

Rational Equations

$$1. 3 = \frac{12}{4x+5}$$

$$3 \cdot (4x+5) = \frac{12}{(4x+5)} \cdot (4x+5)$$

$$12x+15=12$$

$$12x=-3$$

$$x = -\frac{1}{4}$$

$$SS = \left\{ -\frac{1}{4} \right\}$$

$$2. \frac{9}{4x+2} = \frac{1}{2}$$

$$(4x+2)(2) \cdot \frac{9}{4x+2} = (4x+2)(2) \cdot \frac{1}{2}$$

$$(2) \cdot 9 = (4x+2) \cdot 1$$

$$18 = 4x+2$$

$$16 = 4x$$

$$4 = x$$

$$SS = \{4\}$$

$$3. \frac{4}{9+x} = -\frac{1}{3x}$$

$$(9+x)(3x) \cdot \frac{4}{(9+x)} = -(9+x)(3x) \cdot \frac{1}{3x}$$

$$(3x) \cdot 4 = -(9+x) \cdot 1$$

$$12x = -9 - x$$

$$13x = -9$$

$$x = -\frac{9}{13}$$

$$SS = \left\{ -\frac{9}{13} \right\}$$

$$4. \frac{y-5}{9} = \frac{y-7}{5}$$

$$9 \cdot 5 \cdot \frac{(y-5)}{9} = 9 \cdot 5 \cdot \frac{(y-7)}{5}$$

$$5 \cdot (y-5) = 9 \cdot (y-7)$$

$$5y - 25 = 9y - 63$$

$$-4y = -38$$

$$y = \frac{-38}{-4} = \frac{19}{2}$$

$$SS = \left\{ \frac{19}{2} \right\}$$

$$5. \frac{4}{x-3} = \frac{7}{x+2}$$

$$(x+2)(x-3) \frac{4}{(x-3)} = (x+2)(x-3) \frac{7}{(x+2)}$$

$$(x+2) \cdot 4 = (x-3) \cdot 7$$

$$4x+8=7x-21$$

$$-3x=-29$$

$$x = \frac{-29}{-3} = \frac{29}{3}$$

$$SS = \left\{ \frac{29}{3} \right\}$$

$$6. \frac{9}{2x-3} = \frac{6}{3x-7}$$

$$(2x-3)(3x-7) \frac{9}{(2x-3)} = (2x-3)(3x-7) \frac{6}{(3x-7)}$$

$$(3x-7) \cdot 9 = (2x-3) \cdot 6$$

$$27x-63=12x-18$$

$$15x=45$$

$$x=3$$

$$SS = \{3\}$$



$$7. \frac{2x}{6x^2-5} = \frac{1}{3x+10}$$

$$(6x^2-5)(3x+10) \frac{2x}{6x^2-5} = (6x^2-5)(3x+10) \frac{1}{3x+10}$$

$$(3x+10) \cdot 2x = (6x^2-5) \cdot 1$$

$$6x^2+20x=6x^2-5$$

$$20x=-5$$

$$x = \frac{-5}{20} = -\frac{1}{4}$$

$$SS = \left\{ -\frac{1}{4} \right\}$$

$$8. 4 + \frac{x+2}{2} - \frac{x+4}{6} = 0$$

$$2 \cdot 6 \cdot 4 + 2 \cdot 6 \cdot \frac{(x+2)}{2} - 2 \cdot 6 \cdot \frac{(x+4)}{6} = 2 \cdot 6 \cdot 0$$

$$2 \cdot 6 \cdot 4 + 6(x+2) - 2(x+4) = 0$$

$$48 + 6x + 12 - 2x - 8 = 0$$

$$4x + 52 = 0$$

$$4x = -52$$

$$x = \frac{-52}{4} = -13, SS = \{-13\}$$

$$9. \frac{x+1}{2} = \frac{5x-2}{3} - \frac{3x+1}{6}$$



$$2 \cdot 3 \cdot 6 \cdot \frac{(x+1)}{2} = 2 \cdot 3 \cdot 6 \cdot \frac{(5x-2)}{3} - 2 \cdot 3 \cdot 6 \cdot \frac{(3x+1)}{6}$$

$$3 \cdot 6 \cdot (x+1) = 2 \cdot 6 \cdot (5x-2) - 2 \cdot 3 \cdot (3x+1)$$

$$18x+18 = 60x-24-18x-6$$

$$-24x = -48$$

$$x = \frac{-48}{-24} = 2$$

$$SS = \{2\}$$

$$10. \frac{8}{x} + \frac{x+6}{3x} + \frac{x-4}{6x} = \frac{8}{9}$$



$$3 \cdot 6 \cdot 9 \cdot x \cdot \frac{8}{x} + 3 \cdot 6 \cdot 9 \cdot x \cdot \frac{(x+6)}{3x} + 3 \cdot 6 \cdot 9 \cdot x \cdot \frac{(x-4)}{6x} = 3 \cdot 6 \cdot 9 \cdot x \cdot \frac{8}{9}$$

$$3 \cdot 6 \cdot 9 \cdot 8 + 6 \cdot 9 \cdot (x+6) + 3 \cdot 9 \cdot (x-4) = 3 \cdot 6 \cdot x \cdot 8$$

$$1296 + 54x + 324 + 27x - 108 = 144x$$

$$-63x = -1512$$

$$x = \frac{-1512}{-63} = 24$$

$$SS = \{24\}$$

$$11. \frac{3}{x-1} = 2 - \frac{2x-5}{x+1}$$

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

$$(x+1) \cdot 3 = (x-1)(x+1) \cdot 2 - (x-1)(2x-5)$$

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

$$-4x = -10$$

$$x = \frac{-10}{-4} = \frac{5}{2}$$

$$SS = \left\{ \frac{5}{2} \right\}$$

$$12. \frac{2}{x-1} - \frac{3}{x+4} + \frac{1}{x+5} = 0$$

$$(x-1)(x+4)(x+5) \cdot \frac{2}{(x-1)} - (x-1)(x+4)(x+5) \cdot \frac{3}{(x+4)} + (x-1)(x+4)(x+5) \cdot \frac{1}{(x+5)} = 0$$

$$(x+4)(x+5) \cdot 2 - (x-1)(x+5) \cdot 3 + (x-1)(x+4) \cdot 1 = 0$$

$$(x^2 + 9x + 20) \cdot 2 - (x^2 + 4x - 5) \cdot 3 + (x^2 + 3x - 4) \cdot 1 = 0$$

$$2x^2 + 18x + 40 - 3x^2 - 12x + 15 + x^2 + 3x - 4 = 0$$

$$9x = -51$$

$$x = \frac{-51}{9} = -\frac{17}{3}$$

$$SS = \left\{ -\frac{17}{3} \right\}$$

$$13. \frac{18}{x^2-9} + 1 = \frac{x}{x+3}$$

$$(x-3)(x+3) \dots \dots \dots (x+3)$$

$$(x-3)(x+3) \cdot \frac{18}{(x-3)(x+3)} + (x-3)(x+3) \cdot 1 = (x-3)(x+3) \cdot \frac{x}{(x+3)}$$

$$18 + (x-3)(x+3) \cdot 1 = (x-3) \cdot x$$

$$18 + x^2 - 9 = x^2 - 3x$$

$$3x = -9$$

$$x = \frac{-9}{3} = -3$$

$$SS = \{-3\}$$



$$14. \frac{x+1}{x^2-4} = \frac{4}{x+2} - \frac{3}{2-x}$$

$$(x-2)(x+2) \dots \dots \dots (x+2) \dots \dots \dots (-1)(x-2)$$

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

$$(-1)(x+1) = (-1)(x-2) \cdot 4 - (x+2) \cdot 3$$

$$-x-1 = -4x+8-3x-6$$

$$6x = 3$$

$$x = \frac{3}{6} = \frac{1}{2}$$

$$SS = \left\{ \frac{1}{2} \right\}$$



$$\frac{10}{x-3} + \frac{5}{x+1} = \frac{25}{x^2 - 2x - 3}$$

$$(x-3) \dots (x+1) \dots (x-3)(x+1)$$

$$(x-3)(x+1) \left(\frac{10}{x-3} \right) + (x-3)(x+1) \left(\frac{5}{x+1} \right) = (x-3)(x+1) \left(\frac{25}{(x-3)(x+1)} \right)$$

$$15. (x+1)(10) + (x-3)(5) = 25$$

$$10x + 10 + 5x - 15 = 25$$

$$15x = 30$$

$$x = \frac{30}{15} = 2$$

$$SS = \{2\}$$

$$\frac{3}{x^2 + 2x - 15} + \frac{4}{x^2 - 9} = \frac{8}{x^2 + 8x + 15}$$

$$(x+5)(x-3) \dots (x+3)(x-3) \dots (x+5)(x+3)$$

$$(x+3)(x-3)(x+5) \left(\frac{3}{(x+5)(x-3)} \right) + (x+3)(x-3)(x+5) \left(\frac{4}{(x+3)(x-3)} \right) = (x+3)(x-3)(x+5) \left(\frac{8}{(x+5)(x+3)} \right)$$

$$16. (x+3)(3) + (x+5)(4) = (x-3)(8)$$

$$3x + 9 + 4x + 20 = 8x - 24$$

$$-x = -53$$

$$x = 53$$

$$SS = \{53\}$$

$$\frac{4x+4}{x^2+3x+2} = \frac{x}{x+2}$$

$$(x+2)(x+1) \dots (x+2)$$

$$(x+2)(x+1) \left(\frac{4x+4}{(x+2)(x+1)} \right) = (x+2)(x+1) \left(\frac{x}{x+2} \right)$$



$$17. 4x+4 = (x+1)(x)$$

$$4x+4 = x^2 + x$$

$$-x^2 + 3x + 4 = 0 \Rightarrow x^2 - 3x - 4 = 0 \Rightarrow (x-4)(x+1) = 0$$

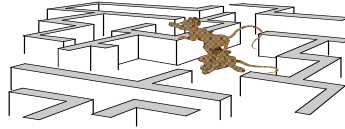
$$x = 4, -1$$

$$SS = \{4\}$$

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

$$x(x-2) \dots 3 \dots x$$

$$3x(x-2) \left(\frac{2}{x(x-2)} \right) - 3x(x-2) \left(\frac{1}{3} \right) = 3x(x-2) \left(\frac{1}{x} \right)$$



18. $3(2) - x(x-2) = 3(x-2)$

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

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

$$x = -4, 3$$

$$SS = \{-4, 3\}$$

$$\frac{3x-5}{x^2+4x+3} + \frac{2x+2}{x+3} = \frac{x-3}{x+1}$$

$$(x+3)(x+1) \dots (x+3) \dots (x+1)$$

$$(x+3)(x+1) \left(\frac{(3x-5)}{(x+3)(x+1)} \right) + (x+3)(x+1) \left(\frac{(2x+2)}{(x+3)} \right) = (x+3)(x+1) \left(\frac{(x-3)}{(x+1)} \right)$$

19. $(3x-5) + (x+1)(2x+2) = (x+3)(x-3)$

$$3x-5+2x^2+4x+2 = x^2-9$$

$$x^2+7x+6 = 0 \Rightarrow (x+6)(x+1) = 0$$

$$x = -6, -1$$

$$SS = \{-6, -1\}$$

$$\frac{1}{x^2+2x-8} + \frac{3x}{2x^2+19x+44} = \frac{2x}{2x^2+7x-22}$$

$$(x+4)(x-2) \dots (2x+11)(x+4) \dots (2x+11)(x-2)$$

$$(x-2)(x+4)(2x+11) \left(\frac{1}{(x+4)(x-2)} \right) + (x-2)(x+4)(2x+11) \left(\frac{3x}{(2x+11)(x+4)} \right) = (x-2)(x+4)(2x+11) \left(\frac{2x}{(2x+11)(x-2)} \right)$$

20. $(2x+11)(1) + (x-2)(3x) = (x+4)(2x)$

$$2x+11+3x^2-6x = 2x^2+8x$$

$$x^2-12x+11 = 0 \Rightarrow (x-11)(x-1) = 0$$

$$x = 11, 1$$

$$SS = \{1, 11\}$$