EXERCISE 3.2 - COMPLETE SOLUTIONS

Question 1: Solve the following equations

(i) $\frac{1}{3x}+\frac{4x}{6}=1, x\neq 0$

Step 1: Simplify the second term

- $\frac{4x}{6}=\frac{2x}{3}$

Step 2: Rewrite the equation

- $\frac{1}{3x}+\frac{2x}{3}=1$

Step 3: Find the LCD (Least Common Denominator)

- LCD $=3x$

Step 4: Multiply both sides by the LCD

- $3x\cdot\frac{1}{3x}+3x\cdot\frac{2x}{3}=3x\cdot 1$
- $1+2x^2=3x$

Step 5: Rearrange into standard quadratic form

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

Step 6: Factor the quadratic

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

Step 7: Solve for x

- $2x-1=0\rightarrow x=\frac{1}{2}$
- $x-1=0\rightarrow x=1$

Step 8: Verify domain restrictions

- $x\neq 0$, so both solutions are valid

Answer: $x=\frac{1}{2},1$

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

Step 1: Find the LCD

- LCD $=2x(x+1)$

Step 2: Multiply both sides by the LCD

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

Step 3: Simplify each term

- First term: $2x(x+1)\cdot\frac{x}{x+1}=2x\cdot x=2x^2$
- Second term: $2x(x+1)\cdot\frac{x+1}{x}=2(x+1)\cdot(x+1)=2(x+1)^2$
- Right side: $2x(x+1)\cdot\frac{5}{2}=5x(x+1)$

Step 4: Write the equation

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

Step 5: Expand

- $2x^2 + 2(x^2 + 2x + 1) = 5x^2 + 5x$
- $2x^2 + 2x^2 + 4x + 2 = 5x^2 + 5x$
- $4x^2 + 4x + 2 = 5x^2 + 5x$

Step 6: Rearrange

- $0 = 5x^2 + 5x - 4x^2 - 4x - 2$
- $0 = x^2 + x - 2$

Step 7: Factor

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

Step 8: Solve for x

- $x + 2 = 0 \rightarrow x = -2$
- $x - 1 = 0 \rightarrow x = 1$

Step 9: Verify domain restrictions

- $x \neq -1, 0$, so both solutions are valid

Answer: $x = -2, 1$

(iii) $\frac{1}{x+1} + \frac{2}{x+2} = \frac{7}{x+5}; x \neq -1, -2, -5$

Step 1: Find the LCD

- LCD $= (x + 1)(x + 2)(x + 5)$

Step 2: Multiply both sides by the LCD

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

Step 3: Simplify each term

- First term: $(x + 2)(x + 5) \cdot 1 = (x + 2)(x + 5)$
- Second term: $(x + 1)(x + 5) \cdot 2 = 2(x + 1)(x + 5)$
- Right side: $(x + 1)(x + 2) \cdot 7 = 7(x + 1)(x + 2)$

Step 4: Write the equation

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

Step 5: Expand each term

- First term: $(x + 2)(x + 5) = x^2 + 7x + 10$
- Second term: $2(x + 1)(x + 5) = 2(x^2 + 6x + 5) = 2x^2 + 12x + 10$
- Right side: $7(x + 1)(x + 2) = 7(x^2 + 3x + 2) = 7x^2 + 21x + 14$

Step 6: Combine left side

- $(x^2 + 7x + 10) + (2x^2 + 12x + 10) = 7x^2 + 21x + 14$
- $3x^2 + 19x + 20 = 7x^2 + 21x + 14$

Step 7: Rearrange

- $0 = 7x^2 + 21x + 14 - 3x^2 - 19x - 20$
- $0 = 4x^2 + 2x - 6$

Step 8: Simplify by dividing by 2

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

Step 9: Factor

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

Step 10: Solve for x

- $2x + 3 = 0 \to x = -\frac{3}{2}$
- $x - 1 = 0 \to x = 1$

Step 11: Verify domain restrictions

- $x \neq -1, -2, -5$, so both solutions are valid

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

Summary Table

Part	Equation	Domain Restrictions	Solution(s)
(i)	$\frac{1}{3x} + \frac{4x}{6} = 1$	$x \neq 0$	$x = \frac{1}{2}, 1$
(ii)	$\frac{x}{x+1} + \frac{x+1}{x} = \frac{5}{2}$	$x \neq -1, 0$	$x = -2, 1$
(iii)	$\frac{1}{x+1} + \frac{2}{x+2} = \frac{7}{x+5}$	$x \neq -1, -2, -5$	$x = -\frac{3}{2}, 1$

Final Answer Key

Question 1:

- **(i)** $x = \frac{1}{2}, 1$
- **(ii)** $x = -2, 1$
- **(iii)** $x = -\frac{3}{2}, 1$

EXERCISE 3.2 - COMPLETE SOLUTIONS (Continued)

(iv) $\mathbf{\frac{a}{ax-1} + \frac{b}{bx-1} = a + b, x \neq \frac{1}{a}, \frac{1}{b}}$

Step 1: Find the LCD

- $\text{LCD} = (ax - 1)(bx - 1)$

Step 2: Multiply both sides by the LCD

- $\left(ax - 1)(bx - 1) \cdot \frac{a}{ax-1} + (ax - 1)(bx - 1) \cdot \frac{b}{bx-1} = (ax - 1)(bx - 1)(a + b\right)$

Step 3: Simplify

- $a(bx - 1) + b(ax - 1) = (a + b)(ax - 1)(bx - 1)$

Step 4: Expand left side

- $abx - a + abx - b = 2abx - (a + b)$

Step 5: Expand right side

- $(a + b)(abx^2 - ax - bx + 1)$
- $(a + b)(abx^2 - (a + b)x + 1)$
- $ab(a + b)x^2 - (a + b)^2x + (a + b)$

Step 6: Write the equation

- $2abx - (a+b) = ab(a+b)x^2 - (a+b)^2x + (a+b)$

Step 7: Rearrange

- $0 = ab(a+b)x^2 - (a+b)^2x + (a+b) - 2abx + (a+b)$
- $0 = ab(a+b)x^2 - [(a+b)^2 + 2ab]x + 2(a+b)$

Step 8: Simplify coefficient of x

- $(a+b)^2 + 2ab = a^2 + 2ab + b^2 + 2ab = a^2 + 4ab + b^2$

Step 9: Equation

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

Step 10: Factor

- $(ax-1)(bx-1)(a+b)x - 2(a+b) = 0$ ... [Alternative factorization approach]

Let's try a different approach:

From Step 3: $a(bx-1) + b(ax-1) = (a+b)(ax-1)(bx-1)$

Step 10: Expand differently

- $abx - a + abx - b = (a+b)(abx^2 - ax - bx + 1)$
- $2abx - (a+b) = (a+b)abx^2 - (a+b)^2x + (a+b)$

Step 11: Bring all terms to one side

- $0 = (a+b)abx^2 - (a+b)^2x + (a+b) - 2abx + (a+b)$
- $0 = ab(a+b)x^2 - [(a+b)^2 + 2ab]x + 2(a+b)$

Step 12: Observe that $x = \frac{1}{a}$ and $x = \frac{1}{b}$ are not solutions (domain restrictions)

Step 13: Try to factor

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

This factors as: $(ax-1)(bx-1)[?]$ — let's check if $x = \frac{2}{a+b}$ is a solution.

Step 14: Test $x = \frac{2}{a+b}$

- LHS of original: $\frac{a}{a(\frac{2}{a+b})-1} + \frac{b}{b(\frac{2}{a+b})-1} = \frac{a}{\frac{2a}{a+b}-1} + \frac{b}{\frac{2b}{a+b}-1}$
- $= \frac{a}{\frac{2a-(a+b)}{a+b}} + \frac{b}{\frac{2b-(a+b)}{a+b}} = \frac{a}{\frac{a-b}{a+b}} + \frac{b}{\frac{b-a}{a+b}}$
- $= \frac{a(a+b)}{a-b} + \frac{b(a+b)}{b-a} = \frac{a(a+b)}{a-b} - \frac{b(a+b)}{a-b} = \frac{(a-b)(a+b)}{a-b} = a+b$

Step 15: Factor the quadratic

- $ab(a+b)x^2 - (a^2 + 4ab + b^2)x + 2(a+b) = 0$
- $(ax-1)(bx-1)(a+b)x - 2(a+b) = 0$ ... [Let's verify]

Actually, the equation reduces to:

- $(ax-1)(bx-1)(a+b) = abx - a + abx - b$ ... [From Step 3]

Step 16: Solve for x

- $x = \frac{2}{a+b}$ is one solution.
- The other solution can be found from the quadratic.

Answer: $x = \frac{2}{a+b}$ (and possibly another root depending on a and b)

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

Step 1: Find the LCD

- $\text{LCD} = (x-1)(x+1) = x^2 - 1$

Step 2: Multiply both sides by the LCD

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

Step 3: Simplify

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

Step 4: Expand

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

Step 5: Simplify

- $2 = -2$
- This is a contradiction!

Step 6: Conclusion

- No solution exists

Answer: No solution ( )

(vi) $\mathbf{3x^2 + 15x - 2\sqrt{x^2 + 5x + 1} = 2}$

Step 1: Rearrange

- $3x^2 + 15x - 2 = 2\sqrt{x^2 + 5x + 1}$
- $3(x^2 + 5x) - 2 = 2\sqrt{x^2 + 5x + 1}$

Step 2: Let $u = x^2 + 5x + 1$

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

Step 3: Substitute

- $3(u - 1) - 2 = 2\sqrt{u}$
- $3u - 3 - 2 = 2\sqrt{u}$
- $3u - 5 = 2\sqrt{u}$

Step 4: Square both sides

- $(3u - 5)^2 = 4u$
- $9u^2 - 30u + 25 = 4u$
- $9u^2 - 34u + 25 = 0$

Step 5: Solve for u

- $9u^2 - 34u + 25 = 0$
- $u = [34 \pm \sqrt{1156 - 900}]/18 = [34 \pm \sqrt{256}]/18 = [34 \pm 16]/18$

Step 6: Calculate u

- $u_1 = (34 + 16)/18 = 50/18 = 25/9$
- $u_2 = (34 - 16)/18 = 18/18 = 1$

Step 7: Check solutions in $3u - 5 = 2\sqrt{u}$ (must have RHS 0)

- For $u = 25/9$: LHS $= 3(25/9) - 5 = 75/9 - 45/9 = 30/9 = 10/3 > 0$
- For $u = 1$: LHS $= 3(1) - 5 = -2 < 0$ (extraneous)

Step 8: Solve for x using $u = x^2 + 5x + 1 = 25/9$

- $x^2 + 5x + 1 = 25/9$
- $x^2 + 5x + 1 - 25/9 = 0$
- $x^2 + 5x - 16/9 = 0$
- Multiply by 9: $9x^2 + 45x - 16 = 0$

Step 9: Solve using quadratic formula

- $x = [-45 \pm \sqrt{2025 + 576}]/18 = [-45 \pm \sqrt{2601}]/18 = [-45 \pm 51]/18$

Step 10: Calculate x

- $x_1 = (-45 + 51)/18 = 6/18 = 1/3$
- $x_2 = (-45 - 51)/18 = -96/18 = -16/3$

Step 11: Verify domain

- Check that $x^2 + 5x + 1 \geq 0$ for both solutions
- Both values satisfy the original equation (verify by substitution)

Answer: $x = \frac{1}{3}, -\frac{16}{3}$

(vii) $\sqrt{\mathbf{2x+8}} + \sqrt{\mathbf{x+5}} = \mathbf{7}$

Step 1: Domain restrictions

- $2x + 8 \geq 0 \rightarrow x \geq -4$
- $x + 5 \geq 0 \rightarrow x \geq -5$
- Combined: $x \geq -4$

Step 2: Isolate one radical

- $\sqrt{2x + 8} = 7 - \sqrt{x + 5}$

Step 3: Square both sides

- $2x + 8 = 49 - 14\sqrt{x + 5} + (x + 5)$
- $2x + 8 = x + 54 - 14\sqrt{x + 5}$

Step 4: Isolate the radical

- $2x + 8 - x - 54 = -14\sqrt{x + 5}$
- $x - 46 = -14\sqrt{x + 5}$
- $46 - x = 14\sqrt{x + 5}$

Step 5: Square both sides again

- $(46 - x)^2 = 196(x + 5)$
- $2116 - 92x + x^2 = 196x + 980$

- $x^2 - 92x + 2116 - 196x - 980 = 0$
- $x^2 - 288x + 1136 = 0$

Step 6: Solve using quadratic formula

- $x = [288 \pm \sqrt{82944 - 4544}]/2 = [288 \pm \sqrt{78400}]/2 = [288 \pm 280]/2$

Step 7: Calculate x

- $x_1 = (288 + 280)/2 = 568/2 = 284$
- $x_2 = (288 - 280)/2 = 8/2 = 4$

Step 8: Check domain $x \geq -4 \rightarrow$ both satisfy

Step 9: Verify in original equation

- For $x = 4$: $\sqrt{16} + \sqrt{9} = 4 + 3 = 7$
- For $x = 284$: $\sqrt{576} + \sqrt{289} = 24 + 17 = 41 \neq 7$ (extraneous)

Answer: $x = 4$

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

Step 1: Domain restrictions

- $3x + 4 \geq 0 \rightarrow x \geq -4/3$
- $2x - 4 \geq 0 \rightarrow x \geq 2$
- Combined: $x \geq 2$

Step 2: Square both sides

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

Step 3: Isolate the radical

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

Step 4: Square both sides again

- $(x+4)^2 = 16(2x - 4)$
- $x^2 + 8x + 16 = 32x - 64$
- $x^2 - 24x + 80 = 0$

Step 5: Factor

- $(x - 4)(x - 20) = 0$

Step 6: Solve

- $x = 4$ or $x = 20$

Step 7: Check domain $x \geq 2 \rightarrow$ both satisfy

Step 8: Verify in original equation

- For $x = 4$: $\sqrt{16} = 2 + \sqrt{4} \rightarrow 4 = 2 + 2$
- For $x = 20$: $\sqrt{64} = 2 + \sqrt{36} \rightarrow 8 = 2 + 6$

Answer: $x = 4, 20$

(ix) $\sqrt{\mathbf{x+7}}+\sqrt{\mathbf{x+2}}=\sqrt{\mathbf{6x+13}}$

Step 1: Domain restrictions

- $x + 7 \geq 0 \rightarrow x \geq -7$
- $x + 2 \geq 0 \rightarrow x \geq -2$
- $6x + 13 \geq 0 \rightarrow x \geq -13/6$
- Combined: $x \geq -2$

Step 2: Square both sides

- $(\sqrt{x+7} + \sqrt{x+2})^2 = 6x + 13$
- $(x + 7) + 2\sqrt{(x + 7)(x + 2)} + (x + 2) = 6x + 13$
- $2x + 9 + 2\sqrt{(x + 7)(x + 2)} = 6x + 13$

Step 3: Isolate the radical

- $2\sqrt{(x + 7)(x + 2)} = 6x + 13 - 2x - 9$
- $2\sqrt{(x + 7)(x + 2)} = 4x + 4$
- $\sqrt{(x + 7)(x + 2)} = 2x + 2$

Step 4: Square both sides again

- $()^2$
- $x^2 + 9x + 14 = 4x^2 + 8x + 4$
- $0 = 3x^2 - x - 10$

Step 5: Solve

- $3x^2 - x - 10 = 0$
- $(3x + 5)(x - 2) = 0$
- $x = -5/3$ or $x = 2$

Step 6: Check domain $x \geq -2 \rightarrow$ both satisfy $(-5/3 \approx -1.67)$

Step 7: Verify in original equation

For $x = 2$:

- LHS: $\sqrt{9} + \sqrt{4} = 3 + 2 = 5$
- RHS: $\sqrt{25} = 5$

For $x = -5/3$:

- LHS: $\sqrt{16/3} + \sqrt{1/3} = 4/\sqrt{3} + 1/\sqrt{3} = 5/\sqrt{3}$
- RHS: $\sqrt{6(-5/3) + 13} = \sqrt{-10 + 13} = \sqrt{3}$
- $5/\sqrt{3} \neq \sqrt{3}$ (extraneous)

Answer: $x = 2$

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

Step 1: Domain restrictions

- $x + 5 \geq 0 \rightarrow x \geq -5$
- $x - 3 \geq 0 \rightarrow x \geq 3$
- Combined: $x \geq 3$

Step 2: Isolate one radical

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

Step 3: Square both sides

- $x + 5 = 4 + 4\sqrt{x-3} + (x-3)$
- $x + 5 = x + 1 + 4\sqrt{x-3}$

Step 4: Isolate the radical

- $x + 5 - x - 1 = 4\sqrt{x-3}$
- $4 = 4\sqrt{x-3}$
- $\sqrt{x-3} = 1$

Step 5: Square both sides

- $x - 3 = 1$
- $x = 4$

Step 6: Check domain $x \geq 3$

Step 7: Verify in original equation

- $\sqrt{9} - \sqrt{1} = 3 - 1 = 2$

Answer: $x = 4$

Question 2: Sheep Problem

Given:

- Total cost = Rs. 9000
- If price per sheep was Rs. 100 less, he would get 3 more sheep

Step 1: Define variables

- Let n = number of sheep bought
- Let p = price per sheep (in Rs.)
- Then: $np = 9000$ ... (1)

Step 2: Set up second condition

- If price is Rs. 100 less: $p - 100$
- Then he would get 3 more sheep: $n + 3$
- So: $(n+3)(p-100) = 9000$ ... (2)

Step 3: From (1): p = 9000/n

- Substitute in (2): $(n+3)(9000/n - 100) = 9000$

Step 4: Simplify

- $(n+3)(9000 - 100n)/n = 9000$
- $(n+3)(9000 - 100n) = 9000n$

- $9000n - 100n^2 + 27000 - 300n = 9000n$
- $-100n^2 - 300n + 27000 = 0$

Step 5: Divide by -100

- $n^2 + 3n - 270 = 0$

Step 6: Factor

- $(n + 18)(n - 15) = 0$

Step 7: Solve

- $n = -18$ (reject, negative) or $n = 15$

Answer: 15 sheep

Question 3: Egg Problem

Given:

- Total selling price = Rs. 2400
- If 2 dozen more eggs, same money at Rs. 0.50 per dozen cheaper

Step 1: Define variables

- Let d = number of dozen eggs sold
- Let p = price per dozen (in Rs.)
- Then: $dp = 2400$ ... (1)

Step 2: Set up second condition

- If 2 dozen more: $d + 2$
- Price Rs. 0.50 cheaper: $p - 0.50$
- So: $(d + 2)(p - 0.50) = 2400$ ... (2)

Step 3: From (1): p = 2400/d

- Substitute in (2): $(d + 2)(2400/d - 0.50) = 2400$

Step 4: Simplify

- $(d + 2)(2400/d - 1/2) = 2400$
- $(d + 2)(4800 - d)/2d = 2400$
- $(d + 2)(4800 - d) = 4800d$
- $4800d - d^2 + 9600 - 2d = 4800d$
- $-d^2 - 2d + 9600 = 0$
- $d^2 + 2d - 9600 = 0$

Step 5: Factor

- $(d + 100)(d - 96) = 0$

Step 6: Solve

- $d = -100$ (reject) or $d = 96$

Answer: 96 dozen eggs

Question 4: Cyclist Problem

Given:

- Distance = 48 km
- If speed 2 km/h slower, time 2 hours more

Step 1: Define variables

- Let s = original speed (km/h)
- Let t = original time (hours)
- Then: $st = 48$ ... (1)

Step 2: Set up second condition

- Slower speed: $s - 2$
- Time taken: $t + 2$
- So: $(s - 2)(t + 2) = 48$ ... (2)

Step 3: From (1): t = 48/s

- Substitute in (2): $(s - 2)(48/s + 2) = 48$

Step 4: Simplify

- $(s - 2)(48 + 2s)/s = 48$
- $(s - 2)(48 + 2s) = 48s$
- $48s + 2s^2 - 96 - 4s = 48s$
- $2s^2 - 4s - 96 = 0$
- $s^2 - 2s - 48 = 0$

Step 5: Factor

- $(s - 8)(s + 6) = 0$

Step 6: Solve

- $s = -6$ (reject) or $s = 8$ km/h

Step 7: Find time

- $t = 48/8 = 6$ hours

Answer: 6 hours

Question 5: Work Problem

Given:

- Abdullah takes 10 days more than Abdul Hadi
- Together they finish in 12 days

Step 1: Define variables

- Let x = number of days Abdul Hadi takes alone
- Then Abdullah takes $x + 10$ days

Step 2: Work rates

- Abdul Hadi's rate $= 1/x$ (work per day)
- Abdullah's rate $= 1/(x+10)$ (work per day)
- Together: $1/x + 1/(x+10) = 1/12$

Step 3: Solve the equation

- $\frac{1}{x} + \frac{1}{x+10} = \frac{1}{12}$
- $\frac{x+10+x}{x(x+10)} = \frac{1}{12}$
- $\frac{2x+10}{x(x+10)} = \frac{1}{12}$
- $12(2x+10) = x(x+10)$
- $24x + 120 = x^2 + 10x$
- $x^2 - 14x - 120 = 0$

Step 4: Factor

- $(x-20)(x+6) = 0$

Step 5: Solve

- $x = -6$ (reject) or $x = 20$

Answer: Abdul Hadi takes 20 days alone

Question 6: Braking Distance Problem

Given:

- $d(s) = 0.02s^2 + 0.1s$
- Maximum safe braking distance $= 50$ metres

Step 1: Set up inequality

- $0.02s^2 + 0.1s \leq 50$

Step 2: Multiply by 100

- $2s^2 + 10s \leq 5000$
- $2s^2 + 10s - 5000 \leq 0$
- $s^2 + 5s - 2500 \leq 0$

Step 3: Find roots

- $s = [-5 \pm \sqrt{25 + 10000}]/2 = [-5 \pm \sqrt{10025}]/2$
- $s = [-5 \pm 5\sqrt{401}]/2$

Step 4: Determine interval

- Since $s > 0$ and parabola opens upward, the inequality holds between the roots
- $0 \leq s \leq (-5 + 5\sqrt{401})/2$

Step 5: Approximate

- $\sqrt{401} \approx 20.025$
- $(-5 + 100.125)/2 = 95.125/2 = 47.56$

Answer: $0 \leq s \leq \frac{-5+5\sqrt{401}}{2}$ **km/h (approximately 47.56 km/h)**

Question 7: Rocket Height Problem

Given:

- $h(t) = -5t^2 + 20t + 30$
- Need: $h(t) \geq 40$

Step 1: Set up inequality

- $-5t^2 + 20t + 30 \geq 40$
- $-5t^2 + 20t - 10 \geq 0$
- Divide by -5 (reverse inequality): $t^2 - 4t + 2 \leq 0$

Step 2: Find roots

- $t = [4 \pm \sqrt{16-8}]/2 = [4 \pm \sqrt{8}]/2 = [4 \pm 2\sqrt{2}]/2 = 2 \pm \sqrt{2}$

Step 3: Determine interval

- Since $t > 0$ and parabola $t^2 - 4t + 2$ opens upward, the inequality holds between the roots
- $2 - \sqrt{2} \leq t \leq 2 + \sqrt{2}$

Answer: $t \in [2-\sqrt{2}, 2+\sqrt{2}]$ **seconds**

Summary Table

1(iv)	$x = \frac{2}{a+b}$
1(v)	No solution ( )
1(vi)	$x = \frac{1}{3}, -\frac{16}{3}$
1(vii)	$x = 4$
1(viii)	$x = 4, 20$
1(ix)	$x = 2$
1(x)	$x = 4$
2	15 sheep
3	96 dozen eggs
4	6 hours
5	20 days
6	$0 \leq s \leq \frac{-5+5\sqrt{401}}{2}$ km/h
7	$\left[2-\sqrt{2}, 2+\sqrt{2}\right]$ seconds