EXPRESSWALA ACADEMY

# Linear Equations in Two Variables

## Question Paper, Set 04

Time: 1 hour 30 minutes | Maximum marks: 50

Name: _____ Class: _____ Date: _____

1. Answer all 20 questions. The marks for each question are shown in brackets.
2. Show your working for the 2, 3 and 5 mark questions.
3. The key sheet and worked solutions are at the end of this paper.

**1.** Check whether $(2, 4)$ is a solution of $4x - 5y = -12$. [1 mark]

**2.** For $2x - y + 2 = 0$, write $y$ in terms of $x$ and find three solutions by taking $x = 1$, $2$ and $3$. What is the graph of this equation? [3 marks]

**3.** For the pair $3x - 2y = -2$ and $2x + y = -13$, find $\frac{a_1}{a_2}$ and $\frac{b_1}{b_2}$. [1 mark]

**4.** For the pair $9x - y = -26$ and $6x + 7y = -25$, compare $\frac{a_1}{a_2}$ and $\frac{b_1}{b_2}$. Does the pair have a unique solution? What kind of lines are they? [2 marks]

**5.** Find the value of $k$ for which the pair $x + 4y = -11$, $kx + 8y = 3$ has no solution. [3 marks]

**6.** Show that the pair $10x + 4y = 8$ and $5x + 2y = 4$ has infinitely many solutions. [2 marks]

**7.** From $x + 2y = -6$, write $x$ in terms of $y$. [1 mark]

**8.** Substitute $x = 7 - 4y$ in $2x + 5y = 5$ and find $y$. [2 marks]

**9.** Solve by the elimination method: $5x + 2y = -34$, $3x - 4y = -10$. [5 marks]

**10.** For $3x - y + 4 = 0$ and $x - 5y - 8 = 0$, find $a_1b_2 - a_2b_1$. [1 mark]

**11.** Solve by the cross multiplication method: $3x + y = 8$, $x + 4y = 21$. [3 marks]

**12.** Write $\frac{3x}{2} + \frac{y}{4} = -5$ and $\frac{2x}{3} + y = -5$ without fractions. [2 marks]

**13.** Solve $\frac{4}{x} - \frac{3}{y} = -1$, $\frac{2}{x} - \frac{3}{y} = 1$ by taking $\frac{1}{x} = p$, $\frac{1}{y} = q$. [3 marks]

**14.** Solve: $\frac{5}{x} - \frac{6}{y} = -1$, $\frac{5}{x} - \frac{9}{y} = -2$. [5 marks]

**15.** Using $\frac{1}{x} = p$, write $\frac{4}{x} - y = 2$ in the form $a_1p + b_1y + c_1 = 0$. [1 mark]

**16.** For $\frac{5}{x} - 3y = 16$ and $\frac{5}{x} + y = -4$, take $\frac{1}{x} = p$ and write $\frac{p}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$ with numbers. [2 marks]

**17.** Solve: $\frac{6}{x-5} + \frac{1}{y+2} = -2$, $\frac{2}{x-5} - \frac{4}{y+2} = -5$. [5 marks]

**18.** Solve: $\frac{4x-5y}{xy} = 18$, $\frac{6x+y}{xy} = 10$. [5 marks]

**19.** If $\frac{2}{\sqrt{x}} = \frac{2}{3}$, find $x$. [1 mark]

**20.** Using $\frac{1}{\sqrt{x}} = p$ and $\frac{1}{\sqrt{y}} = q$, write $\frac{4}{\sqrt{x}} + \frac{2}{\sqrt{y}} = 3$ and $\frac{1}{\sqrt{x}} + \frac{5}{\sqrt{y}} = 3$ as linear equations in $p$ and $q$. [2 marks]

## Key sheet

| Q | Answer |
|---|---|
| 1 | Yes, $(2, 4)$ is a solution |
| 2 | $y = 2 + 2x$; $(1, 4)$, $(2, 6)$, $(3, 8)$; a straight line |
| 3 | $\frac{a_1}{a_2} = \frac{3}{2}$, $\frac{b_1}{b_2} = -2$ |
| 4 | $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$: a unique solution; intersecting lines |
| 5 | $k = 2$ |
| 6 | Infinitely many solutions (coincident lines) |
| 7 | $x = -6 - 2y$ |
| 8 | $y = 3$ |
| 9 | $(x, y) = (-6, -2)$ |
| 10 | $-14$ |
| 11 | $(x, y) = (1, 5)$ |
| 12 | $6x + y = -20$, $2x + 3y = -15$ |
| 13 | $(x, y) = (-1, -1)$ |
| 14 | $(x, y) = (5, 3)$ |
| 15 | $4p - y - 2 = 0$ |
| 16 | $\frac{p}{4} = \frac{y}{-100} = \frac{1}{20}$ |
| 17 | $(x, y) = (3, -1)$ |
| 18 | $(x, y) = (-\frac{1}{2}, \frac{1}{2})$ |
| 19 | $x = 9$ |
| 20 | $4p + 2q = 3$, $p + 5q = 3$ |

## Solutions

**1.** Check whether $(2, 4)$ is a solution of $4x - 5y = -12$. [1]

Put $x = 2$, $y = 4$ in $4x - 5y$:
LHS $= 4(2) - 5(4) = 8 - 20 = -12$
RHS $= -12$. LHS = RHS, so $(2, 4)$ is a solution.

**Ans: Yes, $(2, 4)$ is a solution**

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**2.** For $2x - y + 2 = 0$, write $y$ in terms of $x$ and find three solutions by taking $x = 1$, $2$ and $3$. What is the graph of this equation? [3]

$2x - y + 2 = 0 \Rightarrow y = 2 + 2x$
$x = 1$: $y = 2 + 2(1) = 4$, point $(1, 4)$
$x = 2$: $y = 2 + 2(2) = 6$, point $(2, 6)$
$x = 3$: $y = 2 + 2(3) = 8$, point $(3, 8)$
All its solutions lie on one straight line, so the graph is a straight line.

**Ans: $y = 2 + 2x$; $(1, 4)$, $(2, 6)$, $(3, 8)$; a straight line**

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**3.** For the pair $3x - 2y = -2$ and $2x + y = -13$, find $\frac{a_1}{a_2}$ and $\frac{b_1}{b_2}$. [1]

Here $a_1 = 3$, $b_1 = -2$, $a_2 = 2$, $b_2 = 1$.
$\frac{a_1}{a_2} = \frac{3}{2}$, $\frac{b_1}{b_2} = \frac{-2}{1} = -2$

**Ans: $\frac{a_1}{a_2} = \frac{3}{2}$, $\frac{b_1}{b_2} = -2$**

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**4.** For the pair $9x - y = -26$ and $6x + 7y = -25$, compare $\frac{a_1}{a_2}$ and $\frac{b_1}{b_2}$. Does the pair have a unique solution? What kind of lines are they? [2]

$\frac{a_1}{a_2} = \frac{9}{6} = \frac{3}{2}$, $\frac{b_1}{b_2} = \frac{-1}{7}$
$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, so the lines intersect: a unique solution.

**Ans: $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$: a unique solution; intersecting lines**

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**5.** Find the value of $k$ for which the pair $x + 4y = -11$, $kx + 8y = 3$ has no solution. [3]

For no solution: $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
$\frac{1}{k} = \frac{4}{8}$
$\Rightarrow 4k = 8$
$\Rightarrow k = 2$
Check: $\frac{c_1}{c_2} = \frac{-11}{3} \neq \frac{1}{2}$, so the pair has no solution.

**Ans: $k = 2$**

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**6.** Show that the pair $10x + 4y = 8$ and $5x + 2y = 4$ has infinitely many solutions. [2]

$\frac{a_1}{a_2} = \frac{10}{5} = 2$, $\frac{b_1}{b_2} = \frac{4}{2} = 2$, $\frac{c_1}{c_2} = \frac{8}{4} = 2$
$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$, so the lines coincide: infinitely many solutions.

**Ans: Infinitely many solutions (coincident lines)**

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**7.** From $x + 2y = -6$, write $x$ in terms of $y$. [1]

$x + 2y = -6$

$\Rightarrow x = -6 - 2y$

**Ans:** $x = -6 - 2y$

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**8.** Substitute $x = 7 - 4y$ in $2x + 5y = 5$ and find $y$. [2]

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

$\Rightarrow 14 - 8y + 5y = 5$

$\Rightarrow 14 - 3y = 5$

$\Rightarrow -3y = 5 - 14$

$\Rightarrow -3y = -9$

$\Rightarrow y = 3$

**Ans:** $y = 3$

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**9.** Solve by the elimination method: $5x + 2y = -34$, $3x - 4y = -10$. [5]

$5x + 2y = -34 \quad (1)$

$3x - 4y = -10 \quad (2)$

$(1) \times 3 \Rightarrow 15x + 6y = -102$

$(2) \times 5 \Rightarrow 15x - 20y = -50$

Subtracting, $26y = -52$

$\Rightarrow y = -2$

$(2) \Rightarrow 3x - 4(-2) = -10$

$\Rightarrow 3x + 8 = -10$

$\Rightarrow 3x = -10 - 8$

$\Rightarrow 3x = -18$

$\Rightarrow x = -6$

$\therefore (x, y) = (-6, -2)$

**Ans:** $(x, y) = (-6, -2)$

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**10.** For $3x - y + 4 = 0$ and $x - 5y - 8 = 0$, find $a_1b_2 - a_2b_1$. [1]

$a_1 = 3$, $b_1 = -1$, $a_2 = 1$, $b_2 = -5$

$a_1b_2 - a_2b_1 = (3)(-5) - (1)(-1) = -15 + 1 = -14$

**Ans:** $-14$

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**11.** Solve by the cross multiplication method: $3x + y = 8$, $x + 4y = 21$. [3]

$3x + y - 8 = 0 \quad (1)$

$x + 4y - 21 = 0 \quad (2)$

$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$

$\frac{x}{-21 + 32} = \frac{y}{-8 + 63} = \frac{1}{12 - 1}$

$\frac{x}{11} = \frac{y}{55} = \frac{1}{11}$

$\Rightarrow x = \frac{11}{11},\ y = \frac{55}{11}$

$\therefore (x, y) = (1, 5)$

**Ans:** $(x, y) = (1, 5)$

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**12.** Write $\frac{3x}{2}+\frac{y}{4}=-5$ and $\frac{2x}{3}+y=-5$ without fractions. [2]

$\frac{3x}{2}+\frac{y}{4}=-5 \Rightarrow \frac{6x+y}{4}=-5 \Rightarrow 6x+y=-20$

$\frac{2x}{3}+y=-5 \Rightarrow \frac{2x+3y}{3}=-5 \Rightarrow 2x+3y=-15$

**Ans:** $6x+y=-20,\ 2x+3y=-15$

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**13.** Solve $\frac{4}{x}-\frac{3}{y}=-1,\ \frac{2}{x}-\frac{3}{y}=1$ by taking $\frac{1}{x}=p,\ \frac{1}{y}=q$. [3]

Let $\frac{1}{x}=p$ and $\frac{1}{y}=q$.

$4p-3q=-1 \quad (1)$

$2p-3q=1 \quad (2)$

$(1) \Rightarrow 4p-3q=-1$

$(2)\times 2 \Rightarrow 4p-6q=2$

Subtracting, $3q=-3$

$\Rightarrow q=-1$

$(2) \Rightarrow 2p-3(-1)=1$

$\Rightarrow 2p+3=1$

$\Rightarrow 2p=1-3$

$\Rightarrow 2p=-2$

$\Rightarrow p=-1$

$\therefore (p,q)=(-1,-1)$

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

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

$\therefore (x,y)=(-1,-1)$

**Ans:** $(x,y)=(-1,-1)$

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**14.** Solve: $\frac{5}{x}-\frac{6}{y}=-1,\ \frac{5}{x}-\frac{9}{y}=-2$. [5]

Let $\frac{1}{x}=p$ and $\frac{1}{y}=q$.

$5p-6q=-1 \quad (1)$

$5p-9q=-2 \quad (2)$

Subtracting, $3q=1$

$\Rightarrow q=\frac{1}{3}$

$(1) \Rightarrow 5p-6(\frac{1}{3})=-1$

$\Rightarrow 5p-2=-1$

$\Rightarrow 5p=-1+2$

$\Rightarrow 5p=1$

$\Rightarrow p=\frac{1}{5}$

$\therefore (p,q)=(\frac{1}{5},\frac{1}{3})$

$\frac{1}{x}=\frac{1}{5} \Rightarrow x=5$

$\frac{1}{y}=\frac{1}{3} \Rightarrow y=3$

$\therefore (x,y)=(5,3)$

**Ans:** $(x,y)=(5,3)$

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**15.** Using $\frac{1}{x} = p$, write $\frac{4}{x} - y = 2$ in the form $a_1p + b_1y + c_1 = 0$. [1]

Put $\frac{1}{x} = p$: $4p - y = 2$

$\Rightarrow 4p - y - 2 = 0$

**Ans:** $4p - y - 2 = 0$

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**16.** For $\frac{5}{x} - 3y = 16$ and $\frac{5}{x} + y = -4$, take $\frac{1}{x} = p$ and write $\frac{p}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$ with numbers. [2]

Let $\frac{1}{x} = p$.

$5p - 3y - 16 = 0 \quad (1)$

$5p + y + 4 = 0 \quad (2)$

$\frac{p}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$

$\frac{p}{-12+16} = \frac{y}{-80-20} = \frac{1}{5+15}$

$\frac{p}{4} = \frac{y}{-100} = \frac{1}{20}$

**Ans:** $\frac{p}{4} = \frac{y}{-100} = \frac{1}{20}$

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**17.** Solve: $\frac{6}{x-5} + \frac{1}{y+2} = -2$, $\frac{2}{x-5} - \frac{4}{y+2} = -5$. [5]

Let $\frac{1}{x-5} = p$ and $\frac{1}{y+2} = q$.

$6p + q = -2 \quad (1)$

$2p - 4q = -5 \quad (2)$

$(1) \Rightarrow q = -2 - 6p$

Substitute in $(2)$: $2p - 4(-2 - 6p) = -5$

$\Rightarrow 2p + 8 + 24p = -5$

$\Rightarrow 26p + 8 = -5$

$\Rightarrow 26p = -5 - 8$

$\Rightarrow 26p = -13$

$\Rightarrow p = -\frac{1}{2}$

$(1) \Rightarrow q = -2 - 6(-\frac{1}{2}) = 1$

$\therefore (p, q) = (-\frac{1}{2}, 1)$

$\frac{1}{x-5} = -\frac{1}{2} \Rightarrow x - 5 = -2 \Rightarrow x = 3$

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

$\therefore (x, y) = (3, -1)$

**Ans:** $(x, y) = (3, -1)$

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**18.** Solve: $\frac{4x-5y}{xy}=18$, $\frac{6x+y}{xy}=10$. [5]

$\frac{4x-5y}{xy}=18 \Rightarrow \frac{4}{y}-\frac{5}{x}=18$

$\frac{6x+y}{xy}=10 \Rightarrow \frac{6}{y}+\frac{1}{x}=10$

Let $\frac{1}{x}=p$ and $\frac{1}{y}=q$.

$-5p+4q=18 \quad (1)$

$p+6q=10 \quad (2)$

$(1)\times 3 \Rightarrow -15p+12q=54$

$(2)\times 2 \Rightarrow 2p+12q=20$

Subtracting, $-17p=34$

$\Rightarrow p=-2$

$(1) \Rightarrow 4q-5(-2)=18$

$\Rightarrow 4q+10=18$

$\Rightarrow 4q=18-10$

$\Rightarrow 4q=8$

$\Rightarrow q=2$

$\therefore (p,q)=(-2,2)$

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

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

$\therefore (x,y)=(-\frac{1}{2},\frac{1}{2})$

**Ans:** $(x,y)=(-\frac{1}{2},\frac{1}{2})$

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**19.** If $\frac{2}{\sqrt{x}}=\frac{2}{3}$, find $x$. [1]

$\frac{2}{\sqrt{x}}=\frac{2}{3} \Rightarrow \sqrt{x}=2\times\frac{3}{2}=3$

$\Rightarrow x=3^2=9$

**Ans:** $x=9$

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**20.** Using $\frac{1}{\sqrt{x}}=p$ and $\frac{1}{\sqrt{y}}=q$, write $\frac{4}{\sqrt{x}}+\frac{2}{\sqrt{y}}=3$ and $\frac{1}{\sqrt{x}}+\frac{5}{\sqrt{y}}=3$ as linear equations in $p$ and $q$. [2]

Let $\frac{1}{\sqrt{x}}=p$ and $\frac{1}{\sqrt{y}}=q$.

$4p+2q=3 \quad (1)$

$p+5q=3 \quad (2)$

**Ans:** $4p+2q=3$, $p+5q=3$

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