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# ANSWER KEY

## Chapter 13 · Two Variables, One Line

Class IX · As per New Curriculum **Ganita Manjari**

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## Topic 1: Linear Equations in Two Variables and Their Solutions

**1.** (i) $3x + 0 \cdot y - 1 = 0$

(ii) $-2x + y - 7.5 = 0$ ($a = -2$, $b = 1$, $c = -7.5$); $-2x + 3y + 0 = 0$ $(-2, 3, 0)$

$5x - 3y + 0 = 0$ $(5, -3, 0)$; $4x + 3y - 12 = 0$ $(4, 3, -12)$ *[ multiply by 12 ]*

**Answer:** As above

**2.** (i) $5(4) - 6(3) = 20 - 18 = 2$ ✓

(ii) $3(1) + 2(3) = 9 \neq 12$ ✗

(iii) $4(-2) + 3(5) = 7$ ✓

**Answer:** Yes, no, yes

**3.** (i) (3, 0), (0, −7) *[ x = 0 and y = 0 ]*

(ii) (1, 1), (4, −1)

(iii) (0, 0), (4, 1) *[ passes through the origin ]*

**Answer:** As above (other answers possible)

**4.** $3m(2) + 2(-1) = 10 \Rightarrow 6m = 12 \Rightarrow m = 2$

$5(2) + n(-1) = 7 \Rightarrow n = 3$

**Answer:** $m = 2$, $n = 3$

**5.** (i) (2, −1) in IV, (−1, 4) in II

(ii) (2, 1) in I, (−1, −4) in III

(iii) (1, 4) in I, (−2, −1) in III

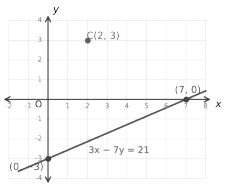
(iv) (−2, 1) in II, (1, −4) in IV

**Answer:** As above (other answers possible)

**6.** (i) (7, 0): $21 - 0 = 21$ ✓; (0, −3): $0 + 21 = 21$ ✓

(ii) $3(2) - 7(3) = -15 \neq 21$

C is not on the line and does not satisfy the equation.




**Answer:** (iii) No — the line is exactly the set of solutions

**7.** (i) F — infinitely many. (ii) F — only when $c = 0$. (iii) F — e.g., (7, 0) for $3x - 7y = 21$.
(iv) T — $x + 0 \cdot y - 3 = 0$. (v) T. (vi) F — $2 + 6 = 8 \neq 7$.

**Answer:** F, F, F, T, T, F

**8.** (i) $6x + 8y = 14$ is $2 \times (3x + 4y = 7)$

(ii) $ap + bq = c \Rightarrow k(ap + bq) = kc$

$kap + kbq = kc \Rightarrow ap + bq = c$ *[ divide by $k \neq 0$ ]*

**∴ same set of solutions**

**Hence proved.**

**9.** $c = 0$: $a \cdot 0 + b \cdot 0 = 0$, so $(0, 0)$ lies on the line

Converse: $(0, 0)$ on the line $\Rightarrow a \cdot 0 + b \cdot 0 + c = 0 \Rightarrow c = 0$ *[ also true ]*

$2x + 3y = 0$ passes through $(0, 0)$; $5x = 0$ is the y-axis; $7y = 0$ is the x-axis.

**Answer:** Agree; the converse is true

**10.** $60x + 50y = 280 \Rightarrow 6x + 5y = 28$

(i) $x = 0, 1, 2, 3, 4$ give $y = 5.6, 4.4, 3.2, 2, 0.8$

(ii) half-kilograms: $x = 0.5 \Rightarrow y = 5$; $x = 3 \Rightarrow y = 2$ *[ others give non-half values ]*

**Answer:** (i) 3 kg and 2 kg (ii) (0.5, 5) and (3, 2)

## Topic 2: Slope and the Slope–Intercept Form

**1.** A: $\frac{100}{250} = 0.4$; B: $\frac{110}{300} \approx 0.37$; C: $\frac{90}{200} = 0.45$ *[ slope = rise ÷ run ]*



**Answer:** B, A, C

**2.** (i) $\frac{6}{3} = 2$ (rises) (ii) $\frac{-8}{4} = -2$ (falls)

(iii) $\frac{0}{4} = 0$ (horizontal) (iv) run = 0: undefined (vertical)

(v) $\frac{-2}{6} = -\frac{1}{3}$ (falls)

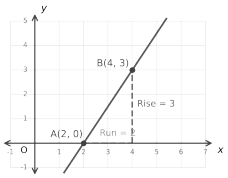
**Answer:** 2, −2, 0, undefined, $-\frac{1}{3}$

**3.** (i) $y = -2x + 7$: $m = -2$, $d = 7$ (ii) $y = \frac{3}{4}x - 3$

(iii) $y = -\frac{4}{3}x + 4$ (iv) $y = 5$: $m = 0$, $d = 5$

**Answer:** Steepest: (i), since $|-2|$ is largest

**4.** (i) $\frac{3}{2}$




(ii) run 8 from A ⇒ rise 12: (10, 12)

(iii) rise −3 ⇒ run −2: (0, −3)

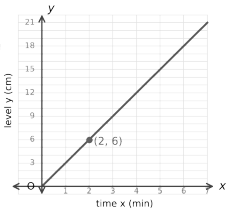
**Answer:** $y = \frac{3}{2}x - 3$

**5.** (i) 45 × 12 = 540 cm

(ii) $\frac{30}{750} = \frac{1}{25} = 4\%$

**Answer:** 540 cm; $\frac{1}{25}$ or 4%

**6.** (i) $\frac{6}{2} = 3$: the level rises 3 cm every minute




(ii) 0 — the tank is empty at the start

(iii) 3 × 5 = 15 cm; 3x = 21 ⇒ 7 min

(iv) 3 × 4 = 12 ≠ 10 ⇒ not on the line

**Answer:** (v) (3, 9)

**7.** $y = 0 \Rightarrow mx + c = 0 \Rightarrow x = -\frac{c}{m}$

$y = 2x - 6$: $x = 3$; $y = -\frac{1}{2}x + 4$: $x = 8$

**Answer:** x-intercept $-\frac{c}{m}$; 3; 8

**8.** Slope AB $= \frac{6-2}{3-1} = 2$; slope BC $= \frac{10-6}{5-3} = 2$

Same slope and the common point B ⇒ A, B, C lie on one line.

Slope BD $= \frac{9-6}{4-3} = 3 \neq 2$

**Answer:** Collinear; D is not on the line

**9.** (i) Infinitely many: $y = mx + d$ for every value of $d$ (all parallel).
(ii) Exactly one: $d = y_0 - mx_0$ *[ line through $(x_0, y_0)$ ]*

**Answer:** Infinitely many; one

**10.** Suppose $(p, q)$ lies on both: $q = mp + d_1$ and $q = mp + d_2$
$\Rightarrow d_1 = d_2$, a contradiction
**$\therefore$ no common point: the lines are parallel**
**Hence proved.**

## Topic 3: Pairs of Equations: Substitution and Elimination

**1.** (i) $2x + 3y = 850$, $4x + y = 1100 \Rightarrow y = 1100 - 4x \Rightarrow -10x = -2450$
$x = 245$, $y = 120$
(ii) $x + 6y = 122$, $x + 8y = 160 \Rightarrow 2y = 38 \Rightarrow y = 19$, $x = 8$
(iii) $x + y = 200$, $150x + 100y = 25000 \Rightarrow 50x = 5000 \Rightarrow x = 100$, $y = 100$

**Answer:** (i) ticket ₹245, box ₹120 (ii) fixed ₹8, ₹19/km (iii) 100 adults, 100 children

**2.** (i) $x = 14 - y \Rightarrow 14 - 2y = 4 \Rightarrow y = 5$, $x = 9$
(ii) $s = 3 + t \Rightarrow 2(3 + t) + 3t = 36 \Rightarrow t = 6$, $s = 9$ *[ multiply by 6 ]*
(iii) $2x + 3y = 13 \Rightarrow x = \frac{13 - 3y}{2}$; $2(13 - 3y) + 5y = 23 \Rightarrow$ *[ multiply by 10 ]*
$y = 3$, $x = 2$

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**Answer:** (9, 5); $s = 9$, $t = 6$; (2, 3)

**3.** (i) $2x - 2y = 2 \Rightarrow x - y = 1$; $\times 4$: $4x - 4y = 4$; add to $3x + 4y = 10 \Rightarrow 7x = 14$
$x = 2$, $y = 1$
(ii) $3x + 4y = -6$ and $3x - y = 9 \Rightarrow 5y = -15 \Rightarrow y = -3$, $x = 2$ *[ clear fractions ]*
(iii) $35x + 30y = 44400$, $18x + 30y = 24000 \Rightarrow 17x = 20400 \Rightarrow x = 1200$, $y = 80$

**Answer:** (2, 1); (2, −3); bat ₹1200, ball ₹80

**4.** (i) $x + y = 52$, $x - y = 14 \Rightarrow 33, 19$
(ii) $x - y = 26$, $x = 3y \Rightarrow y = 13$, $x = 39$
(iii) $x + 12y = 190$, $x + 20y = 302 \Rightarrow y = 14$, $x = 22$; $22 + 30 \times 14 = 442$
(iv) $x + y = 9$, $9(10x + y) = 2(10y + x) \Rightarrow 88x = 11y \Rightarrow y = 8x \Rightarrow x = 1$, $y = 8$

**Answer:** 33, 19; 39, 13; ₹22, ₹14/km, ₹442; 18

**5.** $\frac{x+1}{y+1}=\frac{2}{3}\Rightarrow 3x-2y=-1;\ \frac{x+4}{y+4}=\frac{3}{4}\Rightarrow 4x-3y=-4$

$9x-6y=-3$ and $8x-6y=-8\Rightarrow x=5,\ y=8$

**Answer:** $\frac{5}{8}$

**6.** $A-6=4(S-6)\Rightarrow A-4S=-18;\ A+4=2(S+4)\Rightarrow A-2S=4$

$2S=22\Rightarrow S=11,\ A=26$

**Answer:** Asha 26 years, son 11 years

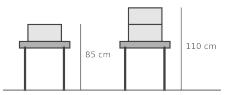
**7.** (i) $x+y=40,\ 50x+100y=3500\Rightarrow x+2y=70\Rightarrow y=30,\ x=10$

(ii) $x+5y=38,\ x+2y=26\Rightarrow y=4,\ x=18$

**Answer:** 10 notes of ₹50, 30 of ₹100; fixed ₹18, ₹4 per extra day

**8.** $s+b=85$ and $s+2b=110$ *[ s = stool, b = block ]*

Subtract: $b=25\Rightarrow s=60$




**Answer:** Stool 60 cm, block 25 cm

**9.** Add: $16(x+y)=208\Rightarrow x+y=13$; subtract: $2(x-y)=6\Rightarrow x-y=3$

$x=8,\ y=5$

Pencils: $12(x+y)=96\Rightarrow x+y=8$; $2(y-x)=4\Rightarrow y-x=2\Rightarrow x=3,\ y=5$

**Answer:** Citron 8, wood-apple 5; pencil ₹3, pen ₹5

**10.** $a+15=60+b\Rightarrow a-b=45$ *[ minutes after 2 + 15 ]*

$a=6b\Rightarrow 5b=45\Rightarrow b=9$

**Answer:** 3:09

## Topic 4: Nature of Solutions and the Graphical Method

**1.** (i) $\frac{5}{7}\neq\frac{-4}{6}\Rightarrow$ intersect

(ii) $\frac{9}{18}=\frac{3}{6}=\frac{12}{24}\Rightarrow$ coincident

(iii) $\frac{6}{2}=\frac{-3}{-1}=3\neq\frac{10}{9}\Rightarrow$ parallel

(iv) $\frac{3}{2} \neq \frac{2}{-3} \Rightarrow$ intersect

**Answer:** Intersect, coincide, parallel, intersect

**2.** (i) all ratios $\frac{1}{2} \Rightarrow$ infinitely many

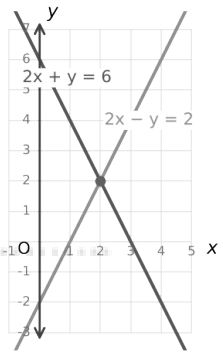
(ii) $\frac{1}{3} = \frac{1}{3} \neq \frac{8}{16} \Rightarrow$ none

(iii) lines meet at (4, 3)

(iv) $\frac{2}{4} = \frac{-2}{-4} \neq \frac{-2}{-5} \Rightarrow$ none

**Answer:** (i) and (iii) have solutions

**3.** 2x + y = 6: (0, 6), (3, 0); 2x − y = 2: (0, −2), (1, 0)




**Answer:** (2, 2); y-axis at (0, 6) and (0, −2)

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**4.** x + y = 12 (boys x, girls y), y − x = 2

**Answer:** 5 boys and 7 girls

**5.** (i) e.g., x − y = 1 ($\frac{2}{1} \neq \frac{3}{-1}$).

(ii) e.g., 4x + 6y − 5 = 0. (iii) e.g., 4x + 6y − 16 = 0.

**Answer:** Answers may vary

**6.** l + w = 40, l − w = 6

**Answer:** Length 23 m, width 17 m

**7.** (i) $\frac{3}{6} \neq \frac{p}{8} \Rightarrow$ p ≠ 4

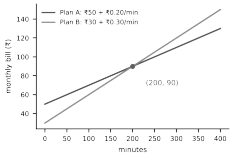
(ii) $\frac{a+b}{3} = \frac{2b}{1} \Rightarrow a = 5b$; $2b = \frac{5a+2b+1}{14} \Rightarrow 28b = 27b + 1$

$b = 1$, $a = 5$

(iii) $\frac{k}{12} = \frac{3}{k} \Rightarrow k = \pm 6$; $k = 6$ makes $\frac{k-3}{k} = \frac{1}{2}$ too (coincident)

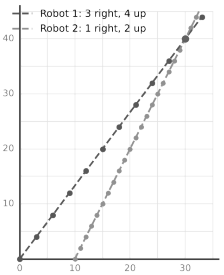
**Answer:** $p \neq 4$; $a = 5$, $b = 1$; $k = -6$

**8.** $50 + 0.2x = 30 + 0.3x \Rightarrow x = 200$




**Answer:** Equal at 200 min (₹90); A cheaper above 200 min, B cheaper below

**9.** (i) $y = \frac{4}{3}x$ and $y = 2(x - 10) \Rightarrow \frac{2}{3}x = 20 \Rightarrow (30, 40)$




Robot 1 corners $(3k, 4k)$: $k = 10$; Robot 2 corners $(10 + j, 2j)$: $j = 20$ — both pass (30, 40).

(ii) $y = x - 3$ and $y = -\frac{3}{5}(x - 7)$ meet at (4.5, 1.5)

But Robot 2 starts at $x = 7$ and moves right and down, so it never reaches $x = 4.5$: the paths do not meet.

**Answer:** (i) Yes, at (30, 40) (ii) No

**10.** Two different lines meet in at most one point; two common points would make them the same line (infinitely many solutions).

The converses hold: a unique solution forces $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, and so on.

**Answer:** No

## Miscellaneous Questions

**1.** $a + 4d = 23$, $a + 11d = 51$

$7d = 28 \Rightarrow d = 4$, $a = 7$

**Answer:** 20th term $= 7 + 19 \times 4 = 83$

**2.** $x + y = 30$, $0.8x + 0.5y = 21$

$0.3x = 6 \Rightarrow x = 20$, $y = 10$

Check: $\frac{20 \times 80 + 10 \times 50}{30} = 70\%$

**Answer:** 20 kg of 80% and 10 kg of 50%

**3.** $l + b = 25$, $l = 2b + 1$

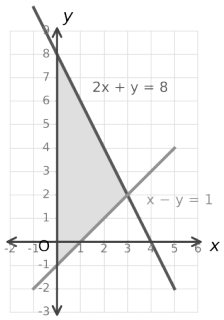
$3b + 1 = 25 \Rightarrow b = 8, l = 17$

**Answer:** 17 cm × 8 cm, area 136 $cm^2$

**4.** Add: $3x = 9 \Rightarrow x = 3, y = 2$

y-axis: (0, 8) and (0, −1)

Base 9 on the y-axis, height 3 $\Rightarrow \frac{1}{2} \times 9 \times 3$




**Answer:** (3, 2); 13.5 sq. units

**5.** D = A + C − B = (2, 4) *[ diagonals bisect each other ]*

Slope AC $= \frac{4}{5} \Rightarrow y - 1 = \frac{4}{5}(x - 1) \Rightarrow 4x - 5y + 1 = 0$

**Answer:** D(2, 4); $4x - 5y + 1 = 0$; (3.5, 3)

**6.** (i) $(x + y)(x - y) = 21 \Rightarrow x - y = 3 \Rightarrow x = 5, y = 2$

(ii) $x + y = 16 \Rightarrow x = 9, y = 7$

(iii) $x = \frac{5}{7}$, $y = \frac{8}{7}$ — denominators 7 ⇒ non-terminating

**Answer:** (5, 2); (9, 7); no

**7.** (i) $\frac{2}{k} = \frac{k}{8} = \frac{4}{8} \Rightarrow k = 4$

(ii) $\frac{2}{k} = \frac{k}{8} \Rightarrow k = \pm 4$; $k = -4$ gives $\frac{4}{8} \neq -\frac{1}{2}$

**Answer:** $k = 4$; $k = -4$; $k \neq \pm 4$

## Competency Based Question Bank

**1.** Only $3x - 2y = 7$ is of degree 1 in x and y.

**Answer:** (c) $3x - 2y = 7$

**2.** $4x + 0 \cdot y + 7 = 0$.

**Answer:** (c) 0

**3.** $6 + 6 = 12$.

**Answer:** (c) $3x + 2y = 12$

**4.** One for every x.

**Answer:** (c) infinitely many solutions

**5.** $c = 0$.

**Answer:** (a) (0, 0)

**6.** $-9a + 16 = -2$.

**Answer:** (c) 2

**7.** $y = 0 \Rightarrow x = 3$.

**Answer:** (d) (3, 0)

**8.** Vertical line.

**Answer:** (a) parallel to the y-axis

**9.** Rise 3, run 2.

**Answer:** (b) $\frac{3}{2}$

**10.** $\frac{-3}{3}$.

**Answer:** (c) $-1$

**11.** $y = mx + d$.

**Answer:** (d) −5, 3

**12.** $y = \frac{3}{4}x - 3$.

**Answer:** (d) $\frac{3}{4}$

**13.** No rise.

**Answer:** (b) 0

**14.** Run = 0.

**Answer:** (d) undefined

**15.** 2.5 ÷ 4.

**Answer:** (d) 0.625

**16.** 18 × 12.

**Answer:** (a) 216 cm

**17.** 2x − 6 = 0.

**Answer:** (b) 3

**18.** 3x = 21.

**Answer:** (c) 7 min

**19.** x has coefficient 1.

**Answer:** (c) x = 3 − 2y

**20.** 5x = 130.

**Answer:** (d) 26

**21.** x = 2000 ⇒ 9 × 2000.

**Answer:** (b) ₹18,000

**22.** Add: 16(x + y) = 208.

**Answer:** (b) 13

**23.** $x + y = 260$, $x - y = 100$.

**Answer:** (d) ₹180

**24.** $x = 4$, $y = 2$.

**Answer:** (a) 42

**25.** Add and subtract.

**Answer:** (a) (9, 5)

**26.** One common point.

**Answer:** (c) a unique solution

**27.** All ratios $\frac{1}{2}$.

**Answer:** (a) coincident

**28.** $3 = 3 \neq \frac{10}{9}$.

**Answer:** (a) no solution

**29.** $\frac{4}{2} \neq \frac{p}{2}$.

**Answer:** (b) $p \neq 4$

**30.** $k = 3$.

**Answer:** (d) 3

**31.** $0.1x = 20$.

**Answer:** (d) 200 min

**32.** Add: $4x = 8$.

**Answer:** (d) (2, 2)

**33.** R explains A.

**Answer:** (a)

**34.** A false (slope 4); R true.

**Answer:** (d)

**35.** R is the no-solution test.

**Answer:** (a)

**36.** R explains A.

**Answer:** (a)

**37.** A false (undefined); R true.

**Answer:** (d)

**38.** A false (infinitely many); R true.

**Answer:** (d)

## Story Time: Case Studies

### Case 1 · Radha at the Fruit Cart

**(i)** 60x + 50y = 280.

**(ii)** 50y = 100 ⇒ 2 kg.

**(iii)** 5.6 kg.

**(iv)** Yes: y = 0.8 kg.

### Case 2 · Paratha and Dahi

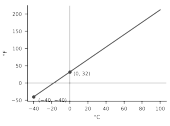
**(i)** p + 2d = 90, 2p + 3d = 155.

**(ii)** ₹25.

**(iii)** ₹40.

**(iv)** 120 + 100 = ₹220.

### Case 3 · Celsius and Fahrenheit



**(i)** 86 °F.

**(ii)** 35 °C.

**(iii)** Each 1 °C adds 1.8 °F; 0 °C = 32 °F.

**(iv)** −40°.

### Case 4 · The Train Puzzle

**(i)** $(v + 6)(t - 6) = vt \Rightarrow 6t - 6v = 36 \Rightarrow t - v = 6$.

**(ii)** $(v - 4)(t + 6) = vt \Rightarrow 6v - 4t = 24$.

**(iii)** v = 24 km/h, t = 30 h.

**(iv)** 720 km.

### Case 5 · Father and Four Children

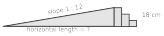
**(i)** 4 × 20 = 80 years.

**(ii)** F + 80 = 2(F + 20).

**(iii)** 40 years.

**(iv)** 60 years (20 years later).

### Case 6 · The Accessible School



**(i)** 24 × 12 = 288 cm.

**(ii)** 360 ÷ 12 = 30 cm.

**(iii)** $y = \frac{x}{12}$.

**(iv)** No: $\frac{1}{10} > \frac{1}{12}$ (too steep).

### Case 7 · Two Taxi Companies

**(i)** y = 40 + 12x, y = 20 + 14x.

**(ii)** 10 km (₹160).

**(iii)** P: ₹220 < Q: ₹230.

**(iv)** The charge per km.

### Case 8 · Shape Puzzle

**(i)** 2T + R = 20, T + 2R = 22, C + T + R = 19.

**(ii)** $3T + 3R = 42 \Rightarrow T + R = 14$.

**(iii)** $T = 6, R = 8$.

**(iv)** $C = 5$.

### Case 9 · Digit Swap

**(i)** $x + y = 15, (10y + x) - (10x + y) = 9$.

**(ii)** $y - x = 1 \Rightarrow x = 7, y = 8$.

**(iii)** 78.

**(iv)** $87 - 78 = 9$ ✓

### Case 10 · Coin Purse

**(i)** $x + y = 22, 5x + 2y = 77$.

**(ii)** $y = 22 - x \Rightarrow 3x = 33 \Rightarrow x = 11, y = 11$.

**(iii)** $2x + 2y = 44 \Rightarrow 3x = 33$.

**(iv)** Either; elimination is quick here.

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