

Quadratic Equations

Question 1.

Solve the following (1 to 12) equations:

(i) $x^2 - 11x + 30 = 0$

(ii) $4x^2 - 25 = 0$

Solution:

(i) $x^2 - 11x + 30 = 0$

$$x^2 - 5x - 6x + 30 = 0 \quad \left\{ \begin{array}{l} \because 30 = -5 \times (-6) \\ -11 = -5 - 6 \end{array} \right.$$

$$\Rightarrow x(x - 5) - 6(x - 5) = 0$$

$$\Rightarrow (x - 5)(x - 6) = 0$$

Either, $x - 5 = 0$, then $x = 5$

or $x - 6 = 0$, then $x = 6$

$$\therefore x = 5, 6$$

(ii) $4x^2 - 25 = 0 \Rightarrow 4x^2 = 0 + 25$

$$\Rightarrow x^2 = \frac{25}{4}$$

$$\therefore x = \pm \sqrt{\frac{25}{4}} = \pm \frac{5}{2}$$

$$\therefore x = \frac{5}{2}, \frac{-5}{2}$$

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Question 2.

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

(ii) $x^2 - 2x = 48$

Solution:

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

$x(2x - 5) = 0$

Either, $x = 0$

or $2x - 5 = 0$, then $2x = 5$

$\Rightarrow x = \frac{5}{2}$

$\therefore x = 0, \frac{5}{2}$

(ii) $x^2 - 2x = 48$

$\Rightarrow x^2 - 2x - 48 = 0$

$\Rightarrow x^2 - 8x + 6x - 48 = 0$ $\left\{ \begin{array}{l} \because -48 = -8 \times 6 \\ -2 = -8 + 6 \end{array} \right.$

$\Rightarrow x(x - 8) + 6(x - 8) = 0$

$\Rightarrow (x - 8)(x + 6) = 0$

Either, $x - 8 = 0$, then $x = 8$

or $x + 6 = 0$, then $x = -6$

$\therefore x = 8, -6$

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Question 3.

(i) $6 + x = x^2$

(ii) $2x^2 + 3x + 1 = 0$

Solution:

(i) $6 + x = x^2$

$\Rightarrow x^2 - x - 6 = 0$

$\Rightarrow x^2 - 3x + 2x - 6 = 0$ $\left\{ \begin{array}{l} \because -6 = -3 \times 2 \\ -1 = -3 + 2 \end{array} \right\}$

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

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

Either, $x - 3 = 0$, then $x = 3$

or $x + 2 = 0$, then $x = -2$

$\therefore x = 3, -2$

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

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

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

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

Either, $x - 1 = 0$, then $x = 1$

or $2x - 1 = 0$, then $2x = 1$

$\Rightarrow x = \frac{1}{2}$

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

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Question 4.

(i) $3x^2 = 2x + 8$

(ii) $4x^2 + 15 = 16x$

Solution:

(i) $3x^2 = 2x + 8$

$\Rightarrow 3x^2 - 2x - 8 = 0$

$\Rightarrow 3x^2 - 6x + 4x - 8 = 0 \quad \left\{ \begin{array}{l} \because -8 \times 3 = -24 \\ -24 = -6 \times 4 \\ -2 = -6 + 4 \end{array} \right\}$

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

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

Either, $x - 2 = 0$, then $x = 2$

or $3x + 4 = 0$, then $3x = -4$

$\Rightarrow x = \frac{-4}{3}$

$\therefore x = 2, \frac{-4}{3}$

(ii) $4x^2 + 15 = 16x$

$\Rightarrow 4x^2 - 16x + 15 = 0$

$\Rightarrow 4x^2 - 6x - 10x + 15 = 0$

$\left\{ \begin{array}{l} \because 4 \times 15 = 60 \\ -16 = -6 + (-10) \\ -16 = -6 - 10 \end{array} \right\}$

$\Rightarrow 2x(2x - 3) - 5(2x - 3) = 0$

$\Rightarrow (2x - 3)(2x - 5) = 0$

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

or $2x - 5 = 0$, then $2x = 5 \Rightarrow x = \frac{5}{2}$

$\therefore x = \frac{3}{2}, \frac{5}{2}$

Question 5.

(i) $x(2x + 5) = 25$

(ii) $(x + 3)(x - 3) = 40$

Solution:

(i) $x(2x + 5) = 25$

$$\Rightarrow 2x^2 + 5x - 25 = 0$$

$$\Rightarrow 2x^2 + 10x - 5x - 25 = 0$$

$$\left\{ \begin{array}{l} \because -25 \times 2 = -50 \\ -50 = 10 \times (-5) \\ 5 = 10 - 5 \end{array} \right\}$$

$$\Rightarrow 2x(x + 5) - 5(x + 5) = 0$$

$$\Rightarrow (x + 5)(2x - 5) = 0$$

Either, $x + 5 = 0$, then $x = -5$

or $2x - 5 = 0$, then $2x = 5 \Rightarrow x = \frac{5}{2}$

$$\therefore x = -5, \frac{5}{2}$$

(ii) $(x + 3)(x - 3) = 40$

$$\Rightarrow x^2 - 9 = 40 \Rightarrow x^2 - 9 - 40 = 0$$

$$\Rightarrow x^2 - 49 = 0 \Rightarrow (x)^2 - (7)^2 = 0$$

$$\Rightarrow (x + 7)(x - 7) = 0$$

Either, $x + 7 = 0$, then $x = -7$

or $x - 7 = 0$, then $x = 7$

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

Question 6.

(i) $(2x + 3)(x - 4) = 6$

(ii) $(3x + 1)(2x + 3) = 3$

Solution:

(i) $(2x + 3)(x - 4) = 6$

$$\Rightarrow 2x^2 - 8x + 3x - 12 - 6 = 0$$

$$\Rightarrow 2x^2 - 5x - 18 = 0$$

$$\Rightarrow 2x^2 - 9x + 4x - 18 = 0$$

$$\left\{ \begin{array}{l} \because -18 \times 2 = -36 \\ \therefore -36 = -9 \times 4 \\ -5 = -9 + 4 \end{array} \right\}$$

$$\Rightarrow x(2x - 9) + 2(2x - 9) = 0$$

$$\Rightarrow (2x - 9)(x + 2) = 0$$

Either, $2x - 9 = 0$, then $2x = 9 \Rightarrow x = \frac{9}{2}$

or $x + 2 = 0$, then $x = -2$

$$\therefore x = \frac{9}{2}, -2$$

(ii) $(3x + 1)(2x + 3) = 3$

$$\Rightarrow 6x^2 + 9x + 2x + 3 - 3 = 0$$

$$\Rightarrow 6x^2 + 11x = 0$$

$$\Rightarrow x(6x + 11) = 0$$

Either, $x = 0$,

or $6x + 11 = 0$, then $6x = -11 \Rightarrow x = \frac{-11}{6}$

$$\therefore x = 0, \frac{-11}{6}$$

Question 7.

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

(ii) $(x - 4)^2 + 5^2 = 132$

Solution:

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

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

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

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

Either, $2x + 1 = 0$, then $x = \frac{-1}{2}$

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

(ii) $(x - 4)^2 + 5^2 = 132$

$\Rightarrow x^2 - 8x + 16 + 25 = 169$

$x^2 - 8x + 16 + 25 - 169 = 0$

$x^2 - 8x - 128 = 0$

$x^2 - 16x + 8x - 128 = 0 \left\{ \begin{array}{l} \because -128 = -16 \times 8 \\ -8 = -16 + 8 \end{array} \right.$

$x(x - 16) + 8(x - 16) = 0$

$(x - 16)(x + 8) = 0$

Either, $x - 16 = 0$, then $x = 16$

or $x + 8 = 0$, then $x = -8$

$\therefore x = 16, -8$

Question 8.

(i) $21x^2 = 4(2x + 1)$

(ii) $\frac{2}{3}x^2 - \frac{1}{3}x - 1 = 0$

Solution:

(i) $21x^2 = 4(2x + 1)$

$\Rightarrow 21x^2 = 8x + 4$

$\Rightarrow 21x^2 - 8x - 4 = 0$

$\Rightarrow 21x^2 - 14x + 6x - 4 = 0 \left\{ \begin{array}{l} \because 21 \times (-4) = -84 \\ \therefore -84 = -14 \times 6 \\ -8 = -14 + 6 \end{array} \right.$

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

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

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

or $7x + 2 = 0$, then $7x = -2 \Rightarrow x = \frac{-2}{7}$

$\therefore x = \frac{2}{3}, \frac{-2}{7}$

(ii) $\frac{2}{3}x^2 - \frac{1}{3}x - 1 = 0$

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

$\Rightarrow 2x^2 - 3x + 2x - 3 = 0$

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

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

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

or $x + 1 = 0$, then $x = -1$

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

Question 10.

(i) $3x - \frac{8}{x} = 2$

(ii) $\frac{x}{3} + \frac{9}{x} = 4$

Solution:

(Note: The following text is a mirrored watermark from the reverse side of the page, appearing as bleed-through. It contains the same mathematical solutions as the original document.)

(i) $3x - \frac{8}{x} = 2$
 $3x^2 - 8 = 2x$
 $3x^2 - 2x - 8 = 0$
 $3x^2 - 8x + 6x - 8 = 0$
 $x(3x - 8) + 2(3x - 8) = 0$
 $(3x - 8)(x + 2) = 0$
 $3x - 8 = 0$ or $x + 2 = 0$
 $3x = 8$ or $x = -2$
 $x = \frac{8}{3}$ or $x = -2$

(ii) $\frac{x}{3} + \frac{9}{x} = 4$
 $x^2 + 27 = 12x$
 $x^2 - 12x + 27 = 0$
 $x^2 - 9x + 3x - 27 = 0$
 $x(x - 9) + 3(x - 9) = 0$
 $(x - 9)(x + 3) = 0$
 $x - 9 = 0$ or $x + 3 = 0$
 $x = 9$ or $x = -3$

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Question 11.

$$(i) \frac{x-1}{x+1} = \frac{2x-5}{3x-7}$$

$$(ii) \frac{1}{x+2} + \frac{1}{x} = \frac{3}{4}$$

Solution:

$$(i) \frac{x-1}{x+1} = \frac{2x-5}{3x-7}$$

By cross multiplication,

$$(x-1)(3x-7) = (x+1)(2x-5)$$

$$\Rightarrow 3x^2 - 7x - 3x + 7 = 2x^2 - 5x + 2x - 5$$

$$3x^2 - 10x + 7 = 2x^2 - 3x - 5 = 0$$

$$3x^2 - 10x + 7 - 2x^2 + 3x + 5 = 0$$

$$\Rightarrow x^2 - 7x + 12 = 0$$

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

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

$$\left\{ \begin{array}{l} \because 12 = -4 \times (-3) \\ -7 = -4 - 3 \end{array} \right\}$$

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

Either, $x - 4 = 0$, then $x = 4$

or $x - 3 = 0$, then $x = 3$

$$\therefore x = 3, 4$$

$$(ii) \frac{1}{x+2} + \frac{1}{x} = \frac{3}{4}$$

$$\frac{x+x+2}{x(x+2)} = \frac{3}{4} \Rightarrow \frac{2x+2}{x(x+2)} = \frac{3}{4}$$

By cross multiplication,

$$\Rightarrow 3x(x+2) = 4(2x+2)$$

$$\Rightarrow 3x^2 + 6x = 8x + 8$$

$$\Rightarrow 3x^2 + 6x - 8x - 8 = 0$$

$$\Rightarrow 3x^2 - 2x - 8 = 0$$

$$\Rightarrow 3x^2 - 6x + 4x - 8 = 0$$

$$\left\{ \begin{array}{l} \because 3 \times (-8) = -24 \\ \therefore -24 = -6 \times 4 \\ -2 = -6 + 4 \end{array} \right\}$$

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

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

Either, $x - 2 = 0$, then $x = 2$

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

$$\text{Hence, } x = 2, \frac{-4}{3}$$

Question 12.

$$(i) \frac{8}{x+3} - \frac{3}{2-x} = 2$$

$$(ii) \frac{x}{x+1} + \frac{x+1}{x} = 2\frac{1}{6}$$

Solution:

$$(i) \frac{8}{x+3} - \frac{3}{2-x} = 2$$

$$\Rightarrow \frac{8(2-x) - 3(x+3)}{(x+3)(2-x)} = \frac{2}{1}$$

$$\Rightarrow \frac{16 - 8x - 3x - 9}{2x - x^2 + 6 - 3x} = \frac{2}{1}$$

$$\Rightarrow \frac{7 - 11x}{-x^2 - x + 6} = \frac{2}{1}$$

$$\Rightarrow 7 - 11x = -2x^2 - 2x + 12$$

(By cross multiplication)

$$\Rightarrow 2x^2 + 2x - 12 + 7 - 11x = 0$$

$$\Rightarrow 2x^2 - 9x - 5 = 0$$

$$\Rightarrow 2x^2 - 10x + x - 5 = 0$$

$$\left\{ \begin{array}{l} \because 2 \times (-5) = -10 \\ \therefore -10 = -10 \times 1 \\ -9 = -10 + 1 \end{array} \right.$$

$$\Rightarrow 2x(x - 5) + 1(x - 5) = 0$$

$$\Rightarrow (x - 5)(2x + 1) = 0$$

Either, $x - 5 = 0$, then $x = 5$

$$\text{or } 2x + 1 = 0, \text{ then } 2x = -1 \Rightarrow x = \frac{-1}{2}$$

$$\text{or } 2x + 1 = 0, \text{ then } 2x = -1 \Rightarrow x = \frac{-1}{2}$$

$$\therefore x = 5, \frac{-1}{2}$$

$$(ii) \frac{x}{x+1} + \frac{x+1}{x} = 2\frac{1}{6}$$

$$\frac{x^2 + (x+1)^2}{x(x+1)} = \frac{13}{6}$$

$$\Rightarrow \frac{x^2 + x^2 + 2x + 1}{x^2 + x} = \frac{13}{6}$$

$$\Rightarrow \frac{2x^2 + 2x + 1}{x^2 + x} = \frac{13}{6}$$

$$13x^2 + 13x = 12x^2 + 12x + 6$$

$$\Rightarrow 13x^2 + 13x - 12x^2 - 12x - 6 = 0$$

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

$$\Rightarrow x^2 + 3x - 2x - 6 = 0 \quad \left\{ \begin{array}{l} \because -6 = 3 \times (-2) \\ 1 = 3 - 2 \end{array} \right\}$$

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

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

$$\text{Either, } x + 3 = 0, \text{ then } x = -3$$

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

$$\therefore x = 2, -3$$

Multiple Choice Questions

Choose the correct Solution from the given four options (1 to 5):

Question 1.

Which of the following is not a quadratic equation :

- (a) $2x^2 = 3x - 5$
- (b) $(2x - 1)(x - 1) = 2x^2 - 7x + 2$
- (c) $(2x - 1)(x + 2) = (x - 1)(x + 1)$
- (d) $(x + 1), = x, + 2x + 2$

Solution:

$(2x - 1)(x - 1) = 2x^2 - 7x + 2$ is not a quadratic equation. (b)

Question 2.

If 2 is a root of the quadratic equation $2x^2 - kx + 1 = 0$, then the value of k is

- (a) 9
- (b) -9
- (c) $\frac{9}{2}$
- (d) $-\frac{9}{2}$

Solution:

$$\because 2 \text{ is root of } 2x^2 - kx + 1 = 0$$

$$\therefore 2(2)^2 - k(2) + 1 = 0$$

$$8 - 2k + 1 = 0 \Rightarrow 9 = 2k$$

$$\Rightarrow k = \frac{9}{2} \quad \text{(c)}$$

Question 3.

If -3 is a root of the quadratic equation $kx^2 + 2x - 3 = 0$, then the value of k is

- (a) 1
- (b) -1
- (c) $\frac{1}{9}$
- (d) $\frac{1}{-9}$

Solution:

-3 is a root of quadratic equation.

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

$$\Rightarrow k(-3)^2 + 2(-3) - 3 = 0$$

$$\Rightarrow 9k - 6 - 3 = 0 \Rightarrow 9k = 9$$

$$\Rightarrow k = \frac{9}{9} = 1 \quad \text{(a)}$$

Question 4.

Which of the following quadratic equations has -1 as a root?

- (a) $x^2 + 5x + 6 = 0$
- (b) $2x^2 - 3x + 1 = 0$
- (c) $2x^2 + x - 3 = 0$
- (d) $2x^2 - x - 3 = 0$

Solution:

\because -1 is a root of the quadratic equation.

\therefore It will satisfy it

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

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

$$\Rightarrow 2 + 1 - 3 = 0$$

$$\Rightarrow 3 - 3 = 0$$

(d)

Question 5.

The root of the quadratic equation $x^2 - 3x - 4 = 0$ are

- (a) -4, 1
- (b) 4, -1
- (c) 4, 1
- (d) -4, -1

Solution:

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

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

$$\Rightarrow (x - 4)(x + 1) = 0$$

$$\text{If } x - 4 = 0, \text{ then } x = 4$$

$$x + 1 = 0, \text{ then } x = -1$$

$$\therefore x = 4, -1$$

(b)

Chapter Test

Solve the following (1 to 3) equations:

Question 1.

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

(ii) $3x^2 - 4x - 4 = 0$

Solution:

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

$$\Rightarrow 2x^2 + 5x - 3 = 0 \quad \left\{ \begin{array}{l} \because 2 \times (-3) = -6 \\ \therefore -6 = 6 \times (-1) \\ 5 = 6 - 1 \end{array} \right\}$$

$$\Rightarrow 2x^2 + 6x - x - 3 = 0$$

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

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

Either, $x + 3 = 0$, then $x = -3$

or $2x - 1 = 0$, then $2x = 1 \Rightarrow x = \frac{1}{2}$

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

(ii) $3x^2 - 4x - 4 = 0$

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

$$\left\{ \begin{array}{l} \because 3 \times (-4) = -12 \\ \therefore -12 = -6 \times 2 \\ -4 = -6 + 2 \end{array} \right\}$$

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

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

Either, $x - 2 = 0$, then $x = 2$

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

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

Question 2.

(i) $4x^2 - 2x + \frac{1}{4} = 0$

(ii) $2x^2 + 7x + 6 = 0$

Solution:

(i) $4x^2 - 2x + \frac{1}{4} = 0$

$\Rightarrow 16x^2 - 8x + 1 = 0$

$\Rightarrow 16x^2 - 8x + 1 = 0$

$\Rightarrow 16x^2 - 4x - 4x + 1 = 0$

$\Rightarrow 4x(4x - 1) - 1(4x - 1) = 0$

$\Rightarrow (4x - 1)(4x - 1) = 0 \Rightarrow (4x - 1)^2 = 0$

$\Rightarrow 4x - 1 = 0 \Rightarrow 4x = 1$

$\therefore x = \frac{1}{4}, \frac{1}{4}$

(ii) $2x^2 + 7x + 6 = 0$

$\Rightarrow 2x^2 + 4x + 3x + 6 = 0$ $\left\{ \begin{array}{l} \because 2 \times 6 = 12 \\ \because 12 = 3 \times 4 \\ 7 = 3 + 4 \end{array} \right.$

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

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

Either, $x + 2 = 0$, then $x = -2$

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

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

Question 3.

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

$$(ii) \frac{6}{x} - \frac{2}{x-1} = \frac{1}{x-2}$$

Solution:

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

$$\frac{(x-1)(x-4) + (x-2)(x-3)}{(x-2)(x-4)} = \frac{10}{3}$$

$$\Rightarrow \frac{x^2 - 5x + 4 + x^2 - 5x + 6}{x^2 - 6x + 8} = \frac{10}{3}$$

$$\Rightarrow \frac{2x^2 - 10x + 10}{x^2 - 6x + 8} = \frac{10}{3}$$

$$\Rightarrow 10x^2 - 60x + 80 = 6x^2 - 30x + 30$$

$$\Rightarrow 10x^2 - 60x + 80 - 6x^2 + 30x - 30 = 0$$

$$\Rightarrow 4x^2 - 30x + 50 = 0$$

$$\Rightarrow 2x^2 - 15x + 25 = 0$$

$$\Rightarrow 2x^2 - 10x - 5x + 25 = 0$$

$$\left. \begin{array}{l} \because 2 \times 25 = 50 \\ \therefore 50 = -10 \times (-5) \\ -15 = -10 - 5 \end{array} \right\}$$

$$\Rightarrow 2x(x-5) - 5(x-5) = 0$$

$$\Rightarrow (x-5)(2x-5) = 0$$

Either, $x - 5 = 0$, then $x = 5$

or $2x - 5 = 0$, then $2x = 5 \Rightarrow x = \frac{5}{2}$

$$\therefore x = 5, \frac{5}{2}$$

$$(ii) \frac{6}{x} - \frac{2}{x-1} = \frac{1}{x-2}$$

$$\frac{6x - 6 - 2x}{x(x-1)} = \frac{1}{x-2}$$

$$\Rightarrow \frac{4x - 6}{x^2 - x} = \frac{1}{x-2}$$

$$\Rightarrow (4x - 6)(x - 2) = x^2 - x$$

(By cross multiplication)

$$\Rightarrow 4x^2 - 8x - 6x + 12 = x^2 - x$$

$$\Rightarrow 4x^2 - 14x + 12 - x^2 + x = 0$$

$$\Rightarrow 3x^2 - 13x + 12 = 0$$

$$\Rightarrow 3x^2 - 4x - 9x + 12 = 0$$

$$\left. \begin{array}{l} \because 3 \times 12 = 36 \\ \therefore 36 = (-4) \times (-9) \\ -13 = -4 - 9 \end{array} \right\}$$

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

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

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

or $x - 3 = 0$, then $x = 3$

$$\therefore x = 3, \frac{4}{3}$$