

## Elimination Drills: 5 Questions

1.  $2x + y = 7$   $3x - y = 8$

$$2x + y = 7$$

$$3x - y = 8$$

$$(2x + 3) + (y - y) = 7 + 8$$

$$5x = 15$$

$$x = 3$$

$$2(3) + y = 7$$

$$6 + y = 7$$

$$y = 1$$

$$\text{Solution: } (3, 1)$$

2.  $4x + 5y = 20$   $2x + 5y = 10$

$$4x + 5y = 20$$

$$2x + 5y = 10$$

$$(4x - 2x) + (5y - 5y) = 20 - 10$$

$$2x = 10$$

$$x = 5$$

$$2(5) + 5y = 10$$

$$10 + 5y = 10$$

$$5y = 0$$

$$\text{Solution: } (5, 0)$$

3.  $(3x + 2y = 12) \cdot 2 = 6x + 4y = 12$       Solution:  $(0, 6)$

$$(5x + 4y = 20) \cdot 2 \quad 5x + 4y = 12$$

$$3(0) + 2y = 12$$

$$2y = 12 \quad y = 6$$

$$(6x - 5x) + (4y - 4y) = 12 - 12$$

$$1x = 0$$

$$x = 0$$

$$1. \quad 3x + 2y = 12$$

$$2x - 2y = 4$$

$$5x = 12 + 4$$

$$5x = 16$$

$$x = \frac{16}{5}$$

$$3\left(\frac{16}{5}\right) + 2y = 12$$

$$\frac{48}{5} + 2y = \frac{12}{1} - \frac{48}{5}$$

$$\frac{60}{5} - \frac{48}{5} = \frac{12}{5}$$

$$2y = \frac{12}{5} \div 2$$

$$\left(\frac{16}{5}, \frac{6}{5}\right)$$

$$y = \frac{6}{5}$$

$$2. \quad 3x + 2y = 12$$

$$-3x + y = 3$$

$$3y = 15$$

$$y = 5$$

$$\left(\frac{2}{3}, 5\right)$$

$$3x + 2(5) = 12$$

$$-3x + 5 = 3$$

$$3x + 10 = 12$$

$$-3x = -2$$

$$3x = 2$$

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

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

$$3. \quad 2x - y = 7$$

$$2x + 3y = 3$$

$$-4y = 4$$

$$y = -1$$

$$(3, -1)$$

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

$$2x - 3 = 3$$

$$2x = 6$$

$$x = 3$$

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

$$2x + 1 = 7$$

$$2x = 6$$

$$x = 3$$

$$4. \quad x + y = 8$$

$$-x + y = 2$$

$$2y = 10$$

$$y = 5$$

$$(3, 5)$$

$$x + 5 = 8$$

$$x = 3$$

$$-x + 5 = 2$$

$$x = 3$$

$$5. \quad 2x + 3y = 12$$

$$5x - 3y = 9$$

$$7x = 21$$

$$x = 3$$

$$(3, 2)$$

$$2(3) + 3y = 12$$

$$6 + 3y = 12$$

$$3y = 6$$

$$y = 2$$

$$6. \quad 4x + 6y = 18$$

$$(2x - 5y = -1) \cdot 2 = 4x - 10y = -2$$

$$16y = 20$$

$$y = \frac{5}{4}$$

$$\left(-\frac{21}{8}, \frac{5}{4}\right)$$

$$4x + 6\left(\frac{5}{4}\right) = 18$$

$$4x + \frac{15}{2} = \frac{2 \cdot 18}{2 \cdot 1} = \frac{15}{2}$$

$$4x = \frac{36}{2} - \frac{15}{2} = \frac{21}{2}$$

$$x = \frac{21}{8}$$

$$7. \quad 3x + 4y = 11$$

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



## Systems of Equations: 10 Problem Drills

$$\begin{array}{r} 1. \quad 2x + y = 9 \\ \quad + \quad + \\ -2x + 3y = 7 \end{array}$$

$$4y = 16$$

$$y = 4$$

$$\text{Answer} = \left(\frac{5}{2}, 4\right)$$

$$2x + 4 = 9$$

$$2x = 5$$

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

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

$$-2x + 12 = 7$$

$$-2x = -5$$

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

$$2. \quad \begin{array}{r} 4x - y = 11 \\ \quad - \quad - \\ 4x + 5y = 1 \end{array}$$

$$-6y = 10$$

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

$$\text{Answer} = \left(\frac{7}{3}, -\frac{5}{3}\right)$$

$$4x - \left(-\frac{5}{3}\right) = 11$$

$$4x + \frac{5}{3} = 11$$

$$4x = 11 - \frac{5}{3} = \frac{33}{3} - \frac{5}{3} = \frac{28}{3}$$

$$4x = \frac{28}{3}$$

$$x = \frac{28}{3} \times \frac{1}{4} = \frac{28}{12} = \frac{7}{3}$$

$$3. \quad \begin{array}{r} x - 2y = -4 \\ \quad + \quad + \\ -x + 5y = 11 \end{array}$$

$$3y = 7$$

$$y = \frac{7}{3}$$

$$\text{Answer} = \left(-\frac{2}{3}, \frac{7}{3}\right)$$

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

$$x - \frac{14}{3} = -4$$

$$x = -4 + \frac{14}{3}$$

$$x = -\frac{12}{3} + \frac{14}{3}$$

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

$$4. \quad \begin{array}{r} 3x + 2y = 10 \\ + \quad 5x - 2y = 4 \end{array}$$

$$8x = 14$$

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

$$\left(\frac{7}{4}, \frac{19}{8}\right)$$

$$3\left(\frac{7}{4}\right) + 2y = 10$$

$$\frac{21}{4} + 2y = 10$$

$$2y = 10 - \frac{21}{4}$$

$$2y = \frac{40}{4} - \frac{21}{4}$$

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

$$y = \frac{19}{4} \div 2$$

$$y = \frac{19}{4} \times \frac{1}{2} = \frac{19}{8}$$

$$5. \quad \begin{array}{r} 7x + 3y = 23 \\ + \quad 2x - 3y = -7 \end{array}$$

$$9x = 16$$

$$x = \frac{16}{9}$$

$$\left(\frac{16}{9}, \frac{95}{27}\right)$$

$$2\left(\frac{16}{9}\right) - 3y = -7$$

$$\frac{32}{9} - 3y = -7$$

$$-3y = -7 - \frac{32}{9}$$

$$-3y = \frac{-7}{1} - \frac{32}{9}$$

$$\frac{-63}{9} - \frac{32}{9} = \frac{-95}{9}$$

$$-3y = \frac{-95}{9}$$

$$y = \frac{-95}{9} \div \frac{-3}{1}$$

$$y = \frac{-95}{-27}$$

$$6. \quad 6x - 5y = 13$$

$$+ \quad + \quad +$$

$$4x + 5y = 7$$

$$10x = 20$$

$$x = 2$$

$$(2, -\frac{1}{5})$$

$$4(2) + 5y = 7$$

$$8 + 5y = 7$$

$$5y = -1$$

$$y = -\frac{1}{5}$$

$$7. \quad 5x - 4y = 6$$

$$(3x + 2y = 18) \cdot 2 = 6x + 4y = 36$$

$$(\frac{14}{3}, 2)$$

$$5x - 4y = 6$$

$$+ \quad + \quad +$$

$$6x + 4y = 36$$

$$9x = 42$$

$$x = \frac{14}{3}$$

$$3(\frac{14}{3}) + 2y = 18$$

$$14 + 2y = 18$$

$$2y = 4$$

$$y = 2$$

$$8. \quad (7x + 9y = 12) \cdot 2 = 14x + 18y = 24$$

$$+ \quad + \quad +$$

$$(5x - 6y = 3) \cdot 3 = 15x - 18y = 9$$

$$29x = 33$$

$$x = \frac{33}{29}$$

$$7(\frac{33}{29}) + 9y = 12$$

$$\frac{231}{29} + 9y = 12$$

$$9y = 12 - \frac{231}{29}$$

$$9y = \frac{348}{29} - \frac{231}{29}$$

$$9y = \frac{117}{29}$$

$$y = \frac{117}{29} \cdot \frac{1}{9}$$

$$y = \frac{117}{261}$$

$$(\frac{33}{29}, \frac{117}{261})$$



$$9. \begin{aligned} (2x - 7y = -1) \cdot 4 &= 8x - 28y = -4 \\ (3x + 4y = 19) \cdot 7 &= 21x + 28y = 133 \end{aligned}$$

$$29x = 129$$

$$x = \frac{129}{29}$$

### Systems of Equations: Final Drill Set - Elimination

$$1. \begin{aligned} 3x + 2y &= 16 \\ -3x + 5y &= 10 \end{aligned}$$

$$7y = 26$$

$$y = \frac{26}{7}$$

$$\left(\frac{20}{7}, \frac{26}{7}\right)$$

$$3x + 2\left(\frac{26}{7}\right) = 16$$

$$3x + \frac{52}{7} = 16$$

$$3x = 16 - \frac{52}{7}$$

$$3x = \frac{112}{7} - \frac{52}{7}$$

$$3x = \frac{60}{7}$$

$$x = \frac{60}{7} \cdot \frac{1}{3}$$

$$x = \frac{60}{7} \times \frac{1}{3} = \frac{60}{21} = \frac{20}{7}$$

$$2. \begin{aligned} 4x - y &= 9 \\ (2x + 3y = 7) \cdot 2 &= 4x + 6y = 14 \end{aligned}$$

$$4x - \left(\frac{5}{7}\right) = 9$$

$$4x = 9 + \frac{5}{7}$$

$$\frac{63}{7} + \frac{5}{7}$$

$$4x = \frac{68}{7}$$

$$-7y = -5$$

$$y = \frac{5}{7}$$

$$x = \frac{17}{7}$$

$$\left(\frac{17}{7}, \frac{5}{7}\right)$$

$$\frac{68}{7} \div \frac{4}{1} = \frac{68}{28}$$

$$3. \begin{array}{rcl} 5x - 6y = 4 & = & 5x - 6y = 4 \\ (2x + 3y = 20) \cdot 2 & = & \begin{array}{r} + \quad + \quad + \\ 4x + 6y = 40 \end{array} \end{array}$$

$$9x = 44$$

$$2\left(\frac{44}{9}\right) + 3y = 20 \quad x = \frac{44}{9}$$

$$\frac{88}{9} + 3y = 20$$

$$\left(\frac{44}{9}, \frac{92}{27}\right)$$

$$3y = 20 - \frac{88}{9}$$

$$3y = \frac{180}{9} - \frac{88}{9} = \frac{92}{9}$$

$$y = \frac{92}{9} \div \frac{3}{1} = \frac{92}{27}$$

$$4. \begin{array}{rcl} (7x + 2y = 15) \cdot 5 & = & 35x + 10y = 75 \\ (3x - 5y = 11) \cdot 2 & = & \begin{array}{r} + \quad + \quad + \\ 6x - 10y = 22 \end{array} \end{array}$$

$$41x = 97$$

$$7\left(\frac{97}{41}\right) + 2y = 15$$

$$x = 97/41$$

$$\frac{679}{41} + 2y = 15$$

$$\left(\frac{97}{41}, -\frac{32}{41}\right)$$

$$2y = 15 - \frac{679}{41}$$

$$2y = -\frac{64}{41} \div 2$$

$$y = -\frac{64}{41} \times \frac{1}{2} = -\frac{32}{41}$$



$$5. (9x - 4y = 22) \cdot 5 = 45x - 20y = 110$$

$$(6x + 5y = 3) \cdot 4$$

$$24x + 20y = 12$$

$$69x = 124$$

$$x = \frac{124}{69}$$

$$6\left(\frac{124}{69}\right) + 5y = 3$$

$$\frac{248}{23} + 5y = 3$$

$$5y = 3 - \frac{248}{23}$$

$$5y = \frac{3}{1} - \frac{248}{23}$$

$$\frac{69}{23} - \frac{248}{23} = -\frac{179}{23}$$

$$5y = -\frac{179}{23} / 5$$

$$y = -\frac{179}{115}$$

$$\left(\frac{124}{69}, -\frac{179}{115}\right)$$

$$6. (8x + 3y = 10) \cdot 2 = 16x + 6y = 20$$

$$(7x - 2y = 1) \cdot 3 = 21x - 6y = 3$$

$$37x = 23$$

$$8\left(\frac{23}{37}\right) + 3y = 10$$

$$x = \frac{23}{37}$$

$$\frac{184}{37} + 3y = 10$$

$$\left(\frac{23}{37}, \frac{62}{37}\right)$$

$$3y = 10 - \frac{184}{37}$$

$$\frac{370}{37} - \frac{184}{37} = \frac{186}{37} / \frac{1}{3} \quad \frac{186}{111} = \frac{62}{37}$$

## Systems of Equations - Final Notes

### 1. Special Cases:

- Unique Solution = The lines intersect at one point.
- No Solution = The lines are parallel (same slope, different intercepts).  $\rightarrow 0 = 5$
- Infinite Solutions = The lines are the same line  $\rightarrow 0 = 0$

### 2. Word Problems:

Steps:

1. Define variables: Translate problem into two unknowns.
2. Form two equations: Usually from totals or cost.
3. Solve substitution or elimination