# CLASS 10 — MATHEMATICS

**Chapter: Pair of Linear Equations in Two Variables**

Answer Key with Step-by-Step Solutions

**Maximum Marks: 40** **Time Allowed: 1 hour 30 minutes**

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**Results used:** for $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$: $a_1/a_2 \neq b_1/b_2 \Rightarrow$ intersecting lines, unique solution (consistent); $a_1/a_2 = b_1/b_2 = c_1/c_2 \Rightarrow$ coincident lines, infinitely many solutions (dependent, consistent); $a_1/a_2 = b_1/b_2 \neq c_1/c_2 \Rightarrow$ parallel lines, no solution (inconsistent). Algebraic methods: substitution and elimination.

## SECTION A — MCQ Answer Key

| Q | Option | Answer | Explanation / calculation |
|---|---|---|---|
| Q1 | **(C)** | infinitely many solutions | $a_1/a_2 = 1/3$, $b_1/b_2 = 2/6 = 1/3$, $c_1/c_2 = 5/15 = 1/3$. All ratios equal ⇒ coincident lines ⇒ infinitely many solutions. |
| Q2 | **(B)** | $-3$ | No solution needs $a_1/a_2 = b_1/b_2 \neq c_1/c_2$: $2/6 = k/(-9) \Rightarrow k = -3$. Then $c_1/c_2 = 7/1 \neq 1/3$ ✓ |
| Q3 | **(A)** | intersecting at exactly one point | $a_1/a_2 = 4/8 = 1/2$ and $b_1/b_2 = -5/3$. Since $1/2 \neq -5/3$, the lines intersect at exactly one point. |
| Q4 | **(D)** | $x = 5$, $y = 2$ | Adding: $2x = 10 \Rightarrow x = 5$; then $y = 7 - 5 = 2$. |
| Q5 | **(B)** | $-2$ | $3(2) + k(-1) = 8 \Rightarrow 6 - k = 8 \Rightarrow k = -2$. |
| Q6 | **(A)** | $x = 2$, $y = 3$ | The lines meet at P(2, 3). Check: $2 + 3 = 5$ ✓ and $2(2) - 3 = 1$ ✓ |
| Q7 | **(C)** | parallel lines | Parallel lines never meet, so there is no common solution; the pair is inconsistent. |
| Q8 | **(D)** | 30 | $x + y = 50$, $x - y = 10 \Rightarrow 2x = 60 \Rightarrow x = 30$ (smaller number 20). |
| Q9 | **(A)** | Both true; R explains A | $a_1/a_2 = 3/6 = 1/2$, $b_1/b_2 = (-4)/(-8) = 1/2$, $c_1/c_2 = 7/10$. So $a_1/a_2 = b_1/b_2 \neq c_1/c_2$: lines are parallel and there is no solution. R is the correct rule that explains A. |
| Q10 | **(D)** | A false, R true | $a_1/a_2 = 1/2$, $b_1/b_2 = (-2)/(-4) = 1/2$, $c_1/c_2 = 3/6 = 1/2$. All equal, so the pair has infinitely many solutions, not a unique one. A is false; R is a true statement. |

**Marking:** 1 mark for each correct option; no part marks in Section A.

## SECTION B — Very Short Answer

**Q11. Substitution: $2x + y = 11$, $3x - 2y = 6$** [2 marks]

From the first equation: $y = 11 - 2x$ ... (1)

Substitute (1) in the second: $3x - 2(11 - 2x) = 6 \Rightarrow 3x - 22 + 4x = 6 \Rightarrow 7x = 28 \Rightarrow x = 4$.

From (1): $y = 11 - 8 = 3$.

Check: $2(4) + 3 = 11$ ✓; $3(4) - 2(3) = 6$ ✓

**Answer: $x = 4$, $y = 3$**

> **Marking scheme:**
> Expressing $y$ in terms of $x$ and substituting correctly: 1 mark
> Correct values $x = 4$, $y = 3$: 1 mark

**Q12. Elimination: $5x + 3y = 19$, $2x - 3y = -5$** [2 marks]

The coefficients of $y$ are equal and opposite, so add the equations to eliminate $y$: $(5x + 3y) + (2x - 3y) = 19 + (-5) \Rightarrow 7x = 14 \Rightarrow x = 2$.

Substitute in $5x + 3y = 19$: $10 + 3y = 19 \Rightarrow y = 3$.

Check: $2(2) - 3(3) = -5$ ✓

**Answer: $x = 2$, $y = 3$**

> **Marking scheme:**
> Eliminating $y$ to get $x = 2$: 1 mark
> Finding $y = 3$: 1 mark

**Q13. Unique solution condition** [2 marks]

For a unique solution, $a_1/a_2 \neq b_1/b_2$.

$3/6 \neq k/8 \Rightarrow 1/2 \neq k/8 \Rightarrow k \neq 4$.

So the pair has a unique solution for every real value of $k$ except 4.

**Answer: All real values of $k$ except $k = 4$**

> **Marking scheme:**
> Correct condition $a_1/a_2 \neq b_1/b_2$: 1 mark
> Conclusion $k \neq 4$: 1 mark

**Q14. Notebooks and pens** [2 marks]

Let one notebook cost ₹ $x$ and one pen cost ₹ $y$. Then $2x + 3y = 110$ ... (1) and $3x + 2y = 115$ ... (2).

Adding: $5x + 5y = 225 \Rightarrow x + y = 45$ ... (3). Subtracting (1) from (2): $x - y = 5$ ... (4).

From (3) and (4): $2x = 50 \Rightarrow x = 25$, and $y = 20$.

Check: $2(25) + 3(20) = 110$ ✓; $3(25) + 2(20) = 115$ ✓

**Answer: Notebook ₹ 25, pen ₹ 20**

> **Marking scheme:**
> Forming both equations: 1 mark
> Solving correctly: 1 mark

**Q15. Rectangle** [2 marks]

Let length = $l$ cm and breadth = $b$ cm. Then $l - b = 5$ ... (1) and $2(l + b) = 42 \Rightarrow l + b = 21$ ... (2).

Adding (1) and (2): $2l = 26 \Rightarrow l = 13$. Then $b = 21 - 13 = 8$.

Check: $13 - 8 = 5$ ✓; $2(13 + 8) = 42$ ✓

**Answer: Length = 13 cm, breadth = 8 cm**

> **Marking scheme:**
> Forming both equations: 1 mark
> Correct length and breadth with units: 1 mark

## SECTION C — Short Answer

**Q16. Infinitely many solutions — find $a$ and $b$** [3 marks]

Write the second equation as $(a - b)x + (a + b)y - (3a + b - 2) = 0$, and the first as $2x + 3y - 7 = 0$.

For infinitely many solutions: $\frac{2}{a-b} = \frac{3}{a+b} = \frac{7}{3a+b-2}$.

From the first two: $2(a + b) = 3(a - b) \Rightarrow 2a + 2b = 3a - 3b \Rightarrow a = 5b$ ... (1)

From the last two: $3(3a + b - 2) = 7(a + b) \Rightarrow 9a + 3b - 6 = 7a + 7b \Rightarrow 2a - 4b = 6 \Rightarrow a - 2b = 3$ ... (2)

Substitute (1) in (2): $5b - 2b = 3 \Rightarrow b = 1$, so $a = 5$.

Check: second equation becomes $4x + 6y = 14$, and $2/4 = 3/6 = 7/14 = 1/2$ ✓

**Answer: $a = 5$, $b = 1$**

> **Marking scheme:**
> Writing the equal-ratio condition: 1 mark
> Forming the two equations in $a$ and $b$: 1 mark
> Solving to get $a = 5$, $b = 1$: 1 mark

**Q17. The fraction** [3 marks]

Let the fraction be $\frac{x}{y}$.

$\frac{x+1}{y+1} = \frac{2}{3} \Rightarrow 3x + 3 = 2y + 2 \Rightarrow 3x - 2y = -1$ ... (1)

$\frac{x-1}{y-1} = \frac{1}{2} \Rightarrow 2x - 2 = y - 1 \Rightarrow 2x - y = 1 \Rightarrow y = 2x - 1$ ... (2)

Substitute (2) in (1): $3x - 2(2x - 1) = -1 \Rightarrow -x + 2 = -1 \Rightarrow x = 3$. Then $y = 5$.

Check: $\frac{4}{6} = \frac{2}{3}$ ✓ and $\frac{2}{4} = \frac{1}{2}$ ✓

**Answer: $\frac{3}{5}$**

> **Marking scheme:**
> Forming equation (1): 1 mark
> Forming equation (2): 1 mark
> Solving to get the fraction 3/5: 1 mark

**Q18. Two-digit number** [3 marks]

Let the tens digit be $x$ and the units digit be $y$. The number is $10x + y$; the reversed number is $10y + x$.

$10x + y = 4(x + y) \Rightarrow 6x = 3y \Rightarrow y = 2x$ ... (1)

$10x + y + 18 = 10y + x \Rightarrow 9x - 9y = -18 \Rightarrow x - y = -2$ ... (2)

Substitute (1) in (2): $x - 2x = -2 \Rightarrow x = 2$, $y = 4$. The number is 24.

Check: $4 \times (2 + 4) = 24$ ✓; $24 + 18 = 42$ ✓

**Answer: 24**

> **Marking scheme:**
> Forming equation (1): 1 mark
> Forming equation (2): 1 mark
> Correct number 24: 1 mark

**Q19. Motorboat** [3 marks]

Let the speed of the boat in still water be $u$ km/h and the speed of the stream be $v$ km/h.

Downstream speed = $u + v = 24 \div 2 = 12$ ... (1). Upstream speed = $u - v = 24 \div 3 = 8$ ... (2).

Adding: $2u = 20 \Rightarrow u = 10$. Subtracting: $2v = 4 \Rightarrow v = 2$.

**Answer: Boat 10 km/h in still water; stream 2 km/h**

> **Marking scheme:**
> Downstream and upstream speeds 12 and 8: 1 mark
> Forming the two equations: 1 mark
> Correct speeds with units: 1 mark

## SECTION D — Long Answer

**Q20. Graphical solution and triangle with the $y$-axis** [4 marks]

Table of values:

| | | | | |
|---|---|---|---|---|
| **$2x + y = 8$** | $x$ | 0 | 4 | 3 |
| | $y = 8 - 2x$ | 8 | 0 | 2 |
| **$x - y = 1$** | $x$ | 0 | 1 | 3 |
| | $y = x - 1$ | $-1$ | 0 | 2 |

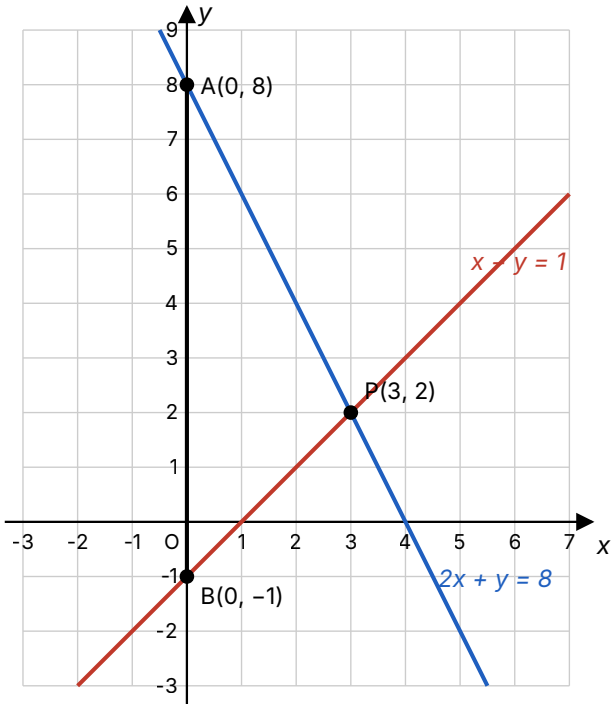
Plot the points and draw both lines (see graph below). They intersect at P(3, 2).

Check: $2(3) + 2 = 8$ ✓; $3 - 2 = 1$ ✓. So $x = 3$, $y = 2$.

Put $x = 0$: $2x + y = 8$ meets the $y$-axis at A(0, 8); $x - y = 1$ meets it at B(0, −1).

Triangle PAB: base AB lies on the $y$-axis, AB = $8 - (-1) = 9$ units. Height = distance of P from the $y$-axis = 3 units.

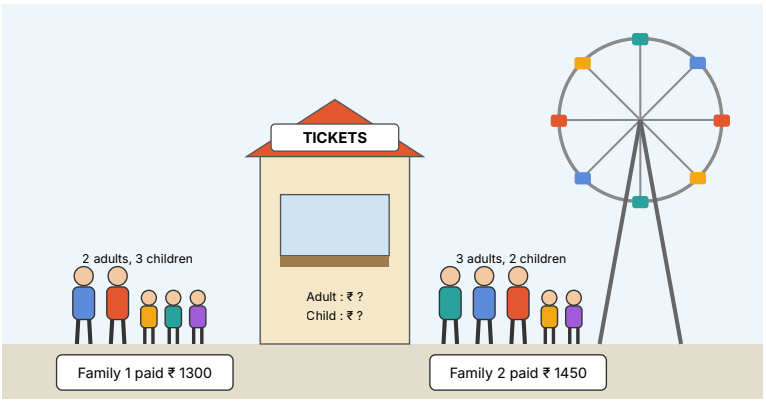
Area = $\frac{1}{2} \times 9 \times 3 = 13.5$ square units.




**Answer: $x = 3$, $y = 2$; lines meet the $y$-axis at (0, 8) and (0, −1); area = 13.5 square units**

> **Marking scheme:**
> Correct tables and both lines drawn: 1 mark
> Solution $x = 3$, $y = 2$ from the graph: 1 mark
> Points A(0, 8) and B(0, −1): 1 mark
> Area = 13.5 square units: 1 mark

## SECTION E — Case Study




**Q21. Amusement park tickets** [4 marks]

**(i)** Family 1: $2x + 3y = 1300$. Family 2: $3x + 2y = 1450$.

**(ii)** $a_1/a_2 = 2/3$ and $b_1/b_2 = 3/2$. Since $2/3 \neq 3/2$, the lines intersect at one point, so the pair has a **unique solution** (consistent).

**(iii)** Adding: $5x + 5y = 2750 \Rightarrow x + y = 550$. Subtracting the first from the second: $x - y = 150$.

So $2x = 700 \Rightarrow x = 350$ and $y = 200$. Adult ticket ₹ 350, child ticket ₹ 200.

Check: $2(350) + 3(200) = 1300$ ✓; $3(350) + 2(200) = 1450$ ✓

4 adults and 5 children: $4 \times 350 + 5 \times 200 = 1400 + 1000 = ₹ 2400$.

**Answer: (i) $2x + 3y = 1300$, $3x + 2y = 1450$ (ii) unique solution (iii) adult ₹ 350, child ₹ 200; total ₹ 2400**

> **Marking scheme:**
> (i) Both equations: 1 mark
> (ii) Ratio comparison and conclusion: 1 mark
> (iii) Adult ₹ 350 and child ₹ 200: 1 mark; total ₹ 2400: 1 mark

## Final Answer Summary

| Q | Final answer | Q | Final answer |
|---|---|---|---|
| **Q1** | (C) infinitely many solutions | **Q12** | $x = 2$, $y = 3$ |
| **Q2** | (B) $-3$ | **Q13** | $k \neq 4$ |
| **Q3** | (A) intersecting | **Q14** | Notebook ₹ 25, pen ₹ 20 |
| **Q4** | (D) $x = 5$, $y = 2$ | **Q15** | 13 cm, 8 cm |
| **Q5** | (B) $-2$ | **Q16** | $a = 5$, $b = 1$ |
| **Q6** | (A) $x = 2$, $y = 3$ | **Q17** | $\frac{3}{5}$ |
| **Q7** | (C) parallel lines | **Q18** | 24 |
| **Q8** | (D) 30 | **Q19** | 10 km/h, 2 km/h |
| **Q9** | (A) | **Q20** | (3, 2); (0, 8), (0, −1); 13.5 sq units |
| **Q10** | (D) | **Q21** | (ii) unique (iii) ₹ 350, ₹ 200; ₹ 2400 |
| **Q11** | $x = 4$, $y = 3$ | | |

Marks: Section A 10 + Section B 10 + Section C 12 + Section D 4 + Section E 4 = **40**

**— End of Solutions —**