

EXERCISE 2.1

1. Write the following quadratic equations in standard form:

(i) $3x - 1 = 2x^2$	(ii) $2x(x + 1) = 4(2x + 3)$
(iii) $2x^2 - 4x = 4x + 7$	(iv) $4(3x - 2) = 9x^2$
(v) $2x + \frac{1}{x} = 5 - \frac{1}{x}, x \neq 0$	(vi) $\frac{6x+6}{20-x} = \frac{1}{x}, x \neq 0, 20$

2. Solve the following quadratic equations by factorization method:

(i) $x^2 - x - 6 = 0$	(ii) $x^2 + 3x - 28 = 0$
(iii) $6x^2 + 13x - 5 = 0$	(iv) $x^2 - \frac{3}{2}x = \frac{9}{2}$
(v) $\frac{3x-8}{x-2} = \frac{5x-2}{x+5}, x \neq 2, -5$	(vi) $\frac{1}{x-1} - \frac{1}{x+3} = \frac{1}{35}, x \neq 1, -3$

3. Solve the following quadratic equations by completing square method:

(i) $2x^2 + 5x + 2 = 0$	(ii) $x^2 + x = 42$
(iii) $12x^2 + 7x = 12$	(iv) $\frac{x+3}{2x-7} = \frac{2x-1}{x-3}, x \neq \frac{7}{2}, 3$
(v) $\frac{1}{1+x} - \frac{1}{3-x} = \frac{6}{35}, x \neq -1, 3$	(vi) $\frac{3x-1}{4x+7} = 1 - \frac{6}{x+7}, x \neq -\frac{7}{4}, -7$

4. Use quadratic formula to solve the following equations:

(i) $2x^2 - 5x + 3 = 0$	(ii) $2x^2 - 7x - 15 = 0$
(iii) $2x^2 + 7x = 15$	(iv) $x^2 + 11 = 7x$
(v) $\frac{x+4}{x-4} + \frac{x-2}{x-3} = 6\frac{1}{3}, x \neq 4, 3$	(vi) $\frac{3x-3}{x+1} = \frac{2x-1}{x-1}, x \neq -1, 1$

5. Solve the following quadratic equations graphically:

(i) $x^2 - 3x - 18 = 0$	(ii) $x^2 - 5x - 14 = 0$
(iii) $2x^2 + 13x + 6 = 0$	(iv) $4x^2 + 12x - 27 = 0$

Quadratic Equations - Exercise 2.1 Solutions

Question 1: Write the following quadratic equations in standard form

Recall: Standard form of a quadratic equation is $ax^2 + bx + c = 0$, where $a \neq 0$

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

Step 1: Bring all terms to one side (keep x^2 term positive):

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

Step 2: Rearrange in descending powers:

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

Step 3: Multiply by -1 to make $a > 0$:

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

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

(ii) $2x(x + 1) = 4(2x + 3)$

Step 1: Expand both sides:

LHS: $2x(x + 1) = 2x^2 + 2x$

RHS: $4(2x + 3) = 8x + 12$

Step 2: Equate and bring all terms to one side:

$$2x^2 + 2x = 8x + 12$$

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

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

Step 3: Divide by 2 (optional, to simplify):

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

Answer: $x^2 - 3x - 6 = 0$

(iii) $2x^2 - 4x = 4x + 7$

Step 1: Bring all terms to one side:

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

Step 2: Combine like terms:

$$2x^2 - 8x - 7 = 0$$

Answer: $2x^2 - 8x - 7 = 0$

(iv) $4(3x - 2) = 9x^2$

Step 1: Expand LHS:

$$12x - 8 = 9x^2$$

Step 2: Bring all terms to one side (keep x^2 term positive):

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

Step 3: Rewrite in standard form:

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

Answer: $9x^2 - 12x + 8 = 0$

(v) $2x + \frac{1}{x} = 5 - \frac{1}{x}, x \neq 0$

Step 1: Multiply both sides by x (since $x \neq 0$):

$$2x \cdot x + \frac{1}{x} \cdot x = 5x - \frac{1}{x} \cdot x$$

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

Step 2: Bring all terms to one side:

$$2x^2 + 1 - 5x + 1 = 0$$

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

Answer: $2x^2 - 5x + 2 = 0$

(vi) $\frac{6x+6}{20-x} = \frac{1}{x}, x \neq 0, 20$

Step 1: Cross multiply (since $x \neq 0$ and $x \neq 20$):

$$x(6x + 6) = 1(20 - x)$$

Step 2: Expand both sides:

$$6x^2 + 6x = 20 - x$$

Step 3: Bring all terms to one side:

$$6x^2 + 6x - 20 + x = 0$$

$$6x^2 + 7x - 20 = 0$$

Answer: $6x^2 + 7x - 20 = 0$

Final Answers Summary

	Standard Form
(i)	$2x^2 - 3x + 1 = 0$
(ii)	$x^2 - 3x - 6 = 0$
(iii)	$2x^2 - 8x - 7 = 0$
(iv)	$9x^2 - 12x + 8 = 0$
(v)	$2x^2 - 5x + 2 = 0$
(vi)	$6x^2 + 7x - 20 = 0$

Quadratic Equations - Exercise 2.1 (Continued)

Question 2: Solve by Factorization Method

(i) $x^2 - x - 6 = 0$

Step 1: Find two numbers whose product = -6 and sum = -1

Step 2: Numbers are -3 and 2 (since $-3 \times 2 = -6$, $-3 + 2 = -1$)

Step 3: Factor: $(x - 3)(x + 2) = 0$

Step 4: $x - 3 = 0$ or $x + 2 = 0$

Answer: $x = 3$ or $x = -2$

(ii) $x^2 + 3x - 28 = 0$

Step 1: Find two numbers whose product = -28 and sum = 3

Step 2: Numbers are 7 and -4 (since $7 \times (-4) = -28$, $7 + (-4) = 3$)

Step 3: Factor: $(x + 7)(x - 4) = 0$

Step 4: $x + 7 = 0$ or $x - 4 = 0$

Answer: $x = -7$ or $x = 4$

(iii) $6x^2 + 13x - 5 = 0$

Step 1: Multiply $a \times c = 6 \times (-5) = -30$

Step 2: Find two numbers whose product = -30 and sum = 13

Step 3: Numbers are 15 and -2 (since $15 \times (-2) = -30$, $15 + (-2) = 13$)

Step 4: Rewrite: $6x^2 + 15x - 2x - 5 = 0$

Step 5: Factor by grouping: $3x(2x + 5) - 1(2x + 5) = 0$

Step 6: $(3x - 1)(2x + 5) = 0$

Step 7: $3x - 1 = 0$ or $2x + 5 = 0$

Answer: $x = \frac{1}{3}$ or $x = -\frac{5}{2}$

(iv) $x^2 - \frac{3}{2}x = \frac{9}{2}$

Step 1: Multiply by 2: $2x^2 - 3x = 9$

Step 2: Bring all terms: $2x^2 - 3x - 9 = 0$

Step 3: $a \times c = 2 \times (-9) = -18$

Step 4: Numbers whose product = -18 and sum = -3 are -6 and 3

Step 5: $2x^2 - 6x + 3x - 9 = 0$

Step 6: $2x(x - 3) + 3(x - 3) = 0$

Step 7: $(2x + 3)(x - 3) = 0$

Answer: $x = -\frac{3}{2}$ or $x = 3$

(v) $\frac{3x-8}{x-2} = \frac{5x-2}{x+5}, x \neq 2, -5$

Step 1: Cross multiply: $(3x - 8)(x + 5) = (5x - 2)(x - 2)$

Step 2: Expand: $3x^2 + 15x - 8x - 40 = 5x^2 - 10x - 2x + 4$

Step 3: $3x^2 + 7x - 40 = 5x^2 - 12x + 4$

Step 4: Bring all terms: $0 = 5x^2 - 12x + 4 - 3x^2 - 7x + 40$

Step 5: $2x^2 - 19x + 44 = 0$

Step 6: $a \times c = 2 \times 44 = 88$

Step 7: Numbers whose product = 88 and sum = -19 are -11 and -8

Step 8: $2x^2 - 8x - 11x + 44 = 0$

Step 9: $2x(x - 4) - 11(x - 4) = 0$

Step 10: $(2x - 11)(x - 4) = 0$

Answer: $x = \frac{11}{2}$ or $x = 4$

(vi) $\frac{1}{x-1} - \frac{1}{x+3} = \frac{1}{35}, x \neq 1, -3$

Step 1: LCM of denominators: $(x - 1)(x + 3)$

Step 2: $\frac{(x+3)-(x-1)}{(x-1)(x+3)} = \frac{1}{35}$

Step 3: $\frac{x+3-x+1}{(x-1)(x+3)} = \frac{4}{(x-1)(x+3)} = \frac{1}{35}$

Step 4: Cross multiply: $4 \times 35 = (x - 1)(x + 3)$

Step 5: $140 = x^2 + 3x - x - 3 = x^2 + 2x - 3$

Step 6: $x^2 + 2x - 143 = 0$

Step 7: Factors: $(x + 13)(x - 11) = 0$

Answer: $x = -13$ or $x = 11$

Question 3: Solve by Completing Square Method

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

Step 1: Divide by 2: $x^2 + \frac{5}{2}x + 1 = 0$

Step 2: $x^2 + \frac{5}{2}x = -1$

Step 3: Add $\left(\frac{5}{4}\right)^2 = \frac{25}{16}$ to both sides:

$$x^2 + \frac{5}{2}x + \frac{25}{16} = -1 + \frac{25}{16}$$

Step 4: $\left(x + \frac{5}{4}\right)^2 = -\frac{16}{16} + \frac{25}{16} = \frac{9}{16}$

Step 5: $x + \frac{5}{4} = \pm \frac{3}{4}$

Step 6: $x = -\frac{5}{4} \pm \frac{3}{4}$

Answer: $x = -\frac{1}{2}$ or $x = -2$

(ii) $x^2 + x = 42$

Step 1: $x^2 + x - 42 = 0 \rightarrow x^2 + x = 42$

Step 2: Add $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$ to both sides:

$$x^2 + x + \frac{1}{4} = 42 + \frac{1}{4}$$

Step 3: $\left(x + \frac{1}{2}\right)^2 = \frac{168}{4} + \frac{1}{4} = \frac{169}{4}$

Step 4: $x + \frac{1}{2} = \pm \frac{13}{2}$

Step 5: $x = -\frac{1}{2} \pm \frac{13}{2}$

Answer: $x = 6$ or $x = -7$

(iii) $12x^2 + 7x = 12$

Step 1: $12x^2 + 7x - 12 = 0$

Step 2: Divide by 12: $x^2 + \frac{7}{12}x - 1 = 0$

Step 3: $x^2 + \frac{7}{12}x = 1$

Step 4: Add $\left(\frac{7}{24}\right)^2 = \frac{49}{576}$ to both sides:

$$x^2 + \frac{7}{12}x + \frac{49}{576} = 1 + \frac{49}{576}$$

Step 5: $\left(x + \frac{7}{24}\right)^2 = \frac{576}{576} + \frac{49}{576} = \frac{625}{576}$

Step 6: $x + \frac{7}{24} = \pm \frac{25}{24}$

Step 7: $x = -\frac{7}{24} \pm \frac{25}{24}$

Answer: $x = \frac{3}{4}$ or $x = -\frac{4}{3}$

(iv) $\frac{x+3}{2x-7} = \frac{2x-1}{x-3}, x \neq \frac{7}{2}, 3$

Step 1: Cross multiply: $(x+3)(x-3) = (2x-1)(2x-7)$

Step 2: $x^2 - 9 = 4x^2 - 14x - 2x + 7 = 4x^2 - 16x + 7$

Step 3: $0 = 4x^2 - 16x + 7 - x^2 + 9$

Step 4: $3x^2 - 16x + 16 = 0$

Step 5: Divide by 3: $x^2 - \frac{16}{3}x + \frac{16}{3} = 0$

Step 6: $x^2 - \frac{16}{3}x = -\frac{16}{3}$

Step 7: Add $\left(-\frac{8}{3}\right)^2 = \frac{64}{9}$:

$$x^2 - \frac{16}{3}x + \frac{64}{9} = -\frac{16}{3} + \frac{64}{9} = -\frac{48}{9} + \frac{64}{9} = \frac{16}{9}$$

Step 8: $\left(x - \frac{8}{3}\right)^2 = \frac{16}{9}$

Step 9: $x - \frac{8}{3} = \pm \frac{4}{3}$

Answer: $x = 4$ or $x = \frac{4}{3}$

(v) $\frac{1}{1+x} - \frac{1}{3-x} = \frac{6}{35}, x \neq -1, 3$

Step 1: LCM: $(1+x)(3-x)$

Step 2: $\frac{(3-x)-(1+x)}{(1+x)(3-x)} = \frac{3-x-1-x}{(1+x)(3-x)} = \frac{2-2x}{(1+x)(3-x)} = \frac{6}{35}$

Step 3: $35(2-2x) = 6(1+x)(3-x)$

Step 4: $70 - 70x = 6(3-x+3x-x^2) = 6(3+2x-x^2)$

Step 5: $70 - 70x = 18 + 12x - 6x^2$

Step 6: $6x^2 - 82x + 52 = 0$

Step 7: Divide by 2: $3x^2 - 41x + 26 = 0$

Step 8: Divide by 3: $x^2 - \frac{41}{3}x + \frac{26}{3} = 0$

Step 9: $x^2 - \frac{41}{3}x = -\frac{26}{3}$

Step 10: Add $\left(-\frac{41}{6}\right)^2 = \frac{1681}{36}$:

$$x^2 - \frac{41}{3}x + \frac{1681}{36} = -\frac{26}{3} + \frac{1681}{36} = -\frac{312}{36} + \frac{1681}{36} = \frac{1369}{36}$$

Step 11: $\left(x - \frac{41}{6}\right)^2 = \frac{1369}{36}$

Step 12: $x - \frac{41}{6} = \pm \frac{37}{6}$

Answer: $x = 13$ or $x = \frac{2}{3}$

(vi) $\frac{3x-1}{4x+7} = 1 - \frac{6}{x+7}, x \neq -\frac{7}{4}, -7$

Step 1: RHS: $1 - \frac{6}{x+7} = \frac{x+7-6}{x+7} = \frac{x+1}{x+7}$

Step 2: $\frac{3x-1}{4x+7} = \frac{x+1}{x+7}$

Step 3: Cross multiply: $(3x-1)(x+7) = (x+1)(4x+7)$

Step 4: $3x^2 + 21x - x - 7 = 4x^2 + 7x + 4x + 7$

Step 5: $3x^2 + 20x - 7 = 4x^2 + 11x + 7$

Step 6: $0 = x^2 - 9x + 14$

Step 7: $x^2 - 9x + 14 = 0$

Step 8: Complete square: $x^2 - 9x = -14$

Step 9: Add $\left(\frac{9}{2}\right)^2 = \frac{81}{4}$:

$$x^2 - 9x + \frac{81}{4} = -14 + \frac{81}{4} = -\frac{56}{4} + \frac{81}{4} = \frac{25}{4}$$

Step 10: $\left(x - \frac{9}{2}\right)^2 = \frac{25}{4}$

Step 11: $x - \frac{9}{2} = \pm \frac{5}{2}$

Answer: $x = 7$ or $x = 2$

Question 4: Use Quadratic Formula

Recall: For $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

Step 1: $a = 2, b = -5, c = 3$

Step 2: $b^2 - 4ac = (-5)^2 - 4(2)(3) = 25 - 24 = 1$

Step 3: $x = \frac{5 \pm \sqrt{1}}{4} = \frac{5 \pm 1}{4}$

Answer: $x = \frac{3}{2}$ or $x = 1$

(ii) $2x^2 - 7x - 15 = 0$

Step 1: $a = 2, b = -7, c = -15$

Step 2: $b^2 - 4ac = 49 - 4(2)(-15) = 49 + 120 = 169$

Step 3: $x = \frac{7 \pm \sqrt{169}}{4} = \frac{7 \pm 13}{4}$

Answer: $x = 5$ or $x = -\frac{3}{2}$

(iii) $2x^2 + 7x = 15$

Step 1: $2x^2 + 7x - 15 = 0$

Step 2: $a = 2, b = 7, c = -15$

Step 3: $b^2 - 4ac = 49 - 4(2)(-15) = 49 + 120 = 169$

Step 4: $x = \frac{-7 \pm \sqrt{169}}{4} = \frac{-7 \pm 13}{4}$

Answer: $x = \frac{3}{2}$ or $x = -5$

(iv) $x^2 + 11 = 7x$

Step 1: $x^2 - 7x + 11 = 0$

Step 2: $a = 1, b = -7, c = 11$

Step 3: $b^2 - 4ac = 49 - 4(1)(11) = 49 - 44 = 5$

Step 4: $x = \frac{7 \pm \sqrt{5}}{2}$

Answer: $x = \frac{7 \pm \sqrt{5}}{2}$

(v) $\frac{x+4}{x-4} + \frac{x-2}{x-3} = \frac{6}{3}, x \neq 4, 3$

Step 1: $\text{RHS} = 2$

Step 2: LCM: $(x-4)(x-3)$

Step 3: $(x+4)(x-3) + (x-2)(x-4) = 2(x-4)(x-3)$

Step 4: $(x^2 + x - 12) + (x^2 - 6x + 8) = 2(x^2 - 7x + 12)$

Step 5: $2x^2 - 5x - 4 = 2x^2 - 14x + 24$

Step 6: $-5x - 4 = -14x + 24$

Step 7: $9x = 28$

Answer: $x = \frac{28}{9}$

(vi) $\frac{3x-3}{x+1} = \frac{2x-1}{x-1}, x \neq -1, 1$

Step 1: Cross multiply: $(3x-3)(x-1) = (2x-1)(x+1)$

Step 2: $3x^2 - 3x - 3x + 3 = 2x^2 + 2x - x - 1$

Step 3: $3x^2 - 6x + 3 = 2x^2 + x - 1$

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

Step 5: $a = 1, b = -7, c = 4$

Step 6: $b^2 - 4ac = 49 - 16 = 33$

Answer: $x = \frac{7 \pm \sqrt{33}}{2}$

Question 5: Solve Graphically

Note: For graphical solutions, the roots are the x-intercepts of the parabola $y = ax^2 + bx + c$

(i) $x^2 - 3x - 18 = 0$

Step 1: Factor: $(x-6)(x+3) = 0$

Step 2: Roots: $x = 6$ and $x = -3$

Step 3: Vertex: $x = \frac{3}{2}, y = \left(\frac{3}{2}\right)^2 - 3\left(\frac{3}{2}\right) - 18 = \frac{9}{4} - \frac{9}{2} - 18 = -\frac{81}{4}$

Answer: $x = 6$ or $x = -3$

(ii) $x^2 - 5x - 14 = 0$

Step 1: Factor: $(x-7)(x+2) = 0$

Step 2: Roots: $x = 7$ and $x = -2$

Step 3: Vertex: $x = \frac{5}{2}, y = \left(\frac{5}{2}\right)^2 - 5\left(\frac{5}{2}\right) - 14 = \frac{25}{4} - \frac{25}{2} - 14 = -\frac{81}{4}$

Answer: $x = 7$ or $x = -2$

(iii) $2x^2 + 13x + 6 = 0$

Step 1: $a \times c = 12$, numbers: 12 and 1

Step 2: $2x^2 + 12x + x + 6 = 0$

Step 3: $2x(x+6) + 1(x+6) = 0$

Step 4: $(2x+1)(x+6) = 0$

Answer: $x = -\frac{1}{2}$ or $x = -6$

(iv) $4x^2 + 12x - 27 = 0$

Step 1: $a \times c = 4 \times (-27) = -108$

Step 2: Numbers whose product = -108 and sum = 12 are 18 and -6

Step 3: $4x^2 + 18x - 6x - 27 = 0$

Step 4: $2x(2x + 9) - 3(2x + 9) = 0$

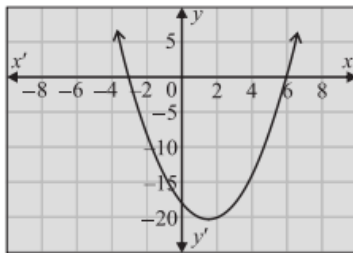
Step 5: $(2x - 3)(2x + 9) = 0$

Answer: $x = \frac{3}{2}$ or $x = -\frac{9}{2}$

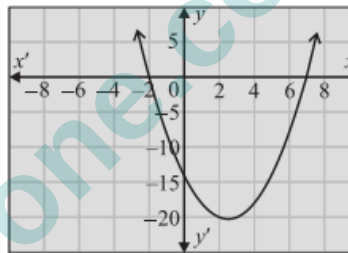
Final Answers Summary - Question 5

Equation	Roots
$x^2 - 3x - 18 = 0$	$x = 6, -3$
$x^2 - 5x - 14 = 0$	$x = 7, -2$
$2x^2 + 13x + 6 = 0$	$x = -\frac{1}{2}, -6$
$4x^2 + 12x - 27 = 0$	$x = \frac{3}{2}, -\frac{9}{2}$

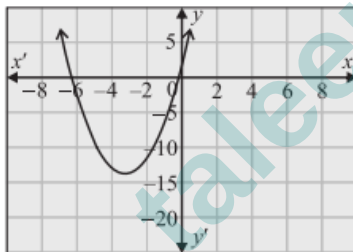
5. (i) Solution set = $\{-3, 6\}$



(ii) Solution set = $\{-2, 7\}$



(iii) Solution set = $\{-6, -0.5\}$



(iv) Solution set = $\{-4.5, 1.5\}$

