EXERCISE 14.2 PAGE NO: 14.13

1. Solving the following quadratic equations by factorization method:
(i) $x^2 + 10ix - 21 = 0$
(ii) $x^2 + (1 - 2i)x - 2i = 0$
(iii) $x^2 - (2\sqrt{3} + 3i)x + 6\sqrt{3}i = 0$
(iv) $6x^2 - 17ix - 12 = 0$
Solution:
(i) $x^2 + 10ix - 21 = 0$
Given: $x^2 + 10ix - 21 = 0$
$x^2 + 10ix - 21 \times 1 = 0$
We know, $i^2 = -1 \Rightarrow 1 = -i^2$
By substituting $1 = -i^2$ in the above equation, we get
$x^2 + 10ix - 21(-i^2) = 0$
$x^2 + 10ix + 21i^2 = 0$
$x^2 + 3ix + 7ix + 21i^2 = 0$
$x(x + 3i) + 7i(x + 3i) = 0$
$(x + 3i)(x + 7i) = 0$
$x + 3i = 0$ or $x + 7i = 0$
$x = -3i$ or $-7i$
∴ The roots of the given equation are $-3i, -7i$

(ii) $x^2 + (1 - 2i)x - 2i = 0$
Given: $x^2 + (1 - 2i)x - 2i = 0$
$x^2 + x - 2ix - 2i = 0$
$x(x + 1) - 2i(x + 1) = 0$
$(x + 1)(x - 2i) = 0$
$x + 1 = 0$ or $x - 2i = 0$
$x = -1$ or $2i$
∴ The roots of the given equation are $-1, 2i$

(iii) $x^2 - (2\sqrt{3} + 3i)x + 6\sqrt{3}i = 0$
Given: $x^2 - (2\sqrt{3} + 3i)x + 6\sqrt{3}i = 0$
$x^2 - (2\sqrt{3}x + 3ix) + 6\sqrt{3}i = 0$
$x^2 - 2\sqrt{3}x - 3ix + 6\sqrt{3}i = 0$
$x(x - 2\sqrt{3}) - 3i(x - 2\sqrt{3}) = 0$
$(x - 2\sqrt{3})(x - 3i) = 0$
$(x - 2\sqrt{3}) = 0$ or $(x - 3i) = 0$
$x = 2\sqrt{3}$ or $x = 3i$

∴ The roots of the given equation are $2\sqrt{3}$, 3i

(iv) $6x^2 – 17ix – 12 = 0$
Given: $6x^2 – 17ix – 12 = 0$
$6x^2 – 17ix – 12 \times 1 = 0$
We know, $i^2 = –1 \Rightarrow 1 = –i^2$
By substituting $1 = –i^2$ in the above equation, we get
$6x^2 – 17ix – 12(–i^2) = 0$
$6x^2 – 17ix + 12i^2 = 0$
$6x^2 – 9ix – 8ix + 12i^2 = 0$
$3x(2x – 3i) – 4i(2x – 3i) = 0$
$(2x – 3i) (3x – 4i) = 0$
$2x – 3i = 0$ or $3x – 4i = 0$
$2x = 3i$ or $3x = 4i$
$x = 3i/2$ or $x = 4i/3$
∴ The roots of the given equation are 3i/2, 4i/3

2. Solve the following quadratic equations:
(i) $x^2 – (3\sqrt{2} + 2i) x + 6\sqrt{2}i = 0$
(ii) $x^2 – (5 - i) x + (18 + i) = 0$
(iii) $(2 + i)x^2 – (5- i)x + 2 (1 - i) = 0$
(iv) $x^2 – (2 + i)x – (1 – 7i) = 0$
(v) $ix^2 – 4x – 4i = 0$
(vi) $x^2 + 4ix – 4 = 0$
(vii) $2x^2 + \sqrt{15}ix – i = 0$
(viii) $x^2 – x + (1 + i) = 0$
(ix) $ix^2 – x + 12i = 0$
(x) $x^2 – (3\sqrt{2} – 2i)x - \sqrt{2}i = 0$
(xi) $x^2 – (\sqrt{2} + i)x + \sqrt{2}i = 0$
(xii) $2x^2 – (3 + 7i)x + (9i - 3) = 0$
Solution:
(i) $x^2 – (3\sqrt{2} + 2i) x + 6\sqrt{2}i = 0$
Given: $x^2 – (3\sqrt{2} + 2i) x + 6\sqrt{2}i = 0$
$x^2 – (3\sqrt{2}x + 2ix) + 6\sqrt{2}i = 0$
$x^2 – 3\sqrt{2}x - 2ix + 6\sqrt{2}i = 0$
$x(x - 3\sqrt{2}) – 2i(x - 3\sqrt{2}) = 0$
$(x - 3\sqrt{2}) (x – 2i) = 0$
$(x - 3\sqrt{2}) = 0$ or $(x – 2i) = 0$
$x = 3\sqrt{2}$ or $x = 2i$

∴ The roots of the given equation are $3\sqrt{2}$, $2i$

(ii) $x^2 - (5 - i)x + (18 + i) = 0$
Given: $x^2 - (5 - i)x + (18 + i) = 0$
We shall apply discriminant rule,
Where, $x = (-b \pm\sqrt{(b^2 - 4ac)})/2a$
Here, a = 1, b = -(5-i), c = (18+i)
So,

$$x = \frac{-(-(5-i)) \pm \sqrt{(-(5-i))^2 - 4(1)(18+i)}}{2(1)}$$

$$= \frac{(5-i) \pm \sqrt{(5-i)^2 - 4(18+i)}}{2}$$

$$= \frac{(5-i) \pm \sqrt{25 - 10i + i^2 - 72 - 4i}}{2}$$

$$= \frac{(5-i) \pm \sqrt{-47 - 14i + i^2}}{2}$$

We have $i^2 = -1$
By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{(5-i) \pm \sqrt{-47 - 14i + (-1)}}{2}$$

$$= \frac{(5-i) \pm \sqrt{-48 - 14i}}{2}$$

$$= \frac{(5-i) \pm \sqrt{(-1)(48 + 14i)}}{2}$$

$$= \frac{(5-i) \pm \sqrt{i^2(48 + 14i)}}{2}$$

$$= \frac{(5-i) \pm i\sqrt{48 + 14i}}{2}$$

We can write 48 + 14i = 49 – 1 + 14i
So,
$48 + 14i = 49 + i^2 + 14i$ [∵ $i^2 = -1$]
$= 7^2 + i^2 + 2(7)(i)$
$= (7 + i)^2$ [Since, $(a + b)^2 = a^2 + b^2 + 2ab$]
By using the result $48 + 14i = (7 + i)^2$, we get

$$= \frac{(5-i) \pm i\sqrt{(7+i)^2}}{2}$$

$$= \frac{(5-i) \pm i(7+i)}{2}$$

$$= \frac{(5-i) + i(7+i)}{2} \text{ or } \frac{(5-i) - i(7+i)}{2}$$

$$= \frac{5 - i + 7i + i^2}{2} \text{ or } \frac{5 - i - 7i - i^2}{2}$$

$$= \frac{5+6i+(-1)}{2} \text{ or } \frac{5-8i-(-1)}{2}$$

$$= \frac{5 + 6i - 1}{2} \text{ or } \frac{5 - 8i + 1}{2}$$

$$= \frac{4 + 6i}{2} \text{ or } \frac{6 - 8i}{2}$$

$$= \frac{2(2 + 3i)}{2} \text{ or } \frac{2(3 - 4i)}{2}$$

$x = 2 + 3i$ or $3 – 4i$

∴ The roots of the given equation are $3 – 4i$, $2 + 3i$

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

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

We shall apply discriminant rule,

Where, $x = (-b \pm\sqrt{(b^2 – 4ac)})/2a$

Here, $a = (2+i)$, $b = -(5-i)$, $c = 2(1-i)$

So,

$$x = \frac{-(-(5-i)) \pm \sqrt{(-(5-i))^2 - 4(2+i)(2(1-i))}}{2(2+i)}$$

$$= \frac{(5-i) \pm \sqrt{(5-i)^2 - 8(2+i)(1-i)}}{2(2+i)}$$

$$= \frac{(5-i) \pm \sqrt{25 - 10i + i^2 - 8(2 - 2i + i - i^2)}}{2(2+i)}$$

We have $i^2 = –1$

By substituting $–1 = i^2$ in the above equation, we get

$$= \frac{(5-i) \pm \sqrt{25 - 10i + (-1) - 8\big(2 - i - (-1)\big)}}{2(2+i)}$$

$$= \frac{(5-i) \pm \sqrt{24 - 10i - 8(3-i)}}{2(2+i)}$$

$$= \frac{(5-i) \pm \sqrt{24 - 10i - 24 + 8i}}{2(2+i)}$$

$$= \frac{(5-i) \pm \sqrt{-2i}}{2(2+i)}$$

We can write $-2i = -2i + 1 - 1$

$-2i = -2i + 1 + i^2$ [Since, $i^2 = -1$]

$= 1 - 2i + i^2$

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

$= (1 - i)^2$ [By using the formula, $(a - b)^2 = a^2 - 2ab + b^2$]

By using the result $-2i = (1 - i)^2$, we get

$$x = \frac{(5-i) \pm \sqrt{(1-i)^2}}{2(2+i)}$$

$$= \frac{(5-i) \pm (1-i)}{2(2+i)}$$

$$= \frac{(5-i) + (1-i)}{2(2+i)} \text{ or } \frac{(5-i) - (1-i)}{2(2+i)}$$

$$= \frac{5 - i + 1 - i}{2(2+i)} \text{ or } \frac{5 - i - 1 + i}{2(2+i)}$$

$$= \frac{6 - 2i}{2(2+i)} \text{ or } \frac{4}{2(2+i)}$$

$$= \frac{3 - i}{2 + i} \text{ or } \frac{2}{2 + i}$$

Let us multiply and divide by (2 - i), we get

$$= \frac{3-i}{2+i} \times \frac{2-i}{2-i} \text{ or } \frac{2}{2+i} \times \frac{2-i}{2-i}$$

$$= \frac{(3-i)(2-i)}{(2+i)(2-i)} \text{ or } \frac{2(2-i)}{(2+i)(2-i)}$$

$$= \frac{6 - 3i - 2i + i^2}{2^2 - i^2} \text{ or } \frac{4 - 2i}{2^2 - i^2}$$

$$= \frac{6-5i+(-1)}{4-(-1)} \text{ or } \frac{4-2i}{4-(-1)}$$

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

$$= \frac{5(1-i)}{5} \text{ or } \frac{4-2i}{5}$$

x = (1 – i) or 4/5 – 2i/5

∴ The roots of the given equation are (1 – i), 4/5 – 2i/5

(iv) $x^2 – (2 + i)x – (1 – 7i) = 0$

Given: $x^2 – (2 + i)x – (1 – 7i) = 0$

We shall apply discriminant rule,

Where, $x = (-b \pm\sqrt{(b^2 – 4ac)})/2a$

Here, a = 1, b = -(2+i), c = -(1-7i)

So,

$$x = \frac{-(-(2+i)) \pm \sqrt{(-(2+i))^2 - 4(1)(-(1-7i))}}{2(1)}$$

$$= \frac{(2+i) \pm \sqrt{(2+i)^2 + 4(1-7i)}}{2}$$

$$= \frac{(2+i) \pm \sqrt{4+4i+i^2+4-28i}}{2}$$

$$= \frac{(2+i) \pm \sqrt{8-24i+i^2}}{2}$$

We have $i^2 = -1$

By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{(2+i) \pm \sqrt{8-24i+(-1)}}{2}$$

$$= \frac{(2+i) \pm \sqrt{7-24i}}{2}$$

We can write 7 – 24i = 16 – 9 – 24i

7 – 24i = 16 + 9(–1) – 24i

$= 16 + 9i^2 – 24i$ [∵ $i^2 = –1$]

$= 4^2 + (3i)^2 – 2(4)(3i)$

$= (4 – 3i)^2$ [∵ $(a – b)^2 = a^2 – b^2 + 2ab$]

By using the result $7 - 24i = (4 - 3i)^2$, we get

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

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

$$= \frac{(2+i) + (4-3i)}{2} \text{ or } \frac{(2+i) - (4-3i)}{2}$$

$$= \frac{2+i+4-3i}{2} \text{ or } \frac{2+i-4+3i}{2}$$

$$= \frac{6-2i}{2} \text{ or } \frac{-2+4i}{2}$$

$$= \frac{2(3-i)}{2} \text{ or } \frac{2(-1+2i)}{2}$$

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

∴ The roots of the given equation are $(-1 + 2i)$, $(3 - i)$

(v) $ix^2 - 4x - 4i = 0$

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

$ix^2 + 4x(-1) - 4i = 0$ [We know, $i^2 = -1$]

So by substituting $-1 = i^2$ in the above equation, we get

$ix^2 + 4xi^2 - 4i = 0$

$i(x^2 + 4ix - 4) = 0$

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

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

$x^2 + 4ix + 4i^2 = 0$ [Since, $i^2 = -1$]

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

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

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

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

$x + 2i = 0$

$x = -2i, -2i$

∴ The roots of the given equation are $-2i, -2i$

(vi) $x^2 + 4ix - 4 = 0$

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

$x^2 + 4ix + 4(-1) = 0$ [We know, $i^2 = -1$]
So by substituting $-1 = i^2$ in the above equation, we get
$x^2 + 4ix + 4i^2 = 0$
$x^2 + 2ix + 2ix + 4i^2 = 0$
$x(x + 2i) + 2i(x + 2i) = 0$
$(x + 2i)(x + 2i) = 0$
$(x + 2i)^2 = 0$
$x + 2i = 0$
$x = -2i, -2i$
∴ The roots of the given equation are $-2i, -2i$

(vii) $2x^2 + \sqrt{15}ix - i = 0$
Given: $2x^2 + \sqrt{15}ix - i = 0$
We shall apply discriminant rule,
Where, $x = (-b \pm\sqrt{(b^2 - 4ac)})/2a$
Here, $a = 2$, $b = \sqrt{15}i$, $c = -i$
So,

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

$$= \frac{-\sqrt{15}i \pm \sqrt{15i^2 + 8i}}{4}$$

We have $i^2 = -1$
By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{-\sqrt{15}i \pm \sqrt{15(-1) + 8i}}{4}$$

$$= \frac{-\sqrt{15}i \pm \sqrt{8i - 15}}{4}$$

$$= \frac{-\sqrt{15}i \pm \sqrt{(-1)(15 - 8i)}}{4}$$

$$= \frac{-\sqrt{15}i \pm \sqrt{i^2(15 - 8i)}}{4}$$

$$= \frac{-\sqrt{15}i \pm i\sqrt{15 - 8i}}{4}$$

We can write $15 - 8i = 16 - 1 - 8i$

15 – 8i = 16 + (–1) – 8i
= 16 + i^2 – 8i [∵ i^2 = –1]
= 4^2 + $(i)^2$ – 2(4)(i)
= $(4 – i)^2$ [Since, $(a – b)^2 = a^2 – b^2 + 2ab$]
By using the result 15 – 8i = $(4 – i)^2$, we get

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

$$=\frac{-\sqrt{15}i\pm i(4-i)}{4}$$

$$=\frac{-\sqrt{15}i+i(4-i)}{4}\text{ or }\frac{-\sqrt{15}i-i(4-i)}{4}$$

$$=\frac{-\sqrt{15}i+4i-i^2}{4}\text{ or }\frac{-\sqrt{15}i-4i+i^2}{4}$$

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

$$=\frac{-\sqrt{15}i+4i+1}{4}\text{ or }\frac{-\sqrt{15}i-4i-1}{4}$$

$$=\frac{1+\left(4-\sqrt{15}\right)i}{4}\text{ or }\frac{-1-\left(4+\sqrt{15}\right)i}{4}$$

∴ The roots of the given equation are [1+ (4 - √15)i/4] , [-1 -(4 + √15)i/4]

(viii) $x^2 – x + (1 + i) = 0$
Given: $x^2 – x + (1 + i) = 0$
We shall apply discriminant rule,
Where, x = (-b ±√(b^2 – 4ac))/2a
Here, a = 1, b = -1, c = (1+i)
So,

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

$$=\frac{1\pm\sqrt{1-4(1+i)}}{2}$$

$$= \frac{1 \pm \sqrt{1-4-4i}}{2}$$

$$= \frac{1 \pm \sqrt{-3-4i}}{2}$$

$$= \frac{1 \pm \sqrt{(-1)(3+4i)}}{2}$$

We have $i^2 = -1$

By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{1 \pm \sqrt{i^2(3+4i)}}{2}$$

$$= \frac{1 \pm i\sqrt{3+4i}}{2}$$

We can write $3 + 4i = 4 - 1 + 4i$

$3 + 4i = 4 + i^2 + 4i$ [$\because i^2 = -1$]

$= 2^2 + i^2 + 2(2)(i)$

$= (2 + i)^2$ [Since, $(a + b)^2 = a^2 + b^2 + 2ab$]

By using the result $3 + 4i = (2 + i)^2$, we get

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

$$= \frac{1 \pm i(2+i)}{2}$$

$$= \frac{1 + i(2+i)}{2} \text{ or } \frac{1 - i(2+i)}{2}$$

$$= \frac{1 + 2i + i^2}{2} \text{ or } \frac{1 - 2i - i^2}{2}$$

$$= \frac{1+2i+(-1)}{2} \text{ or } \frac{1-2i-(-1)}{2}$$

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

$x = 2i/2$ or $(2 - 2i)/2$

$x = i$ or $2(1-i)/2$

$x = i$ or $(1 - i)$

∴ The roots of the given equation are $(1-i)$, i

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

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

$ix^2 + x(-1) + 12i = 0$ [We know, $i^2 = -1$]
so by substituting $-1 = i^2$ in the above equation, we get
$ix^2 + xi^2 + 12i = 0$
$i(x^2 + ix + 12) = 0$
$x^2 + ix + 12 = 0$
$x^2 + ix - 12(-1) = 0$
$x^2 + ix - 12i^2 = 0$ [Since, $i^2 = -1$]
$x^2 - 3ix + 4ix - 12i^2 = 0$
$x(x - 3i) + 4i(x - 3i) = 0$
$(x - 3i)(x + 4i) = 0$
$x - 3i = 0$ or $x + 4i = 0$
$x = 3i$ or $-4i$
∴ The roots of the given equation are -4i, 3i

(x) $x^2 - (3\sqrt{2} - 2i)x - \sqrt{2}i = 0$
Given: $x^2 - (3\sqrt{2} - 2i)x - \sqrt{2}i = 0$
We shall apply discriminant rule,
Where, $x = (-b \pm\sqrt{(b^2 - 4ac)})/2a$
Here, $a = 1$, $b = -(3\sqrt{2} - 2i)$, $c = -\sqrt{2}i$
So,

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

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

$$= \frac{\left(3\sqrt{2}-2i\right) \pm \sqrt{18 - 12\sqrt{2}i + 4i^2 + 4\sqrt{2}i}}{2}$$

$$= \frac{\left(3\sqrt{2}-2i\right) \pm \sqrt{18 - 8\sqrt{2}i + 4i^2}}{2}$$

We have $i^2 = -1$
By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{\left(3\sqrt{2}-2i\right) \pm \sqrt{18 - 8\sqrt{2}i + 4(-1)}}{2}$$

$$= \frac{(3\sqrt{2} - 2i) \pm \sqrt{18 - 8\sqrt{2}i - 4}}{2}$$

$$= \frac{(3\sqrt{2} - 2i) \pm \sqrt{14 - 8\sqrt{2}i}}{2}$$

We can write $14 - 8\sqrt{2}i = 16 - 2 - 8\sqrt{2}i$

$14 - 8\sqrt{2}i = 16 + 2(-1) - 8\sqrt{2}i$

$= 16 + 2i^2 - 8\sqrt{2}i$ [Since, $i^2 = -1$]

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

$= (4 - \sqrt{2}i)^2$ [By using the formula, $(a - b)^2 = a^2 - 2ab + b^2$]

By using the result $14 - 8\sqrt{2}i = (4 - \sqrt{2}i)^2$, we get

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

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

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

∴ The roots of the given equation are $\frac{3\sqrt{2} - 2i}{2} \pm \frac{4 - \sqrt{2}i}{2}$

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

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

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

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

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

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

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

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

∴ The roots of the given equation are $i, \sqrt{2}$

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

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

We shall apply discriminant rule,

Where, $x = (-b \pm\sqrt{(b^2 - 4ac)})/2a$

Here, $a = 2$, $b = -(3 + 7i)$, $c = (9i - 3)$

So,

$$x = \frac{-(-(3+7i)) \pm \sqrt{(-(3+7i))^2 - 4(2)(9i-3)}}{2(2)}$$

$$= \frac{(3+7i) \pm \sqrt{(3+7i)^2 - 8(9i-3)}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{9+42i+49i^2-72i+24}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{33-30i+49i^2}}{4}$$

We have $i^2 = -1$

By substituting $-1 = i^2$ in the above equation, we get

$$= \frac{(3+7i) \pm \sqrt{33-30i+49(-1)}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{33-30i-49}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{-16-30i}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{(-1)(16+30i)}}{4}$$

$$= \frac{(3+7i) \pm \sqrt{i^2(16+30i)}}{4}$$

$$= \frac{(3+7i) \pm i\sqrt{16+30i}}{4}$$

We can write $16 + 30i = 25 - 9 + 30i$

$16 + 30i = 25 + 9(-1) + 30i$

$= 25 + 9i^2 + 30i$ [$\because i^2 = -1$]

$= 5^2 + (3i)^2 + 2(5)(3i)$

$= (5 + 3i)^2$ [$\because (a + b)^2 = a^2 + b^2 + 2ab$]

By using the result $16 + 30i = (5 + 3i)^2$, we get

$$x = \frac{(3+7i) \pm i\sqrt{(5+3i)^2}}{4}$$

$$= \frac{(3+7i) \pm i(5+3i)}{4}$$

$$= \frac{(3+7i)+i(5+3i)}{4} \text{ or } \frac{(3+7i)-i(5+3i)}{4}$$

$$= \frac{3+7i+5i+3i^2}{4} \text{ or } \frac{3+7i-5i-3i^2}{4}$$

$$= \frac{3+12i+3i^2}{4} \text{ or } \frac{3+2i-3i^2}{4}$$

$$= \frac{3+12i+3(-1)}{4} \text{ or } \frac{3+2i-3(-1)}{4}$$

$$= \frac{3+12i-3}{4} \text{ or } \frac{3+2i+3}{4}$$

$$= \frac{12}{4}i \text{ or } \frac{6+2i}{4}$$

$$= 3i \text{ or } \frac{6}{4}+\frac{2}{4}i$$

$$x = 3i \text{ or } \frac{3}{2}+\frac{1}{2}i$$

$= 3i$ or $(3 + i)/2$

∴ The roots of the given equation are $(3 + i)/2$, $3i$