 4$$

$$= -3$$

from (A)

$$\therefore x = \frac{-(-1) \pm \sqrt{-3}}{2}$$

$$= \frac{1 \pm \sqrt{3}i}{2}$$

$$\therefore x = \frac{1}{2} + \frac{\sqrt{3}}{2}i, \quad \frac{1}{2} - \frac{\sqrt{3}}{2}i$$

Q12

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= 1^2 - 4.1.1 \\ &= 1 - 4 \\ &= -3 \end{aligned}$$

from (A)

$$x = \frac{-1 \pm \sqrt{-3}}{2}$$

$$= \frac{-1 \pm \sqrt{3}i}{2}$$

$$\therefore x = \frac{-1}{2} + \frac{\sqrt{3}}{2}i, \quad \frac{-1}{2} - \frac{\sqrt{3}}{2}i$$

Q13

$$17x^2 - 8x + 1 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= (-8)^2 - 4.17.1 \\ &= 64 - 68 \\ &= -4 \end{aligned}$$

from (A)

$$x = \frac{-(-8) \pm \sqrt{-4}}{2.17}$$

$$= \frac{8 \pm 2i}{34}$$

$$= \frac{4 \pm i}{17}$$

$$\therefore x = \frac{4}{17} + \frac{i}{17}, \quad \frac{4}{17} - \frac{i}{17}$$

Q14

$$27x^2 - 10x + 1 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (-10)^2 - 4.27.1$$

$$= 100 - 108$$

$$= -8$$

from (A)

$$x = \frac{-(-10) \pm \sqrt{-8}}{54}$$

$$= \frac{10 \pm 2\sqrt{2}i}{54}$$

$$= \frac{5 \pm \sqrt{2}i}{27}$$

$$\therefore x = \frac{5}{27} + \frac{\sqrt{2}i}{27}, \quad \frac{5}{27} - \frac{\sqrt{2}i}{27}$$

Q15

$$17x^2 + 28x + 12 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (28)^2 - 4.17.12$$

$$= 784 - 816$$

$$= -32$$

from (A)

$$x = \frac{-28 \pm \sqrt{-32}}{2.17}$$

$$= \frac{-28 \pm 4\sqrt{2}i}{34}$$

$$\therefore x = \frac{-14 \pm 2\sqrt{2}i}{17}$$

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Q16

$$21x^2 - 28x + 10 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (-28)^2 - 4 \cdot 21 \cdot 10$$

$$= 784 - 840$$

$$= -56$$

from (A)

$$x = \frac{-(-28) \pm \sqrt{-56}}{2 \cdot 21}$$

$$= \frac{28 \pm 2\sqrt{14}i}{42}$$

$$\therefore x = \frac{2}{3} \pm \frac{\sqrt{14}}{21}i$$

Q17

$$8x^2 - 9x + 3 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\text{where } D = b^2 - 4ac$$

$$= (-9)^2 - 4 \cdot 8 \cdot 3$$

$$= 81 - 96$$

$$= -15$$

from (A)

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

$$= \frac{-(-9) \pm \sqrt{-15}}{2 \cdot 8}$$

$$= \frac{9 \pm \sqrt{15}i}{16}$$

Thus

$$\therefore x = \frac{9 \pm \sqrt{15}i}{16}$$

Q18

$$13x^2 + 7x + 1 = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= 7^2 - 4.13.1 \\ &= 49 - 52 \\ &= -3 \end{aligned}$$

Thus, from (A)

$$\begin{aligned} x &= \frac{-7 \pm \sqrt{-3}}{2.13} \\ &= \frac{-7 \pm \sqrt{3}i}{26} \end{aligned}$$

Thus

$$\therefore x = \frac{-7}{26} \pm \frac{\sqrt{3}}{26}i$$

Q19

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= 1^2 - 4.2.1 \\ &= 1 - 8 \\ &= -7 \end{aligned}$$

Thus, from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-7}}{2.2} \\ &= \frac{-1 \pm \sqrt{7}i}{4} \end{aligned}$$

Thus

$$\therefore x = \frac{-1}{4} \pm \frac{\sqrt{7}}{4}i$$

Q20

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

where $D = b^2 - 4ac$

$$\begin{aligned} &= (-\sqrt{2})^2 - 4 \cdot \sqrt{3} \cdot 3\sqrt{3} \\ &= 2 - 36 \\ &= -34 \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-(-\sqrt{2}) \pm \sqrt{-34}}{2 \cdot \sqrt{3}} \\ &= \frac{\sqrt{2} \pm \sqrt{34}i}{2\sqrt{3}} \end{aligned}$$

Thus

$$\therefore x = \frac{\sqrt{2} \pm \sqrt{34}i}{2\sqrt{3}}$$

Q21

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

where $D = b^2 - 4ac$

$$\begin{aligned} &= 1^2 - 4 \cdot \sqrt{2} \cdot \sqrt{2} \\ &= 1 - 8 \\ &= -7 \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-7}}{2 \cdot \sqrt{2}} \\ &= \frac{-1 \pm \sqrt{7}i}{2\sqrt{2}} \end{aligned}$$

Thus

$$\therefore x = \frac{-1 \pm \sqrt{7}i}{2\sqrt{2}}$$

Q22

$$x^2 + x + \frac{1}{\sqrt{2}} = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

where $D = b^2 - 4ac$

$$\begin{aligned} &= 1^2 - 4.1.\frac{1}{\sqrt{2}} \\ &= 1 - 2\sqrt{2} \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-(2\sqrt{2} - 1)}}{2} \\ &= \frac{-1 \pm \sqrt{2\sqrt{2} - 1}i}{2} \end{aligned}$$

Thus,

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

Q23

$$x^2 + \frac{x}{\sqrt{2}} + 1 = 0 \quad \Rightarrow \quad \sqrt{2}x^2 + x + \sqrt{2} = 0$$

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} D &= b^2 - 4ac \\ &= 1^2 - 4.\sqrt{2}.\sqrt{2} \\ &= 1 - 8 \\ &= -7 \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-7}}{2\sqrt{2}} \\ &= \frac{-1 \pm \sqrt{7}i}{2\sqrt{2}} \end{aligned}$$

Thus,

$$\therefore x = \frac{-1 \pm \sqrt{7}i}{2\sqrt{2}}$$

Q24

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= 1^2 - 4.\sqrt{5}.\sqrt{5} \\ &= 1 - 20 \\ &= -19 \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-19}}{2.\sqrt{5}} \\ &= \frac{-1 \pm \sqrt{19}i}{2\sqrt{5}} \end{aligned}$$

Thus,

$$\therefore x = \frac{-1 \pm \sqrt{19}i}{2\sqrt{5}}$$

Q25

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

We will apply discriminant rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \dots\dots\dots (A)$$

$$\begin{aligned} \text{where } D &= b^2 - 4ac \\ &= 1^2 - 4.(-1).(-2) \\ &= 1 - 8 \\ &= -7 \end{aligned}$$

from (A)

$$\begin{aligned} x &= \frac{-1 \pm \sqrt{-7}}{2.(-1)} \\ &= \frac{-1 \pm \sqrt{7}i}{-2} \end{aligned}$$

Thus,

$$\therefore x = \frac{-1 \pm \sqrt{7}i}{-2}$$

Q26

We will apply discriminate rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \quad \dots\dots(A)$$

Where $D = b^2 - 4ac$

$$\begin{aligned} &= (-2)^2 - 4(1)\left(\frac{3}{2}\right) \\ &= 4 - 6 \\ &= -2 \end{aligned}$$

From (A)

$$\begin{aligned} x &= \frac{-(-2) \pm \sqrt{-2}}{2(1)} \\ &= \frac{2 \pm i\sqrt{2}}{2} \\ &= 1 \pm \frac{i}{\sqrt{2}} \end{aligned}$$

Thus,

$$\therefore x = 1 \pm \frac{i}{\sqrt{2}}$$

Q27

We will apply discriminate rule,

$$x = \frac{-b \pm \sqrt{D}}{2a} \quad \dots\dots(A)$$

Where $D = b^2 - 4ac$

$$\begin{aligned} &= (-4)^2 - 4(3)\left(\frac{20}{3}\right) \\ &= 16 - 80 \\ &= -64 \end{aligned}$$

From (A)

$$\begin{aligned} x &= \frac{-(-4) \pm \sqrt{-64}}{2(3)} \\ &= \frac{4 \pm i8}{6} \\ &= \frac{2}{3} \pm \frac{4i}{3} \end{aligned}$$

Thus,

$$\therefore x = \frac{2}{3} \pm \frac{4i}{3}$$

Ex 14.2

Q1(i)

$$x^2 + 10ix - 21 = 0$$

$$\Rightarrow x^2 + 10ix + 21i^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow x^2 + 7ix + 3ix + 21i^2 = 0$$

$$\Rightarrow x(x + 7i) + 3i(x + 7i) = 0$$

$$\Rightarrow (x + 3i)(x + 7i) = 0$$

$$\therefore x = -3i, -7i$$

Q1(ii)

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

$$\Rightarrow x^2 + x - 2i - 2i = 0$$

$$\Rightarrow x(x + 1) - 2i(x + 1) = 0$$

$$\Rightarrow (x - 2i)(x + 1) = 0$$

$$\Rightarrow x = 2i, -1$$

Q1(iii)

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

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

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

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

$$\Rightarrow x = 3i, 2\sqrt{3}$$

Q1(iv)

$$6x^2 - 17ix - 12 = 0$$

$$\Rightarrow 6x^2 - 17ix + 12i^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow 6x^2 - 9ix - 8ix + 12i^2 = 0$$

$$\Rightarrow 3x(2x - 3i) - 4i(2x - 3i) = 0$$

$$\Rightarrow (3x - 4i)(2x - 3i) = 0$$

$$\Rightarrow x = \frac{4}{3}i \quad \text{or} \quad \frac{3}{2}i$$

Q2(i)

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

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

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

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

$$\Rightarrow x = 2i \quad \text{or} \quad 3\sqrt{2}$$

Q2(ii)

$$x^2 - (5 - i)x + (18 + i) = 0$$

$$\Rightarrow x^2 - 5x - ix + 18 + i = 0$$

$$\Rightarrow x^2 - (3 - 4i)x - (2 + 3i)x + (18 + i) = 0$$

$$\Rightarrow x(x - (3 - 4i)) - (2 + 3i)(x - (3 - 4i)) = 0$$

$$\Rightarrow (x - (2 + 3i))(x - (3 - 4i)) = 0$$

$$\Rightarrow x = 2 + 3i \quad \text{or} \quad 3 - 4i$$

Q2(iii)

$$(2 + i)x^2 - (5 - i)x + 2(1 - i) = 0$$

$$\Rightarrow (2 + i)x^2 - 2x - (3 - i)x + 2(1 - i) = 0$$

$$\Rightarrow x[2 + i)x - 2] - (1 - i)[(2 + i)x - 2] = 0$$

$$\Rightarrow [x - (1 - i)][(2 + i)x - 2] = 0$$

$$\text{either } [x - (1 - i)] = 0 \quad \text{or} \quad [(2 + i)x - 2] = 0$$

$$\Rightarrow x = 1 - i \quad \text{or} \quad x = \frac{2}{2 + i}$$

$$\Rightarrow x = 1 - i \quad \text{or} \quad x = \frac{2 \times 2 - i}{(2 + i)(2 - i)}$$

$$\text{or } x = \frac{4 - 2i}{4 + 1} = \frac{4}{5} - \frac{2}{5}i$$

Thus,

$$x = 1 - i, \quad \frac{4}{5} - \frac{2}{5}i$$

Q2(iv)

$$x^2 - (2+i)x - (1-7i) = 0$$

$$\Rightarrow x^2 - (2+i)x - (1-7i) = 0$$

$$\Rightarrow x^2 - (3-i)x + (1-2i)x - (1-7i) = 0$$

$$\Rightarrow x(x - (3-i)) + (1-2i)(x - (3-i)) = 0$$

$$\Rightarrow [x + (1-2i)][x - (3-i)] = 0$$

$$\Rightarrow x = -1+2i, \quad 3-i$$

Q2(v)

$$ix^2 - 4x - 4i = 0$$

$$\Rightarrow ix^2 + 4i^2x + 4i^3 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow x^2 + 4ix + 4i^2 = 0$$

$$\Rightarrow x^2 + 2ix + 2ix + 4i^2 = 0$$

$$\Rightarrow x(x + 2i) + 2i(x + 2i) = 0$$

$$\Rightarrow (x + 2i)(x + 2i)$$

$$\therefore x = -2i, \quad -2i$$

Q2(vi)

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

$$\Rightarrow x^2 + 4ix + 4i^2 = 0 \quad [\because i^2 = -1]$$

$$\Rightarrow x^2 + 2ix + 2ix + 4i^2 = 0$$

$$\Rightarrow x(x + 2i) + 2i(x + 2i) = 0$$

$$\Rightarrow (x + 2i)(x + 2i) = 0$$

$$\Rightarrow x = -2i, \quad -2i$$

Q2(vii)

$$2x^2 + \sqrt{15}ix - i = 0$$

Comparing the given equation with the general form

$$ax^2 + bx + c = 0, \text{ we get } a = 2, b = \sqrt{15}i, c = -i$$

Substituting a and b in,

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

$$\alpha = \frac{-\sqrt{15}i + \sqrt{-15 + 8i}}{4} \quad \text{and} \quad \beta = \frac{-\sqrt{15}i - \sqrt{-15 + 8i}}{4}$$

$$\text{Let } \sqrt{-15 + 8i} = a + bi$$

$$\Rightarrow -15 + 8i = (a + bi)^2$$

$$\Rightarrow -15 + 8i = a^2 - b^2 + 2abi$$

$$\Rightarrow a^2 - b^2 = -15 \text{ and } 2abi = 8i$$

$$\text{Now } (a^2 + b^2)^2 = (a^2 - b^2)^2 + 4a^2b^2$$

$$\Rightarrow (a^2 + b^2)^2 = (-15)^2 + 64 = 289$$

$$\Rightarrow a^2 + b^2 = 17$$

Solving $a^2 - b^2 = -15$ and $a^2 + b^2 = 17$, we get

$$a^2 = 1 \text{ and } b^2 = 16$$

$$\Rightarrow a = \pm 1 \text{ and } b = \pm 4$$

$$\Rightarrow a = \pm 1 \text{ and } b = \pm 4$$

$$\Rightarrow a = 1, b = 4 \text{ or } a = -1, b = -4$$

$$\therefore \sqrt{-15 + 8i} = 1 + 4i, -1 - 4i$$

$$\text{When } \sqrt{-15 + 8i} = 1 + 4i$$

$$\alpha = \frac{-\sqrt{15}i + 1 + 4i}{4} = \frac{1 + (4 - \sqrt{15})i}{4}$$

$$\text{and } \beta = \frac{-\sqrt{15}i - (1 + 4i)}{4} = \frac{-1 - (4 + \sqrt{15})i}{4}$$

$$\text{When } \sqrt{-15 + 8i} = -1 - 4i$$

$$\alpha = \frac{-\sqrt{15}i - 1 - 4i}{4} = \frac{-1 - (4 + \sqrt{15})i}{4}$$

$$\text{and } \beta = \frac{-\sqrt{15}i - (-1 - 4i)}{4} = \frac{1 + (4 - \sqrt{15})i}{4}$$

Q2(viii)

$$\begin{aligned}x^2 - x + (1+i) &= 0 \\x^2 - x + (1+i) &= 0 \\x^2 - ix - (1-i)x + i(1-i) &= 0 \\(x-i)(x-(1-i)) &= 0 \\x &= i, 1-i\end{aligned}$$

Q2(ix)

We will apply discriminate rule on $ax^2 + bx + c = 0$,

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

Now,

$$ix^2 - x + 12i = 0$$

$$\begin{aligned}x &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4(i)(12i)}}{2i} \\&= \frac{1 \pm \sqrt{1+48}}{2i} \\&= \frac{1 \pm \sqrt{49}}{2i} \\&= \frac{1 \pm 7}{2i} \\&= \frac{8}{2i}, \frac{-6}{2i} \\&= \frac{4}{i}, -\frac{3}{i} \\&= -4i, 3i\end{aligned}$$



Q2(x)

We will apply discriminate rule on $ax^2 + bx + c = 0$,

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

Now,

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

$$x = \frac{(3\sqrt{2} - 2i) \pm \sqrt{[-(3\sqrt{2} - 2i)]^2 - 4(1)(-\sqrt{2}i)}}{2(1)}$$

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

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

Q2(xi)

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

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

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

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

$$x = i, \sqrt{2}$$

Q2(xii)

$$2x^2 - (3 + 7i)x + (9i - 3) = 0$$

$$2x^2 - 3x - 7ix + (9i - 3) = 0$$

$$(2x - 3 - i)(x - 3i) = 0$$

$$\left(x - \frac{3+i}{2}\right)(x - 3i) = 0$$

$$x = \frac{3+i}{2}, 3i$$