

## Chapter 15 Exercise 15.1

**Q. 1.**  $2x + 3 = 7 - x$

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

$$3x = 4$$

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

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

**Q. 2.**  $5x - 3 = 4x + 3$

$$5x - 4x = 3 + 3$$

$$x = 6$$

**Q. 3.**  $10(x + 5) - 4(x + 2) = 6$

$$10x + 50 - 4x - 8 = 6$$

$$10x - 4x = 6 + 8 - 50$$

$$6x = -36$$

$$\frac{6x}{6} = \frac{-36}{6} \Rightarrow x = -6$$

**Q. 4.**  $5(y - 3) = 2y - (y + 4)$

$$5y - 15 = 2y - y - 4$$

$$5y - 2y + y = -4 + 15$$

$$4y = 11$$

$$\frac{4y}{4} = \frac{11}{4}$$

$$y = \frac{11}{4}$$

**Q. 5.**  $4x + 3(x + 2) = 11x + 2(3 - x)$

$$4x + 3x + 6 = 11x + 6 - 2x$$

$$4x + 3x - 11x + 2x = 6 - 6$$

$$-2x = 0$$

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

$$x = 0$$

**Q. 6.**  $5[2 - (x + 3)] = 1 + 3x$

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

$$-5x - 5 = 1 + 3x$$

$$-5 - 1 = 3x + 5x$$

$$8x = -6 \Rightarrow x = \frac{-6}{8} = \frac{-3}{4}$$

**Q. 7.**  $2(t + 1) - 3(t - 1) - 12 = 0$

$$2t + 2 - 3t + 3 - 12 = 0$$

$$2t - 3t = 12 - 3 - 2$$

$$-t = 7$$

$$\frac{-t}{-1} = \frac{7}{-1} \Rightarrow t = -7$$

**Q. 8.**  $9(x - 3) - 5(x - 1) + 5 = -9$

$$9x - 27 - 5x + 5 + 5 = -9$$

$$9x - 5x = 27 - 5 - 5 - 9$$

$$4x = 8$$

$$x = 2$$

**Q. 9.**  $2x - 4 - 2(x + 2) + 8 = x$

$$2x - 4 - 2x - 4 + 8 = x$$

$$-4 - 4 + 8 = x$$

$$0 = x$$

$$x = 0$$

**Q. 10.**  $-(p - 2) = 2(p + 5) - 13$

$$-p + 2 = 2p + 10 - 13$$

$$-p - 2p = 10 - 13 - 2$$

$$-3p = -5$$

$$\frac{-3p}{-3} = \frac{-5}{-3}$$

$$p = \frac{5}{3}$$

**Q. 11.**  $\frac{3}{4} = 2x$

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

$$\frac{3}{4 \times 2} = \frac{2x}{2}$$

$$\frac{3}{8} = x$$

$$x = \frac{3}{8}$$

**Q. 12.**  $\frac{2x + 5}{8} = \frac{1}{2}$

$$\text{LCD} = 8$$

$$\frac{8(2x + 5)}{8} = \frac{8(1)}{2}$$

$$2x + 5 = 4$$

$$2x = 4 - 5$$

$$2x = -1$$

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

$$\text{Q. 13. } \frac{3x - 1}{2} = 7$$

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

$$3x - 1 = 14$$

$$3x = 15$$

$$x = 5$$

$$\text{Q. 14. } \frac{2x + 3}{3} - \frac{4x}{5} = 1$$

$$\text{LCD} = 15$$

$$\frac{15(2x + 3)}{3} - \frac{15(4x)}{5} = 15(1)$$

$$5(2x + 3) - 3(4x) = 15$$

$$10x + 15 - 12x = 15$$

$$10x - 12x = 15 - 15$$

$$-2x = 0$$

$$\frac{-2x}{-2} = \frac{0}{-2} \Rightarrow x = 0$$

$$\text{Q. 15. } \frac{5y - 2}{4} + \frac{2y - 1}{3} = \frac{13}{12}$$

$$\frac{12(5y - 2)}{4} + \frac{12(2y - 1)}{3} = \frac{12(13)}{12}$$

$$3(5y - 2) + 4(2y - 1) = 13$$

$$15y - 6 + 8y - 4 = 13$$

$$15y + 8y = 13 + 6 + 4$$

$$23y = 23$$

$$y = 1$$

$$\text{Q. 16. } x - \frac{4x - 7}{2} = 1\frac{1}{2}$$

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

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

$$2x - (4x - 7) = 3$$

$$2x - 4x + 7 = 3$$

$$2x - 4x = 3 - 7$$

$$-2x = -4$$

$$x = 2$$

$$\text{Q. 17. } \frac{2x - 11}{6} + \frac{5x - 1}{3} = 2$$

$$\frac{2(2x - 11)}{6} + \frac{2(5x - 1)}{3} = 6(2)$$

$$(2x - 11) + 2(5x - 1) = 12$$

$$2x - 11 + 10x - 2 = 12$$

$$2x + 10x = 12 + 11 + 2$$

$$12x = 25$$

$$\frac{12x}{12} = \frac{25}{12} \Rightarrow x = \frac{25}{12} \text{ OR } \left(2\frac{1}{12}\right)$$

$$\text{Q. 18. } \frac{-x - 1}{4} + \frac{1 - x}{7} = \frac{1}{28}$$

$$\frac{7(28)(-x - 1)}{4} + \frac{4(28)(1 - x)}{7} = \frac{28(1)}{28}$$

$$7(-x - 1) + 4(1 - x) = 1$$

$$-7x - 7 + 4 - 4x = 1$$

$$-7x - 4x = 1 + 7 - 4$$

$$-11x = 4$$

$$\frac{-11x}{-11} = \frac{4}{-11} \Rightarrow x = \frac{-4}{11}$$

$$\text{Q. 19. } \frac{2x - 2}{3} - \frac{3x - 1}{5} = 0$$

$$\frac{5(15)(2x - 2)}{3} - \frac{3(15)(3x - 1)}{5} = 15(0)$$

$$5(2x - 2) - 3(3x - 1) = 0$$

$$10x - 10 - 9x + 3 = 0$$

$$10x - 9x = 10 - 3$$

$$x = 7$$

$$\text{Q. 20. } \frac{7t - 1}{3} - \frac{2t + 5}{6} = \frac{-3}{2}$$

$$\frac{6(7t - 1)}{3} - \frac{6(2t + 5)}{6} = \frac{6(-3)}{2}$$

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

$$14t - 2 - 2t - 5 = -9$$

$$14t - 2t = -9 + 2 + 5$$

$$12t = -2$$

$$t = \frac{-2}{12} = \frac{-1}{6}$$

$$\text{Q. 21. } \frac{13x - 3}{8} + \frac{6 - 5x}{4} = \frac{1}{2}$$

$$\frac{8(13x - 3)}{8} + \frac{8(6 - 5x)}{4} = \frac{8(1)}{2}$$

$$13x - 3 + 2(6 - 5x) = 4$$

$$13x - 3 + 12 - 10x = 4$$

$$13x - 10x = 4 + 3 - 12$$

$$3x = -5$$

$$x = \frac{-5}{3}$$

$$\begin{aligned} \text{Q. 22. } \frac{2x+1}{6} - \frac{2x+1}{10} &= \frac{4}{5} \\ \frac{30(2x+1)}{6} - \frac{30(2x+1)}{10} &= \frac{30(4)}{5} \\ 5(2x+1) - 3(2x+1) &= 6(4) \\ 10x+5 - 6x-3 &= 24 \\ 10x-6x &= 24-5+3 \\ 4x &= 22 \\ 2x &= 11 \\ x &= \frac{11}{2} \end{aligned}$$

$$\begin{aligned} \text{Q. 23. } 3(2x+1) + \frac{1}{4}(3x) &= 9 \\ (6x+3) + \frac{3x}{4} &= 9 \\ 4(6x+3) + \frac{4(3x)}{4} &= 4(9) \\ 24x+12+3x &= 36 \\ 24x+3x &= 36-12 \\ 27x &= 24 \\ x &= \frac{24}{27} = \frac{8}{9} \end{aligned}$$

$$\begin{aligned} \text{Verify: } 3\left[2\left(\frac{8}{9}\right) + 1\right] + \frac{1}{4}\left[3\left(\frac{8}{9}\right)\right] &= 9 \\ 3\left[\frac{16}{9} + 1\right] + \frac{1}{4}\left(\frac{24}{9}\right) &= 9 \\ 3\left(\frac{25}{9}\right) + \frac{1}{4}\left(\frac{24}{9}\right) &= 9 \\ \frac{75}{9} + \frac{6}{9} &= 9 \\ \frac{81}{9} &= 9 \\ 9 &= 9 \\ \text{TRUE} \end{aligned}$$

$$\begin{aligned} \text{Q. 24. } \frac{1}{3}(x+4) - \frac{2}{5}(x+1) &= 2 \\ \frac{x+4}{3} - \frac{2(x+1)}{5} &= 2 \\ \frac{15(x+4)}{3} - \frac{15[2(x+1)]}{5} &= 15(2) \\ 5(x+4) - 3[2(x+1)] &= 30 \\ 5x+20 - 6x-6 &= 30 \\ 5x-6x &= 30-20+6 \\ -x &= 16 \\ x &= -16 \end{aligned}$$

Verify:

$$\begin{aligned} \frac{[(-16)+4]}{3} - \frac{2[(-16)+1]}{5} &= 2 \\ \frac{-12}{3} - \frac{2(-15)}{5} &= 2 \\ -4 + 6 &= 2 \\ 2 &= 2 \\ \text{TRUE} \end{aligned}$$

$$\begin{aligned} \text{Q. 25. } \frac{3}{7}(2x+1) - \frac{1}{2}(3x-1) &= \frac{1}{5} \\ \frac{3(2x+1)}{7} - \frac{3x-1}{2} &= \frac{1}{5} \\ \frac{6x+3}{7} - \frac{3x-1}{2} &= \frac{1}{5} \\ \frac{10(6x+3)}{7} - \frac{35(3x-1)}{2} &= \frac{70(1)}{5} \\ 10(6x+3) - 35(3x-1) &= 14 \\ 60x+30 - 105x+35 &= 14 \\ 60x-105x &= 14-30-35 \\ -45x &= -51 \\ x &= \frac{51}{45} = \frac{17}{15} \end{aligned}$$

Verify:

$$\begin{aligned} \frac{3\left[2\left(\frac{17}{15}\right) + 1\right]}{7} - \frac{3\left[\left(\frac{17}{15}\right) - 1\right]}{2} &= \frac{1}{5} \\ \frac{3\left[\left(\frac{34}{15}\right) + 1\right]}{7} - \frac{\left[\left(\frac{51}{15}\right) - 1\right]}{2} &= \frac{1}{5} \\ \frac{3\left(\frac{49}{15}\right)}{7} - \frac{\left(\frac{36}{15}\right)}{2} &= \frac{1}{5} \\ \frac{\left(\frac{49}{5}\right)}{7} - \frac{\left(\frac{36}{15}\right)}{2} &= \frac{1}{5} \\ \frac{7}{5} - \frac{18}{15} &= \frac{1}{5} \\ \frac{7}{5} - \frac{6}{5} &= \frac{1}{5} \\ \frac{1}{5} &= \frac{1}{5} \\ \text{TRUE} \end{aligned}$$

## Exercise 15.2

**Q. 1.**  $x + y = 4$   
 $x + 7y = 10$

$$\begin{array}{r} x + y = 4 \\ -x - 7y = -10 \\ \hline -6y = -6 \\ y = 1 \end{array}$$

$$\begin{array}{r} x + (1) = 4 \\ x = 4 - 1 \\ x = 3 \end{array}$$

$x = 3$
$y = 1$

**Q. 2.**  $x - y = -2$   
 $x + 9y = 8$

$$\begin{array}{r} x - y = -2 \\ -x - 9y = -8 \\ \hline -10y = -10 \\ y = 1 \end{array}$$

$$\begin{array}{r} x - (1) = -2 \\ x = -2 + 1 \\ x = -1 \end{array}$$

$x = -1$
$y = 1$

**Q. 3.**  $4x + y = 3$   
 $2x + y = 1$

$$\begin{array}{r} 4x + y = 3 \\ -2x - y = -1 \\ \hline 2x = 2 \\ x = 1 \end{array}$$

$$\begin{array}{r} 4(1) + y = 3 \\ y = 3 - 4 \\ y = -1 \end{array}$$

$x = 1$
$y = -1$

**Q. 4.**  $p - 2q = 0$   
 $2p - 9q = 10$

$$\begin{array}{r} 2p - 4q = 0 \\ 2p - 9q = 10 \\ \hline -2p + 9q = -10 \\ 5q = -10 \\ q = -2 \end{array}$$

$$\begin{array}{r} 2p - 4(-2) = 0 \\ 2p + 8 = 0 \\ 2p = -8 \\ p = -4 \end{array}$$

$p = -4$
$q = -2$

**Q. 5.**  $3a - 2b = 19$   
 $2a + 5b = 0$

$$\begin{array}{r} 6a - 4b = 38 \\ 6a + 15b = 0 \\ -6a + 4b = -38 \\ \hline 6a + 15b = 0 \\ 19b = -38 \\ b = -2 \end{array}$$

$$\begin{array}{r} 6a - 4(-2) = 38 \\ 6a + 8 = 38 \\ 6a = 38 - 8 \\ 6a = 30 \\ a = 5 \end{array}$$

$a = 5$
$b = -2$

**Q. 6.**  $4m + 5n = 32$   
 $2m - 3n = -6$

$$\begin{array}{r} 4m + 5n = 32 \\ -4m + 6n = 12 \\ \hline 11n = 44 \\ n = 4 \end{array}$$

$$4m + 5(4) = 32$$

$$4m + 20 = 32$$

$$4m = 12$$

$$m = 3$$

$$m = 3$$

$$n = 4$$

**Q. 7.**  $3r + 2s = -6$

$$5r + 4s = -8$$

$$6r + 4s = -12$$

$$5r + 4s = -8$$

$$6r + 4s = -12$$

$$\underline{-5r - 4s = 8}$$

$$r = -4$$

$$3(-4) + 2s = -6$$

$$2s - 12 = -6$$

$$2s = -6 + 12$$

$$2s = 6$$

$$s = 3$$

$$r = -4$$

$$s = 3$$

**Q. 8.**  $3u + 2v = -21$

$$u + v = -8$$

$$3u + 2v = -21$$

$$\underline{-2u - 2v = 16}$$

$$u = -5$$

$$-5 + v = -8$$

$$v = -8 + 5$$

$$v = -3$$

$$u = -5$$

$$v = -3$$

**Q. 9.**  $5x - 3y + 9 = 0$

$$3x - 7y = 5$$

$$5x - 3y = -9$$

$$3x - 7y = 5$$

$$15x - 9y = -27 \quad (\times 3)$$

$$15x - 35y = 25 \quad (\times 5)$$

$$15x - 9y = -27$$

$$\underline{-15x + 35y = -25 \quad (\times -1)}$$

$$26y = -52$$

$$y = -2$$

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

$$3x + 14 = 5$$

$$3x = 5 - 14$$

$$3x = -9$$

$$x = -3$$

$$x = -3$$

$$y = -2$$

**Q. 10.**  $3x = 4y + 13$

$$3y = 3 - 2x$$

$$3x - 4y = 13$$

$$2x + 3y = 3$$

$$6x - 8y = 26 \quad (\times 2)$$

$$\underline{-6x - 9y = -9 \quad (\times -3)}$$

$$-17y = 17$$

$$y = -1$$

$$3x - 4(-1) = 13$$

$$3x + 4 = 13$$

$$3x = 13 - 4$$

$$3x = 9$$

$$x = 3$$

$$x = 3$$

$$y = -1$$

**Q. 11.**  $6x + 3y - 21 = 0$

$$2x - 5y + 11 = 0$$

$$6x + 3y = 21$$

$$2x - 5y = -11$$

$$6x + 3y = 21$$

$$6x - 15y = -33$$

$$\begin{array}{r} 6x + 3y = 21 \\ -6x + 15y = 33 \\ \hline 18y = 54 \\ y = 3 \end{array}$$

$$\begin{array}{r} 6x + 3(3) = 21 \\ 6x + 9 = 21 \\ 6x = 21 - 9 \\ 6x = 12 \\ x = 2 \end{array}$$

$$\begin{array}{l} x = 2 \\ y = 3 \end{array}$$

**Q. 12.**  $2x + 3y + 26 = 3$   
 $3x - 2 = 2y - 10$

$$\begin{array}{r} 2x + 3y = -14 \\ 3x - 2y = -8 \\ 4x + 6y = -28 \quad (\times 2) \\ 9x - 6y = -24 \quad (\times 3) \\ \hline 13x = -52 \\ x = -4 \end{array}$$

$$\begin{array}{r} 2x + 3y = -14 \\ 2(-4) + 3y = -14 \\ -8 + 3y = -14 \\ 3y = -14 + 8 \\ 3y = -6 \\ y = -2 \end{array}$$

$$\begin{array}{l} x = -4 \\ y = -2 \end{array}$$

**Q. 13.**  $14 = 9x - 2y$   
 $0 = 3y + x - 8$

$$\begin{array}{r} 9x - 2y = 14 \\ x + 3y = 8 \\ 27x - 6y = 42 \quad (\times 3) \\ 2x + 6y = 16 \quad (\times 2) \\ \hline 29x = 58 \\ x = 2 \\ (2) + 3y = 8 \end{array}$$

$$\begin{array}{r} 3y = 8 - 2 \\ 3y = 6 \\ y = 2 \end{array}$$

$$\begin{array}{l} x = 2 \\ y = 2 \end{array}$$

**Q. 14.** Multiply by 6:

$$\begin{array}{r} 6\left(\frac{1}{2}\right)x + 6\left(\frac{2}{3}\right)y = 6(6) \\ 3x + 4y = 36 \\ 8\left(\frac{1}{8}\right)x + 8\left(\frac{5}{4}\right)y = 8(8) \\ x + 10y = 64 \\ 3x + 4y = 36 \\ x + 10y = 64 \\ \hline -26y = -156 \\ y = \frac{-156}{-26} = 6 \end{array}$$

$$\begin{array}{r} \frac{1}{2}x + \frac{2}{3}y = 6 \\ \frac{1}{2}x + \frac{2}{3}(6) = 6 \\ \frac{1}{2}x + 4 = 6 \\ \frac{1}{2}x = 2 \\ x = 4 \end{array}$$

$$\begin{array}{l} x = 4 \\ y = 6 \end{array}$$

**Q. 15.**  $2x + y = 3$   
 $y = 0.2x + 0.8$

$$\begin{array}{r} 2x + y = 3 \\ 5y = x + 4 \\ 2x + y = 3 \\ x - 5y = -4 \\ \hline 2x + y = 3 \\ -(2x - 10y = -8) \\ \hline 11y = 11 \\ y = 1 \end{array}$$

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

$$2x = 3 - 1$$

$$2x = 2$$

$$x = 1$$

$$x = 1$$

$$y = 1$$

**Q. 16.**  $6x - 8y = 1$

$$7x + 2y = 4$$

$$6x - 8y = 1$$

$$28x + 8y = 16$$

$$\hline 34x = 17$$

$$x = \frac{17}{34}$$

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

$$6\left(\frac{1}{2}\right) - 8y = 1$$

$$3 - 8y = 1$$

$$3 - 1 = 8y$$

$$2 = 8y$$

$$y = \frac{2}{8} = \frac{1}{4}$$

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

$$y = \frac{1}{4}$$

**Q. 17.**  $9x + 5y = 5$

$$3x + 5y = 3$$

$$9x + 5y = 5$$

$$\hline -3x - 5y = -3$$

$$6x = 2$$

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

$$9\left(\frac{1}{3}\right) + 5y = 5$$

$$3 + 5y = 5$$

$$5y = 2$$

$$y = \frac{2}{5}$$

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

$$y = \frac{2}{5}$$

**Q. 18.**  $5x - 6y = -4$

$$x - 3y = -1$$

$$5x - 6y = -4$$

$$2x - 6y = -2$$

$$5x - 6y = -4$$

$$\hline -2x + 6y = 2$$

$$3x = -2$$

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

$$5\left(\frac{-2}{3}\right) - 6y = -4$$

$$\frac{-10}{3} - 6y = -4$$

$$6y = 4 - \frac{10}{3}$$

$$6y = \frac{12}{3} - \frac{10}{3}$$

$$6y = \frac{2}{3}$$

$$y = \frac{1}{9}$$

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

$$y = \frac{1}{9}$$

**Q. 19.**  $\frac{x+1}{4} + \frac{y-1}{2} = 3$

$$x + y = 10$$

$$\text{Top line: } \frac{4(x+1)}{4} + \frac{4(y-1)}{2} = 4(3)$$

$$x + 1 + 2y - 2 = 12$$

$$x + 2y = 12 + 2 - 1$$

$$x + 2y = 13$$

$$x + 2y = 13$$

$$x + y = 10$$

$$x + 2y = 13$$

$$\hline -x - y = -10$$

$$y = 3$$

$$x + 3 = 10$$

$$x = 7$$

$$x = 7$$

$$y = 3$$

**Q. 20.**  $3x + 2y + 1 = 0$

$$\frac{x}{2} + \frac{y + 8}{4} = 2$$

Bottom line:  $4\left(\frac{x}{2}\right) + \frac{4(y + 8)}{4} = 4(2)$

$$2x + (y + 8) = 8$$

$$2x + y + 8 = 8$$

$$2x + y = 0$$

$$3x + 2y = -1$$

$$2x + y = 0$$

$$3x + 2y = -1$$

$$-4x - 2y = 0 \quad (\times -2)$$

$$\hline -x = -1$$

$$x = 1$$

$$2(1) + y = 0$$

$$y = -2$$

$$x = 1$$

$$y = -2$$

**Q. 21.**  $\frac{x + 2y}{6} = 2$

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

$$x + 2y = 12$$

$$x + 2y = 12$$

$$x + 15y = 25$$

$$-x - 2y = -12$$

$$x + 15y = 25$$

$$\hline 13y = 13$$

$$y = 1$$

$$x + 15(1) = 25$$

$$x = 25 - 15$$

$$x = 10$$

$$x = 10$$

$$y = 1$$

$$\frac{x}{5} + 3y = 5$$

$$5\left(\frac{x}{5}\right) + 5(3y) = 5(5)$$

$$x + 15y = 25$$

**Q. 22.**  $\frac{4x - y}{5} = 3$

$$\frac{5(4x - y)}{5} = 3(5) \quad 14\left(\frac{2x}{7}\right) - \frac{14(y + 5)}{2}$$

$$= 14(-1)$$

$$4x - y = 15$$

$$2(2x) - 7(y + 5) = -14$$

$$4x - 7y - 35 = -14$$

$$4x - 7y = 21$$

$$4x - y = 15$$

$$4x - 7y = 21$$

$$4x - y = 15$$

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

$$\hline 6y = -6$$

$$y = -1$$

$$4x - (-1) = 15$$

$$4x = 15 - 1$$

$$4x = 14$$

$$x = \frac{14}{4} = \frac{7}{2}$$

$$x = \frac{7}{2}$$

$$y = -1$$

**Q. 23.**  $2p + 3q = 7p + 10q = 1$

$$\left. \begin{array}{l} 2p + 3q = 1 \\ 7p + 10q = 1 \end{array} \right\} \text{Solve simultaneous equations}$$

$$14p + 21q = 7 \quad (\times 7)$$

$$14p + 20q = 2 \quad (\times 2)$$

$$14p + 21q = 7$$

$$\hline -14p - 20q = -2 \quad (\times -1)$$

$$q = 5$$

$$2p + 3(5) = 1$$

$$2p + 15 = 1$$

$$2p = 1 - 15$$

$$2p = -14$$

$$p = -7$$

$$p = -7$$

$$q = 5$$



$$\text{Q. 24. } \frac{3x - 2}{4} - \frac{y - 3}{2} = \frac{-1}{2}$$

$$\frac{2x + 4}{3} + \frac{y + 1}{4} = \frac{1}{4}$$

Top line:

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

$$3x - 2 - 2(y - 3) = -2$$

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

$$3x - 2y = -6$$

Bottom line:

$$\frac{12(2x + 4)}{3} + \frac{12(y + 1)}{4} = \frac{12(1)}{4}$$

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

$$8x + 16 + 3y + 3 = 3$$

$$8x + 3y = 3 - 3 - 16$$

$$8x + 3y = -16$$

Solve simultaneous equations:

$$3x - 2y = -6$$

$$8x + 3y = -16$$

$$9x - 6y = -18 \quad (\times 3)$$

$$16x + 6y = -32 \quad (\times 2)$$

$$25x = -50$$

$$x = -2$$

$$8(-2) + 3y = -16$$

$$3y = -16 + 16$$

$$3y = 0$$

$$y = 0$$

$$x = -2$$

$$y = 0$$

### Exercise 15.3

$$\text{Q. 1. } 10(ax + b) = 50x + 30$$

$$10ax + 10b = 50x + 30$$

$$10ax = 50x$$

$$10a = 50$$

$$a = 5$$

$$10b = 30$$

$$b = 3$$

$$a = 5$$

$$b = 3$$

$$\text{Q. 2. } 3(bx - 2dy) = 9x + 12y$$

$$3bx - 6dy = 9x + 12y$$

$$3bx = 9x$$

$$3b = 9$$

$$b = 3$$

$$-6dy = 12y$$

$$-6d = 12$$

$$d = -2$$

$$b = 3$$

$$d = -2$$

$$\text{Q. 3. } (x + 5)(x - 3) = ax^2 + bx + c$$

$$= x^2 - 3x + 5x - 15$$

$$= x^2 + 2x - 15$$

$$x^2 = ax^2$$

$$2x = bx$$

$$-15 = c$$

$$a = 1$$

$$b = 2$$

$$c = -15$$

$$\text{Q. 4. } (x + b)^2 = x^2 - 8x + c$$

$$(x + b)(x + b) = x^2 + bx + bx + b^2$$

$$= x^2 + 2bx + b^2$$

$$2bx = -8x$$

$$2b = -8$$

$$b = -4$$

$$b^2 = c$$

$$(-4)^2 = c$$

$$16 = c$$

$$b = -4$$

$$c = 16$$

**Q. 5.**  $(ax - 2)(x - b) = 2x^2 + 6x - 8$

$$ax^2 - axb - 2x + 2b = 2x^2 + 6x - 8$$

$$ax^2 + (-ab - 2)x + 2b = 2x^2 + 6x - 8$$

$$ax^2 = 2x^2$$

$$a = 2$$

$$2b = -8$$

$$b = -4$$

Double check:  $(-ab - 2) = 6$

$$-ab = 8$$

$$ab = -8$$

$$(2)(-4) = -8$$

$$-8 = -8$$

TRUE

$$a = 2$$

$$b = -4$$

**Q. 6.**  $p(2x - 3) - q(3x - 1) = 9x - 10$

$$2px - 3p - 3qx + q$$

$$= (2p - 3q)x + (q - 3p) = 9x - 10$$

$$(2p - 3q)x = 9x$$

$$\left. \begin{array}{l} 2p - 3q = 9 \\ q - 3p = -10 \end{array} \right\} \text{ simultaneous equations}$$

$$2p - 3q = 9$$

$$-3p + q = -10$$

$$2p - 3q = 9$$

$$\underline{-9p + 3q = -30} \quad (\times 3)$$

$$-7p = -21$$

$$7p = 21$$

$$p = 3$$

$$2(3) - 3q = 9$$

$$6 - 3q = 9$$

$$-3q = 3$$

$$q = -1$$

$$p = 3$$

$$q = -1$$

**Q. 7.**  $3(x^2 + 2cx) - b(2x + 1) + c = 3x^2 - 2x + 1$

$$3x^2 + 6cx - 2bx - b + c = 3x^2 - 2x + 1$$

$$3x^2 - 2bx + 6cx - b + c = 3x^2 - 2x + 1$$

$$3x^2 - 2x(b - 3c) - b + c = 3x^2 - 2x + 1$$

$$-2x(b - 3c) = -2x$$

$$b - 3c = 1$$

$$-b + c = 1$$

$$b - 3c = 1$$

$$\Rightarrow -(b - c = -1)$$

$$\underline{-2c = 2}$$

$$c = -1$$

$$-b + c = 1$$

$$b - c = -1$$

$$\Rightarrow b - 3c = 1$$

$$b - 3(-1) = 1$$

$$b + 3 = 1$$

$$b = 1 - 3$$

$$b = -2$$

$$b = -2$$

$$c = -1$$

**Q. 8.**  $2(x - p)(x - 4) + q(x + 5) = 2x^2 - 8x + 1$   
 $2(x^2 - 4x - px + 4p) + q(x + 5) = 2x^2 - 8x + 1$   
 $2x^2 - 8x - 2px + 8p + qx + 5q = 2x^2 - 8x + 1$   
 $2x^2 - 2px + qx - 8x + 8p + 5q = 2x^2 - 8x + 1$   
 $2x^2 - x(2p - q + 8) + 8p + 5q = 2x^2 - 8x + 1$   
 $-x(2p - q + 8) = -8x$   
 $2p - q + 8 = 8$   
 $2p - q = 0$

$$2p - q = 0 \quad (\times 5)$$

$$8p + 5q = 1$$

$$10p - 5q = 0$$

$$+(8p + 5q = 1)$$

$$\hline 18p = 1$$

$$p = \frac{1}{18}$$

$$2p - q = 0$$

$$2\left(\frac{1}{18}\right) - q = 0$$

$$\frac{1}{9} - q = 0$$

$$\frac{1}{9} = q$$

$p = \frac{1}{18}$ $q = \frac{1}{9}$
--------------------------------------

**Q. 9.**  $p(x + 2)(x + 1) - q(x - 3)(x - 1) = 5x^2 + x + 12$   
 $p(x^2 + 3x + 2) - q(x^2 - 4x + 3) = 5x^2 + x + 12$   
 $px^2 - qx^2 + 3px + 4qx + 2p - 3q = 5x^2 + x + 12$   
 $(p - q)x^2 = 5x^2$

$$p - q = 5 \quad [a]$$

$$(3p + 4q)x = x$$

$$3p + 4q = 1 \quad [b]$$

$$2p - 3q = 12 \quad [c]$$

Using:

$$p - q = 5 \quad [a]$$

$$3p + 4q = 1 \quad [b]$$

$$4p - 4q = 20 \quad (\times 4)$$

$$3p + 4q = 1$$

$$\hline 7p = 21$$

$$p = 3$$

$$p - q = 5$$

$$3 - q = 5$$

$$-q = 5 - 3$$

$$-q = 2$$

$$q = -2$$

$p = 3$ $q = -2$
------------------

## Exercise 15.4

**Q. 1.** (i)  $(2x + 5) + (3x) + (4x) = 23$

$$9x + 5 = 23$$

$$9x = 18$$

$$x = 2$$

$$\Rightarrow \text{side } (2x + 5) = [2(2) + 5] = \boxed{9}$$

$$\text{side } (3x) = 3(2) = \boxed{6}$$

$$\text{side } (4x) = 4(2) = \boxed{8}$$

$$\boxed{9, 6, 8}$$

(ii)  $(2x + 3) + (4x - 1) + (10x - 5) = 21$

$$16x - 3 = 21$$

$$16x = 24$$

$$x = \frac{24}{16} = 1.5$$

$$\text{side } 2x + 3 = 2(1.5) + 3 = 6$$

$$\text{side } 4x - 1 = 4(1.5) - 1 = 5$$

$$\text{side } 10x - 5 = 10(1.5) - 5 = 10$$

$$\boxed{5, 6, 10}$$

(iii)  $(3x + 1) + (3x + 1) + (6x - 2) = 42$

$$12x = 42$$

$$x = 3.5$$

$$\text{side } 3x + 1 = 3(3.5) + 1 = 11.5$$

$$\text{side } 3x + 1 = 3(3.5) + 1 = 11.5$$

$$\text{side } 6x - 2 = 6(3.5) - 2 = 19$$

$$\boxed{11.5, 11.5, 19}$$

**Q. 2.** (i) Total seats =  $x$  + no. of deluxe seats

$$\Rightarrow \text{no. of deluxe seats} = 100 - x$$

(ii) Amount of money =  $20x$

(iii)  $30(100 - x)$  **OR**  $3,000 - 30x$

(iv)  $20x + 30(100 - x) = 2,350$

(v)  $20x + 3,000 - 30x = 2,350$

$$20x - 30x = 2350 - 3,000$$

$$-10x = -650$$

$$10x = 650$$

$$x = 65$$

$$\Rightarrow 65 \text{ ordinary seats}$$

$$35 \text{ deluxe seats}$$

**Q. 3.** (i)  $x + y = 7$

(ii)  $2x - 5y = 28$

(iii)  $x + y = 7$

$$2x - 5y = 28$$

$$5x + 5y = 35$$

$$2x - 5y = 28$$

$$\hline 7x = 63$$

$$x = 9$$

$$9 + y = 7$$

$$y = 7 - 9$$

$$y = -2$$

$$\boxed{x = 9}$$

$$\boxed{y = -2}$$

**Q. 4.** (i)  $x$  is the number of 50c coins

$$\Rightarrow (30 - x) \text{ is the number of } \text{€}2 \text{ coins}$$

(ii)  $x(0.50) + (30 - x)(2) = 33$

(iii)  $\frac{1}{2}(x) + 60 - 2x = 33$

$$\frac{-3}{2}x = 33 - 60$$

$$\frac{-3}{2}x = -27$$

$$x = \frac{27(2)}{3} = 18$$

Answer: 18 50c coins

12 €2 coins

**Q. 5.** Let  $x$  be the number of children.

$$(1)(x) + (3)(100 - x) = 158$$

$$x + 300 - 3x = 158$$

$$-2x = 158 - 300$$

$$-2x = -142$$

$$2x = 142$$

$$x = 71$$

$$100 - 71 = 29 \text{ adults}$$

**Q. 6.** Let  $x$  be number of people who paid full price

$$10(x) + (40 - x)(5) = 340$$

$$10x + 200 - 5x = 340$$

$$5x = 340 - 200$$

$$5x = 140$$

$$x = 28$$

28 people paid full price

**Q. 7.** Let one part be  $x$  and let the other part be  $\frac{2}{3}x$ .

$$x + \frac{2}{3}x = 57$$

$$\frac{5}{3}x = 57$$

$$x = \frac{171}{5} = 34.2$$

One part is €34.2

The other is €22.8

**Q. 8.** Let  $x$  be no. of sheep  
 $y$  be no. of ducks

$$x + y = 70$$

$$4x + 2y = 232$$

$$-2x - 2y = -140$$

$$4x + 2y = 232$$

$$\hline 2x = 92$$

$$x = 46$$

$$x + y = 70$$

$$46 + y = 70$$

$$y = 24$$

24 ducks

46 sheep

**Q. 9.** Let the number =  $x$

$$\frac{1}{2}x - \frac{1}{6}x = \frac{2}{3}x + 4$$

$$6\left(\frac{x}{2}\right) - 6\left(\frac{x}{6}\right) = 6\left(\frac{2x}{3}\right) + 6(4)$$

$$3x - x = 4x + 24$$

$$3x - x - 4x = 24$$

$$-2x = 24$$

$$x = -12$$

**Q. 10.** Let the mother's age at any stage =  $x$   
 $\Rightarrow$  the girl's age is always:

$$41 - 15 = 26 \text{ years younger.}$$

$$\text{mother} = x$$

$$\text{daughter} = (x - 26)$$

When the mother is twice the age of the daughter:

$$x = 2(x - 26)$$

$$x = 2x - 52$$

$$-x = -52 \Rightarrow x = 52$$

This happens when the mother is 52, which is in  $(52 - 41) = 11$  years' time.

Answer: 11 years

**Q. 11.** Carla's salary =  $x$

$$\text{Lana's salary} = 0.75x$$

Carla spends  $x - 80$  per month or  $12(x - 80)$  per year.

Lana spends  $0.75x - 80$  per month or  $12(0.75x - 80)$  per year.

Lana spends €1,500 less per year.

$$12(x - 80) - 1,500 = 12(0.75x - 80)$$

$$12x - 960 - 1,500 = 9x - 960$$

$$12x - 2,460 = 9x - 960$$

$$3x = -960 + 2,460$$

$$3x = 1,500$$

$$x = 500$$

Each month Lara spends

$$0.75(500) - 80 = 295.$$

Answer: €295

**Q. 12.** Let  $x$  be the distance travelled at 32 km/hr;  $100 - x$  is the distance travelled at 24 km/hr.

$$\frac{x}{32} + \frac{100 - x}{24} = 3.5$$

$$\frac{3x}{96} + \frac{400 - 4x}{96} = 3.5$$

$$\frac{-x + 400}{96} = 3.5 \Rightarrow 64 = x$$

$\Rightarrow$  64 km at 36 km/hr; 36 km at 24 km/hr

**Q. 13.** Let  $x$  be cost of a double room; Let  $y$  be cost of a single room.

$$x + 3y = 59$$

$$2x + y = 53$$

$$-2x - 6y = -118$$

$$\frac{2x + y = 53}{-5y = -65}$$

$$y = 13$$

$$2x + 13 = 53$$

$$2x = 40$$

$$x = 20$$

A double room costs €20.

A single room costs €13.

**Q. 14.** (i) second fund = total – first fund  
 $= 9,000 - x$

(ii) Earns:  $(0.05)x$

(iii) Earns  $(0.06)(9,000 - x)$

(iv)  $0.05x = (0.06)(9,000 - x) + 180$

$$0.05x = 540 - 0.06x + 180$$

(v)  $0.05x + 0.06x = 540 + 180$

$$0.11x = 720$$

$$x = \frac{720}{0.11}$$

$$x = 6,545.45$$

$$9,000 - x = 2,454.55$$

$$\text{first: } €6,545.45$$

$$\text{second: } €2,454.55$$

**Q. 15.** Let  $x$  be litres of milk.  
Let  $y$  be litres of cream.  
 $x + y = 90$

$$0.04x + 0.4y = 0.2(90)$$

$$0.04x + 0.4y = 18$$

$$x + 10y = 450 \quad (\times 25)$$

$$\frac{-x - y = -90}{9y = 360}$$

$$y = 40$$

$$x + 40 = 90$$

$$x = 90 - 40$$

$$x = 50$$

50 litres milk

40 litres cream

**Q. 16.**  $x$  = amount invested in 1st company

$y$  = amount invested in 2nd

$$x + y = 1,000$$

$$0.2(x) - 0.3(y) = 0.05(1,000)$$

$$0.2x - 0.3y = 50$$

$$2x + 2y = 2,000 \quad (\times 2)$$

$$\frac{-2x + 3y = -500 \quad (\times -10)}{5y = 1,500}$$

$$y = 300$$

$$x = 700$$

1st company: €700

2nd company: €300

**Q. 17.** (i)  $x$  = distance from home to work

$$\begin{aligned} \text{time} &= \frac{\text{distance}}{\text{speed}} \\ &= \frac{x}{80} \text{ hours} \end{aligned}$$

(ii)  $\frac{x}{60}$  hours

(iii)  $\frac{x}{80} + \frac{x}{60} = 84$  mins

$$\Rightarrow \frac{x}{80} + \frac{x}{60} = \frac{7}{5} \text{ (hours)}$$

$$240\left(\frac{x}{80}\right) + 240\left(\frac{x}{60}\right) = 240\left(\frac{7}{5}\right)$$

$$3x + 4x = 336$$

$$7x = 336$$

$$x = 48 \text{ km}$$

48 km = distance between home and work

**Q. 18.** (i)  $3x + 8y = 180$

(ii)  $40x + 100y = 2,300$

(iii)  $120x + 320y = 7,200 \quad (\times 40)$

$$120x + 300y = 6,900 \quad (\times 3)$$

$$120x + 320y = 7,200$$

$$\frac{-120x - 300y = -6,900}{20y = 300}$$

$$y = 15$$

$$3x + 8(15) = 180$$

$$3x + 120 = 180$$

$$3x = 60$$

$$x = 20$$

20 tents

15 caravans

(iv) The amount collected per day is

$$\begin{aligned} 20(10) + 15(18) &= 200 + 270 \\ &= \text{€}470 \end{aligned}$$

**Q. 19.** Let train heading north have speed  $x$  km/hr.

$\Rightarrow$  train heading south has speed  $(x - 20)$  km/hr

Distance travelled by 1st train +  
distance travelled by 2nd train  
= 320 km

The trains travelled for 2.5 hours  
before meeting at 1.30 p.m.

Distance travelled by 1st train =  
 $(x)(2.5)$  km

Distance travelled by 2nd train =  
 $(x - 20)(2.5)$  km

$$2.5x + 2.5(x - 20) = 320$$

$$2.5x + 2.5x - 50 = 320$$

$$5x = 370$$

$$x = 74 \text{ km/hr}$$

$\Rightarrow$  Speed of southbound train  
=  $(74 - 20) = 54$  km/hr

**Q. 20.** (i) time =  $\frac{\text{distance}}{\text{speed}} = \frac{x}{4}$  seconds

(ii)  $\frac{x}{5}$  seconds

$$(iii) \frac{x}{4} + \frac{x}{5} = 6(60)$$

$$\frac{x}{4} + \frac{x}{5} = 360$$

$$20\left(\frac{x}{4}\right) + 20\left(\frac{x}{5}\right) = 20(360)$$

$$5x + 4x = 7,200$$

$$9x = 7,200$$

$$x = 800 \text{ m}$$

Total distance =  $2x = 1,600$  m

$$\begin{aligned} (iv) \text{ Average speed} &= \frac{1,600}{6(60)} = \frac{1,600}{360} \\ &= \frac{40}{9} \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{extra distance} &= \frac{40}{9} \text{ m/s} \times 90\text{s} \\ &= 400 \text{ m} \end{aligned}$$

% increase in distance =

$$\frac{400}{1600} \times 100 = 25\%$$

**Q. 21.** (i)  $x$  = no. plastic parts  
 $y$  = no. metal parts

$$3x + 2y = 90$$

$$10x + 15y = 600$$

$$30x + 20y = 900 \quad (\times 10)$$

$$30x + 45y = 1800 \quad (\times 3)$$

$$-30x - 20y = -900$$

$$30x + 45y = 1800$$

$$\hline 25y = 900$$

$$y = 36$$

$$3x + 2(36) = 90$$

$$3x + 72 = 90$$

$$3x = 18$$

$$x = 6$$

6 plastic parts

36 metal parts

$$\begin{aligned} (ii) (6 \times 8) + (36 \times 6) \\ = 48 + 216 = \text{€}264 \end{aligned}$$

**Q. 22.** Let  $x$  = no. of correct answers

$$x(4) + (30 - x)(-3) = 71$$

$$4x - 90 + 3x = 71$$

$$7x = 161$$

$$x = 23$$

23 correct answers  $\Rightarrow$  7 incorrect  
answers

**Q. 23.** (i) Time =  $\frac{x}{50}$  hrs

(ii) Time =  $\frac{x + 10}{60}$  hrs

$$(iii) \frac{x}{50} + \frac{x+10}{60} + \frac{1}{12} = 3$$

$$\begin{array}{cccc} \uparrow & \uparrow & \uparrow & \uparrow \\ \text{A to B} & \text{B to C} & \text{rest} & \text{total time} \end{array}$$

$$(iv) \frac{x}{50} + \frac{x+10}{60} = 2\frac{11}{12}$$

$$\frac{x}{50} + \frac{x+10}{60} = \frac{35}{12} \quad (\text{LCD} = 300)$$

$$300\left(\frac{x}{50}\right) + 300\left(\frac{x+10}{60}\right) = 300\left(\frac{35}{12}\right)$$

$$6x + 5(x+10) = 25(35)$$

$$6x + 5x + 50 = 875$$

$$11x = 825$$

$$x = 75$$

Distance from A to B is 75 km

$$(v) \text{ Time taken to travel from B to C}$$

$$\text{is } \frac{(x+10)}{60} = \frac{(75+10)}{60}$$

$$= \frac{17}{12} \text{ hours}$$

**Q. 24.** (i) Let  $x$  = no. of offices

$$3,000(x) + 7,000(9-x) = 39,000$$

$$3,000x + 63,000 - 7,000x = 39,000$$

$$3,000x - 7,000x = 39,000 - 63,000$$

$$-4,000x = -24,000$$

$$x = 6$$

$\Rightarrow$  6 offices

3 flats

(ii)  $6(150) + 3(275) = 900 + 825$   
 $= 1,725$  (per week)

$$\frac{39,000}{1,725} = 22.6$$

$\Rightarrow$  After 23 weeks landlord will have recouped conversion costs.

**Q. 25.** Let  $x$  = number of compact radiators  
 Let  $y$  = number of flat panel radiators

$$100x + 120y = 4,660 \quad (\text{A})$$

$$120y - 100x = 860 \quad (\text{B})$$

$$-100x + 120y = 860$$

$$\frac{100x + 120y = 4,660}{240y = 5,520}$$

$$y = 23$$

$$100x + 120(23) = 4,660$$

$$100x + 2,760 = 4,660$$

$$100x = 1,900$$

$$x = 19$$

19 compact radiators and 23 flat panel radiators were installed.

**Q. 26.** (i)  $3 = \frac{d}{s}$

(ii)  $2 = \frac{d-20}{s+10}$

(iii) (a)  $2(s+10) = d-20$   
 $2s+20 = d-20$   
 $2s = d-40$   
 $d = 2s+40$   
 but:  $3 = \frac{d}{s} \Rightarrow d = 3s$   
 $3s = 2s+40$   
 $s = 40$   
 $d = 3(40) = 120$  km  
 2nd journey: distance =  $d-20$   
 $= 120-20 = 100$  km

(b) speed =  $s+10 = 40+10$   
 $= 50$  km/hr

## Revision Exercises

**Q. 1.** (a) (i)  $2(x-2) = 6(x-8)$   
 $2x-4 = 6x-48$   
 $2x-6x = -48+4$   
 $-4x = -44$   
 $x = 11$

(ii)  $16(x+1) = 12(x+4)$   
 $16x+16 = 12x+48$   
 $16x-12x = 48-16$   
 $4x = 32$   
 $x = 8$

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



$$\begin{aligned}
 \text{(b) (i)} \quad & 2x - y = 7 \\
 & 3x + 2y = 21 \\
 & 4x - 2y = 14 \\
 & \underline{3x + 2y = 21} \\
 & 7x = 35 \\
 & x = 5 \\
 & 2(5) - y = 7 \\
 & 10 - y = 7 \\
 & -y = 7 - 10 \\
 & -y = -3 \\
 & y = 3 \\
 & \boxed{x = 5} \\
 & \boxed{y = 3}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad & x + y = 2 \\
 & 4x - 3y = 15 \\
 & 3x + 3y = 6 \\
 & \underline{4x - 3y = 15} \\
 & 7x = 21 \\
 & x = 3 \\
 & 3 + y = 2 \\
 & y = 2 - 3 \\
 & y = -1 \\
 & \boxed{x = 3} \\
 & \boxed{y = -1}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & 7x - 3y = 26 \\
 & x + 5y = 1 \\
 & \underline{7x - 3y = 26} \\
 & -7x - 35y = -7 \\
 & \underline{-38y = 19} \\
 & y = -\frac{1}{2} \\
 & x + 5\left(-\frac{1}{2}\right) = 1 \\
 & x = 1 + \frac{5}{2} \\
 & x = \frac{7}{2} \\
 & \boxed{x = \frac{7}{2}} \\
 & \boxed{y = -\frac{1}{2}}
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) (i)} \quad & \frac{5(x - 1) + 2}{11} = 2 \\
 & 5x - 5 + 2 = 22 \\
 & 5x = 22 - 2 + 5 \\
 & 5x = 25 \\
 & x = 5 \\
 \text{(ii)} \quad & \frac{7(x - 1)}{10} = x - 4 \\
 & 7x - 7 = 10(x - 4) \\
 & 7x - 7 = 10x - 40 \\
 & -7 + 40 = 10x - 7x \\
 & 33 = 3x \\
 & x = 11
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & \frac{x}{6} + \frac{x}{3} = 6 \\
 & 6\left(\frac{x}{6}\right) + 6\left(\frac{x}{3}\right) = 6(6) \\
 & x + 2x = 36 \\
 & 3x = 36 \\
 & x = 12
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad & \frac{x}{4} + \frac{x}{5} = 2 \\
 & 20\left(\frac{x}{4}\right) + 20\left(\frac{x}{5}\right) = 20(2) \\
 & 5x + 4x = 40 \\
 & 9x = 40 \\
 & x = \frac{40}{9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Q. 2. (a) (i)} \quad & x - 3y = 9 \\
 & 5x - 11y = 35 \\
 & -5x + 15y = -45 \quad (\times -5) \\
 & \underline{5x - 11y = 35} \\
 & 4y = -10 \\
 & y = -\frac{5}{2} \\
 \text{If: } & x - 3y = 9 \\
 & x - 3\left(-\frac{5}{2}\right) = 9 \\
 & x + \frac{15}{2} = 9 \\
 & x = \frac{3}{2} \\
 & \boxed{x = \frac{3}{2}} \\
 & \boxed{y = -\frac{5}{2}}
 \end{aligned}$$

$$(ii) a = b - 1$$

$$4a = 3b$$

By substitution:  $4(b - 1) = 3b$

$$4b - 4 = 3b$$

$$4b - 3b = 4$$

$$b = 4$$

$$a = 4 - 1$$

$$a = 3$$

$$a = 3$$

$$b = 4$$

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

$$7x + 1 = 15$$

$$7x = 14$$

$$x = 2$$

$$(ii) \frac{11x - 3}{7} = 9$$

$$11x - 3 = 63$$

$$11x = 66$$

$$x = 6$$

$$(iii) \frac{5x - 1}{7} = 7$$

$$5x - 1 = 49$$

$$5x = 50$$

$$x = 10$$

$$(c) (i) \frac{x + 1}{3} + \frac{3x + 1}{5} = x$$

$$\frac{15(x + 1)}{3} + \frac{15(3x + 1)}{5} = 15(x)$$

$$5(x + 1) + 3(3x + 1) = 15x$$

$$5x + 5 + 9x + 3 = 15x$$

$$5 + 3 = 15x - 9x - 5x$$

$$8 = x$$

$$x = 8$$

$$(ii) \frac{9 - x}{6} - \frac{x + 1}{2} + x = 0$$

$$\frac{6(9 - x)}{6} - \frac{6(x + 1)}{2} + 6(x) = 0$$

$$9 - x - 3(x + 1) + 6x = 0$$

$$9 - x - 3x - 3 + 6x = 0$$

$$6x - 3x - x = -9 + 3$$

$$2x = -6$$

$$x = -3$$

$$\mathbf{Q. 3.} (a) (i) 2x = 6 + 3y$$

$$2y = 3x - 4$$

$$2x - 3y = 6$$

$$-3x + 2y = -4$$

$$6x - 9y = 18 \quad (\times 3)$$

$$-6x + 4y = -8 \quad (\times 2)$$

$$\hline -5y = 10$$

$$y = -2$$

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

$$2x = 6 - 6$$

$$x = 0$$

$$x = 0$$

$$y = -2$$

$$(ii) 0 = 5 - 2p - 5q$$

$$23 + q = 6p$$

$$2p + 5q = 5$$

$$6p - q = 23$$

$$2p + 5q = 5$$

$$30p - 5q = 115$$

$$\hline 32p = 120$$

$$p = \frac{15}{4}$$

$$2\left(\frac{15}{4}\right) + 5q = 5$$

$$5q = 5 - \frac{15}{2}$$

$$5q = -\frac{5}{2}$$

$$q = -\frac{1}{2}$$

$$p = \frac{15}{4}$$

$$q = -\frac{1}{2}$$

$$(b) (i) \frac{4(6x - 1)}{7} - \frac{3(2x + 3)}{4}$$

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

$$\frac{24x - 4}{7} - \frac{6x + 9}{4} = \frac{2x - 1}{2}$$

$$\frac{28(24x - 4)}{7} - \frac{28(6x + 9)}{4}$$

$$= \frac{28(2x - 1)}{2}$$

$$4(24x - 4) - 7(6x + 9)$$

$$= 14(2x - 1)$$

$$96x - 16 - 42x - 63$$

$$= 28x - 14$$

$$96x - 42x - 28x$$

$$= -14 + 63 + 16$$

$$26x = 65$$

$$x = \frac{65}{26} = \frac{5}{2}$$

$$(ii) \frac{5(x - 1) + 6}{9} = \frac{3x + 7}{7}$$

$$\frac{5x - 5 + 6}{9} = \frac{3x + 7}{7}$$

$$\frac{5x + 1}{9} = \frac{3x + 7}{7}$$

$$7(5x + 1) = 9(3x + 7)$$

$$35x + 7 = 27x + 63$$

$$35x - 27x = 63 - 7$$

$$8x = 56$$

$$x = 7$$

$$(c) \quad (i) \quad \text{Left: } \frac{3x + 1}{2} - \frac{y - 1}{5} = 6$$

$$\frac{10(3x + 1)}{2} - \frac{10(y - 1)}{5}$$

$$= 10(6)$$

$$5(3x + 1) - 2(y - 1) = 60$$

$$15x + 5 - 2y + 2 = 60$$

$$15x - 2y = 60 - 5 - 2$$

$$15x - 2y = 53$$

$$\text{Right: } x + y + 1 = 0$$

$$x + y = -1$$

Solve simultaneous eqns:

$$15x - 2y = 53$$

$$\frac{2x + 2y = -2}{17x = 51}$$

$$17x = 51$$

$$x = 3$$

$$x + y = -1$$

$$3 + y = -1$$

$$y = -1 - 3$$

$$y = -4$$

$$x = 3$$

$$y = -4$$

$$(ii) \frac{x + y + 1}{4} - \frac{y}{3} + 1 = 0$$

$$9x + 2y = 0$$

$$\text{Left: } 12 \frac{(x + y + 1)}{4} - 12 \left( \frac{y}{3} \right) + 12 = 0$$

$$3(x + y + 1) - 4y + 12 = 0$$

$$3x + 3y + 3 - 4y + 12 = 0$$

$$3x - y = -15$$

Solve as simultaneous eqns:

$$6x - 2y = -30$$

$$\frac{9x + 2y = 0}{15x = -30}$$

$$15x = -30$$

$$x = -2$$

$$9(-2) + 2y = 0$$

$$2y = 18$$

$$y = 9$$

$$x = -2$$

$$y = 9$$

**Q. 4.** (a) Let the numbers be  $x$  and  $x + 1$ .

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

$$12 \left( \frac{x}{3} \right) + \frac{12(x + 1)}{4} = 12(9)$$

$$4x + 3(x + 1) = 108$$

$$4x + 3x + 3 = 108$$

$$7x = 105$$

$$x = 15$$

$$x + 1 = 16$$

Answer: 15, 16

$$\begin{aligned}
 \text{(b) (i)} \quad & 2(ax - 4by) = 6x + 8y \\
 & 2ax - 8by = 6x + 8y \\
 & 2a = 6 \\
 & a = 3 \\
 & -8b = 8 \\
 & b = -1
 \end{aligned}$$

$$\begin{array}{l}
 a = 3 \\
 b = -1
 \end{array}$$

$$\begin{aligned}
 \text{(ii)} \quad & 2(3x^2 - c) - 2b(4x - 5) - cx \\
 & = 6x^2 + 19x - 40 \\
 & 6x^2 - 2c - 8bx + 10b - cx \\
 & = 6x^2 + 19x - 40 \\
 & 6x^2 + (-8b - c)x + (10b - 2c) \\
 & = 6x^2 + 19x - 40
 \end{aligned}$$

$$\begin{aligned}
 -8b - c &= 19 \\
 10b - 2c &= -40 \\
 -16b - 2c &= 38 \quad (\times 2) \\
 10b - 2c &= -40
 \end{aligned}$$

$$\begin{array}{l}
 16b + 2c = -38 \\
 10b - 2c = -40 \\
 \hline
 26b = -78
 \end{array}$$

$$b = -3$$

$$\begin{aligned}
 -8(-3) - c &= 19 \\
 -c &= 19 - 24 \\
 -c &= -5 \\
 c &= 5
 \end{aligned}$$

$$\begin{array}{l}
 b = -3 \\
 c = 5
 \end{array}$$

$$\begin{aligned}
 \text{(iii)} \quad & p(2x - 1)(x + 3) + q(3x - 5) \\
 & (2x - 7) = 12x^2 - 16x + 26 \\
 \text{LHS:} \\
 & p(2x^2 + 5x - 3) + \\
 & q(6x^2 - 21x - 10x + 35) \\
 & = 2px^2 + 5px - 3p + 6qx^2 \\
 & \quad - 31qx + 35q \\
 & (2p + 6q)x^2 + (5p - 31q)x \\
 & + (35q - 3p) = 12x^2 - 16x + 26
 \end{aligned}$$

$$\begin{aligned}
 2p + 6q &= 12 \\
 -3p + 35q &= 26 \\
 6p + 18q &= 36 \quad (\times 3) \\
 -6p + 70q &= 52 \quad (\times 2) \\
 \hline
 88q &= 88 \\
 \Rightarrow q &= 1
 \end{aligned}$$

$$\begin{aligned}
 2p + 6(1) &= 12 \\
 2p &= 6 \\
 p &= 3
 \end{aligned}$$

$$\begin{array}{l}
 p = 3 \\
 q = 1
 \end{array}$$

$$\begin{aligned}
 \text{(c)} \quad & a(x + 1)(x - 4) - b(x - 2)(x - 3) \\
 & = \frac{-3x^2 + 25x - 68}{40}
 \end{aligned}$$

LHS:

$$\begin{aligned}
 & a(x^2 - 3x - 4) - b(x^2 - 5x + 6) \\
 & (a - b)x^2 + (-3a + 5b)x + (-4a - 6b) \\
 & = \frac{-3x^2 + 25x - 68}{40}
 \end{aligned}$$

$$a - b = -\frac{3}{40}$$

$$-3a + 5b = \frac{25}{40}$$

$$3a - 3b = -\frac{9}{40} \quad (\times 3)$$

$$-3a + 5b = \frac{25}{40}$$

$$2b = \frac{16}{40}$$

$$b = \frac{8}{40} = \frac{1}{5}$$

$$a - \frac{1}{5} = -\frac{3}{40}$$

$$a = -\frac{3}{40} + \frac{8}{40}$$

$$a = \frac{5}{40} = \frac{1}{8}$$

$$\begin{array}{l}
 a = \frac{1}{8} \\
 b = \frac{1}{5}
 \end{array}$$

- Q. 5.** (i) Distance = speed  $\times$  time =  $50t$   
(ii)  $55t$   
(iii)  $50t + 55t = 140t$

(iv)  $105t = 140$

$$t = \frac{140}{105}$$

$$t = \frac{4}{3} \text{ hrs OR } 1 \text{ hr } 20 \text{ mins}$$

(v)  $55t - 50t = 30$

$$5t = 30$$

$$t = 6 \text{ hours}$$

$$10:30 + 6 \text{ hours} = 16:30$$

**Q. 6.** (a) Let  $x$  and  $y$  be the two parts of 31.

$$x + y = 31$$

$$\frac{x}{4} = \frac{y}{5} + 1$$

$$20\left(\frac{x}{4}\right) = 20\left(\frac{y}{5}\right) + 20(1)$$

$$5x = 4y + 20$$

$$5x - 4y = 20$$

Solve as simultaneous eqns:

$$x + y = 31$$

$$5x - 4y = 20$$

$$4x + 4y = 124$$

$$5x - 4y = 20$$

---

$$9x = 144$$

$$x = 16$$

$$16 + y = 31$$

$$y = 31 - 16 \quad y = 15$$

Answer: 16, 15

(b) Let the three numbers be  $x$ ,  $x + 1$  and  $x + 2$ .

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

$$105\left(\frac{x}{7}\right) + 105\left(\frac{x + 1}{5}\right) = 105\frac{(x + 2)}{3}$$

$$15x + 21(x + 1) = 35(x + 2)$$

$$15x + 21x - 35x = 70 - 21$$

$$x = 49$$

Answer: 49, 50, 51

(c)  $x$  = bigger part

$60 - x$  = smaller part

$$\frac{x}{4} = \frac{(60 - x)}{3} + 1$$

$$12\left(\frac{x}{4}\right) = 12\frac{(60 - x)}{3} + 12(1)$$

$$3x = 4(60 - x) + 12$$

$$3x = 240 - 4x + 12$$

$$7x = 252$$

$$x = 36$$

$$60 - x = 24$$

Answer: 36, 24

**Q. 7.** (i)  $70(x)$

(ii)  $61\left(x + \frac{3}{2}\right)$

(iii)  $70x = 61\left(x + \frac{3}{2}\right)$

$$70x = 61x + \frac{183}{2}$$

$$9x = \frac{183}{2}$$

$$x = \frac{183}{18} = \frac{61}{6} \text{ hours (10 hours } 10 \text{ mins)}$$

(iv)  $81x = 61\left(x + \frac{1}{3}\right)$

$$81x = 61x + \frac{61}{3}$$

$$20x = \frac{61}{3}$$

$$60x = 61$$

$$x = \frac{61}{60} \text{ hours OR } 1 \text{ hr } 1 \text{ min}$$

**Q. 8.** (a)  $x$  = no. of goals

$y$  = no. of points

$$x + y = 15$$

$$3x + y = 23$$

$$-x - y = -15$$

$$3x + y = 23$$

---

$$2x = 8$$

$$x = 4$$

$$4 + y = 15$$

$$y = 11$$

$x = 4$
---------

$y = 11$
----------

(b) Let  $x$  = no. of 5c coins  
 $y$  = no. of 10c coins  
 $8x = y$   
 $0.10y - 0.05x = 4.50$   
 $(0.1)(8x) - 0.05x = 4.50$   
 $0.75x = 4.50$   
 $x = 6$   
 $y = 8(6) = 48$

6 5c coins  
 48 10c coins

(c) (i)  $\frac{x}{6}$  (as a fraction of the room)  
 (ii)  $\frac{x}{4}$  (as a fraction of the room)  
 (iii)  $\frac{x}{6} + \frac{x}{4} = 1$   
 $12\left(\frac{x}{6}\right) + 12\left(\frac{x}{4}\right) = 12(1)$   
 $2x + 3x = 12$   
 $5x = 12$   
 $x = \frac{12}{5}$  hours **OR** 2 hours  
 24 mins

**Q. 9.** (a) distance =  $15x$   
 $= 8(x + 7)$   
 $15x = 8(x + 7)$   
 $15x = 8x + 56$   
 $7x = 56$   
 $x = 8$  km/hr

(b) Let  $x$  be the number of tickets sold to children and  $y$  the number sold to adults.  
 $x + y = 100$   
 $x(1.5) + y(2.5) = x(1) + y(5) - 10$   
 $1.5x - x + 2.5y - 5y = -10$   
 $0.5x - 2.5y = -10$   
 Solve as simultaneous eqns:  
 $x + y = 100$   
 $\frac{1}{2}x - \frac{5}{2}y = -10$   
 $x + y = 100$   
 $x - 5y = -20$  ( $\times 2$ )  
 $x + y = 100$   
 $-x + 5y = 20$   
 $\frac{6y = 120}{y = 20}$

$x + 20 = 100$   
 $x = 80$

80 children  
 20 adults

(c) After first hour Edward has  $\frac{1}{6}$  room done  
 $\Rightarrow \frac{5}{6}$  of room left  
 Let  $x$  be the number of hours to finish wallpapering the room.

Edward wallpapers:  $\frac{x}{6}$   
 Zack wallpapers:  $\frac{x}{9}$

$\frac{x}{6} + \frac{x}{9} = \frac{5}{6}$

$18\left(\frac{x}{6}\right) + 18\left(\frac{x}{9}\right) = 18\left(\frac{5}{6}\right)$

$3x + 2x = 15$

$5x = 15$

$x = 3$  hours

10 a.m. + 3 hours = 1 p.m.

**Q. 10.** (a)  $x$  = cost of turkey  
 $y$  = cost of ham  
 $x + y = 33$   
 $1.1(x) + 1.08(y) = 36$   
 $55x + 54y = 1800$  ( $\times 50$ )  
 $x + y = 33$   
 $55x + 54y = 1800$   
 $54x + 54y = 1782$  ( $\times 54$ )  
 $55x + 54y = 1800$   
 $-54x - 54y = -1782$  ( $\times -1$ )  
 $55x + 54y = 1800$   
 $x = 18$   
 $18 + y = 33$   
 $y = 15$   
 Turkey = €18  
 Ham = €15

(b) (i)  $\frac{x}{38}$   
 (ii)  $\frac{x}{22}$

$$\begin{aligned} \text{(iii)} \quad \frac{x}{22} + \frac{x}{38} &= 1 \\ 836\left(\frac{x}{22}\right) + 836\left(\frac{x}{38}\right) &= 836(1) \\ 38x + 22x &= 836 \\ 60x &= 836 \\ x &= \frac{209}{15} \text{ mins OR } 13\frac{14}{15} \text{ mins} \\ &= 13 \text{ mins } 56 \text{ secs} \end{aligned}$$

$$\begin{aligned} \text{(iv)} \quad \frac{x}{22} + \frac{x}{38} - \frac{x}{15} &= 1 \\ 6,270\left(\frac{x}{22}\right) + 6,270\left(\frac{x}{38}\right) \\ - 6,270\left(\frac{x}{15}\right) &= 6,270 \\ 285x + 165x - 418x &= 6270 \\ 32x &= 6,270 \\ x &= \frac{3,135}{16} \text{ OR } 195\frac{15}{16} \text{ mins} \\ &= 195 \text{ mins } 56.25 \text{ secs} \end{aligned}$$

**Q. 11.**

$$\begin{aligned} \text{(i)} \quad \text{Speed} &= \frac{\text{distance}}{\text{time}} = \frac{150}{15} \\ &= 10 \text{ km/hr} \\ \text{(ii)} \quad \text{Speed} &= \frac{150}{8} = 18.75 \text{ km/hr} \\ \text{(iii)} \quad x - y &= 10 \\ \text{(iv)} \quad x + y &= 18.75 \\ \text{(v)} \quad x - y &= 10 \\ \underline{x + y} &= 18.75 \\ 2x &= 28.75 \\ x &= 14.375 \text{ OR } \left(\frac{115}{8}\right) \text{ km/hr} \\ \text{(vi)} \quad x - y &= 10 \\ 14.375 - y &= 10 \\ y &= 4.375 \text{ km/hr} \end{aligned}$$

**Q. 12.**

$$\begin{aligned} \text{(i)} \quad &23.83 + (0.05187)(x) \\ \text{(ii)} \quad &20.67 + (0.05432)(x) \\ \text{(iii)} \quad \text{Company A: } &23.83 + (0.05187) \\ &(5,500) \\ &= 23.83 + 285.285 \\ &= 309.115 \\ &\approx \text{€}309.12 \end{aligned}$$

$$\begin{aligned} \text{Company B: } &20.67 + (0.05432) \\ &(5,500) \\ &= 20.67 + 298.76 \\ &= 319.43 \end{aligned}$$

$$\begin{aligned} 319.43 - 309.115 &= \text{€}10.315 \\ &\approx \text{€}10.32 \end{aligned}$$

Company A is cheaper by  
€10.32

$$\begin{aligned} \text{(iv)} \quad 23.83 + (0.05187)x &= 20.67 + \\ &(0.05432)(x) \\ 23.83 - 20.67 & \\ = [0.05432 - 0.05187]x & \\ 3.16 &= 0.00245x \\ x &= \frac{3.16}{0.00245} = 1289.80 \text{ kWh} \end{aligned}$$

(v) Customers who on average use more than 1,289.80 kWh should use Company A, whereas those that use less on average should use Company B.

$$\begin{aligned} \text{(vi)} \quad 22.35 + (0.05631)\left(\frac{5x}{7}\right) + \\ (0.0483)\left(\frac{2x}{7}\right) \end{aligned}$$

$$\begin{aligned} \text{(vii)} \quad 22.35 + (0.05631)\left(\frac{5}{7}\right)(5,500) + \\ (0.0483)\left(\frac{2}{7}\right)(5,500) \\ = 22.35 + 221.218 + 75.90 \\ = 319.468 \\ \approx \text{€}319.47 \end{aligned}$$

$$\begin{aligned} \text{(viii)} \quad 23.83 + (0.05187)(x) &= 22.35 \\ + (x)\left[(0.05631)\left(\frac{5}{7}\right) + (0.0483)\left(\frac{2}{7}\right)\right] \\ 23.83 - 22.35 &= (x)[0.040221 \\ + 0.0138 - 0.05187] \\ 1.48 &= (x)(0.05402 - 0.05187) \\ x &= \frac{1.48}{0.00215} \\ &= 688.37 \text{ kWh} \end{aligned}$$