LINEAR SIMULTANEOUS EQUATIONS

Task 1 – Solve the simultaneous equations. Do not use trial and improvement.

1) $x + 5y = 23$
$x + 3y = 15$

$$x + 5y = 23$$
$$-(x + 3y = 15)$$
$$2y = 8$$
$$y = 4$$

$x + 5(4) = 23$
$x + 20 = 23$
$x = 3$

$\boldsymbol{x = 3, y = 4}$

2) $2x + 3y = 7$
$2x + y = 5$

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

$2x + 3(1) = 7$
$2x + 3 = 7$
$2x = 4$
$x = 2$

$\boldsymbol{x = 2, y = 1}$

3) $5x + 3y = 23$
$2x + 3y = 20$

$$5x + 3y = 23$$
$$-(2x + 3y = 20)$$
$$3x = 3$$
$$x = 1$$

$5(1) + 3y = 23$
$5 + 3y = 23$
$3y = 18$
$y = 6$

$\boldsymbol{x = 1, y = 6}$

4) $8x - y = 20$
$7x + y = 10$

$$8x - y = 20$$
$$+(7x + y = 10)$$
$$15x = 30$$
$$x = 2$$

$8(2) - y = 20$
$16 - y = 20$
$-y = 4$
$y = -4$

$\boldsymbol{x = 2, y = -4}$

5) $4x - 8y = 0$
$4x + 10y = -9$

$$4x - 8y = 0$$
$$-(4x + 10y = -9)$$
$$-18y = 9$$
$$y = -\frac{9}{18} = -\frac{1}{2}$$

$4x - 8\left(-\frac{1}{2}\right) = 0$
$4x + 4 = 0$
$4x = -4$
$x = -1$

$\boldsymbol{x = -1, y = -\frac{1}{2}}$

Task 2 – Solve the simultaneous equations. Do not use trial and improvement.

6) $4x + 5y = 40$
$2x + 2y = 18 \quad \times 2$

$4x + 5y = 40$
$-(4x + 4y = 36)$
$y = 4$

$4x + 5(4) = 40$
$4x + 20 = 40$
$4x = 20$
$x = 5$

$\boldsymbol{x = 5, y = 4}$

7) $6x - 7y = 22$
$3x + 5y = 28 \quad \times 2$

$6x - 7y = 22$
$-(6x + 10y = 56)$
$-17y = -34$
$y = \frac{-34}{-17} = 2$

$6x - 7(2) = 22$
$6x - 14 = 22$
$6x = 36$
$x = 6$

$\boldsymbol{x = 6, y = 2}$

8) $3x + 8y = 104 \quad \times 2$
$2x - 6y = -44 \quad \times 3$

$6x + 16y = 208$
$-(6x - 18y = -132)$
$34y = 340$
$y = 10$

$3x + 8(10) = 104$
$3x + 80 = 104$
$3x = 24$
$x = 8$

$\boldsymbol{x = 8, y = 10}$

9) $5x - 3y = -3 \quad \times 2$
$2x + 6y = 42$

$10x - 6y = -6$
$+(2x + 6y = 42)$
$12x = 36$
$x = 3$

$5(3) - 3y = -3$
$15 - 3y = -3$
$-3y = -18$
$y = 6$

$\boldsymbol{x = 3, y = 6}$

10) $-5x - 9y = -26 \quad \times 3$
$3x + 10y = 34 \quad \times 5$

$-15x - 27y = -78$
$+(15x + 50y = 170)$
$23y = 92$
$y = 4$

$-5x - 9(4) = -26$
$-5x - 36 = -26$
$-5x = 10$
$x = -2$

$\boldsymbol{x = -2, y = 4}$

11) $7x + 3y = -63 \quad \times 3$
$8x + 9y = -111$

$21x + 9y = -189$
$-(8x + 9y = -111)$
$13x = -78$
$x = -6$

$7(-6) + 3y = -63$
$-42 + 3y = -63$
$3y = -21$
$y = -7$

$\boldsymbol{x = -6, y = -7}$

12) $9x - 2y = 13 \quad \times 4$
$6x + 8y = 4$

$36x - 8y = 52$
$+(6x + 8y = 4)$
$42x \quad = 56$
$x = \frac{56}{42} = \frac{4}{3}$

$9\left(\frac{4}{3}\right) - 2y = 13$

$12 - 2y = 13$

$-2y = 1$

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

$\boldsymbol{x = \frac{4}{3}, y = -\frac{1}{2}}$

Task 3

13) At the cinema, 2 adult tickets and 1 child ticket cost £25. 1 adult ticket and 3 child tickets cost £27.
Work out the price of one adult ticket.
Work out the price of one child ticket.
Do not use trial and improvement.

$Adult\ ticket = x$
$Child\ ticket = y$

$2x + y = 25 \quad \times 3$
$x + 3y = 27$

$6x + 3y = 75$
$-(x + 3y = 27)$
$5x \quad = 48$
$x = 9.60$

$2(9.60) + y = 25$
$19.20 + y = 25$
$y = 5.80$

One adult ticket costs £9.60
One child ticket costs £5.80

14) In a café, 2 sandwiches and 3 drinks cost £17.75. 3 sandwiches and 2 drinks cost £21.
Work out the cost of one sandwich.
Work out the cost of one drink.
Do not use trial and improvement.

$Sandwich = x$
$Drink = y$

$2x + 3y = 17.75 \quad \times 3$
$3x + 2y = 21 \quad \times 2$

$6x + 9y = 53.25$
$-(6x + 4y = 42)$
$5y = 11.25$
$y = 2.25$

$2x + 3(2.25) = 17.75$
$2x + 6.75 = 17.75$
$2x = 11$
$x = 5.50$

One sandwich costs £5.50
One drink costs £2.25

Challenge

15) Solve the simultaneous equations
$3x + 4y - 18 = 0$
$y = 2x + 8$

$3x + 4y = 18$
$2x - y = -8 \quad \times 4$

$3x + 4y = 18$
$+(8x - 4y = -32)$
$11x \quad = -14$
$x = -\frac{14}{11}$

$3\left(-\frac{14}{11}\right) + 4y = 18$

$-\frac{42}{11} + 4y = 18$

$4y = \frac{240}{11}$

$y = \frac{60}{11}$

$\boldsymbol{x = -\frac{14}{11}, y = \frac{60}{11}}$

16) Solve the simultaneous equations

$$2x = 8 - 7y$$

$$\frac{y}{2} + 10 - x = 2$$

$2x + 7y = 8$

$-x + \frac{y}{2} = -8 \quad \times 2$

$$\begin{array}{r} 2x + 7y = 8 \\ +(-2x + y = -16) \\ \hline 8y = -8 \\ y = -1 \end{array}$$

$2x + 7(-1) = 8$

$2x - 7 = 8$

$2x = 15$

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

$\boldsymbol{x = \frac{15}{2}, \quad y = -1}$

17) Solve the simultaneous equations

$$x + y + z = 4.5$$
$$2x + 2y = 4$$
$$2z = x$$

$x = 2z$

Substitute into first two equations:

$2z + y + z = 4.5$

$y + 3z = 4.5 \quad \times 2$

$2(2z) + 2y = 4$

$2y + 4z = 4$

$$\begin{array}{r} 2y + 6z = 9 \\ -(2y + 4z = 4) \\ \hline 2z = 5 \\ z = 2.5 \end{array}$$

$2(2.5) = x$

$x = 5$

$5 + y + 2.5 = 4.5$

$y + 7.5 = 4.5$

$y = -3$

$\boldsymbol{x = 5, y = -3, z = 2.5}$

18) A basket contains apples and oranges. The total number of fruits is 50. There are 12 more apples than oranges. Work out the number of apples and oranges. Do not use trial and improvement.

$Apples = x$

$Oranges = y$

$x + y = 50$

$x + x - 12 = 50$

$2x - 12 = 50$

$2x = 62$

$x = 31$

$31 + y = 50$

$y = 19$

31 apples and 19 oranges