

Linear Equations, Inequalities and Systems: practice solutions, Grade 11 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Slope from two points



$$m = \frac{7 - (-1)}{6 - 2} = \frac{8}{4} = 2.$$

Point-slope form with P : $y + 1 = 2(x - 2)$, so $y = 2x - 5$. Check with Q : $2(6) - 5 = 7$.

The slope is 2 and the equation is $y = 2x - 5$.

2 Rewrite in slope-intercept form



Subtract $3x$: $4y = -3x + 12$. Divide by 4 : $y = -\frac{3}{4}x + 3$.

The slope is $-\frac{3}{4}$ and the y-intercept is 3 . For the x-intercept set $y = 0$: $3x = 12$, so $x = 4$.

3 Solve a linear equation



Distribute: $5x - 10 + 3 = 2x + 14$, so $5x - 7 = 2x + 14$.

Subtract $2x$ and add 7 : $3x = 21$, so $x = 7$.

Check: left side $5(5) + 3 = 28$, right side $14 + 14 = 28$.

4 A basic absolute value equation



The expression inside equals **9** or **-9**.

$x + 4 = 9$ gives $x = 5$; $x + 4 = -9$ gives $x = -13$.

Check: $|5 + 4| = 9$ and $|-13 + 4| = |-9| = 9$. The solutions are **5** and **-13**.

5 A three-part inequality



Add **3** to all three parts: $-2 \leq x < 7$.

Interval notation: $[-2, 7)$.

On the number line, draw a closed circle at **-2**, an open circle at **7**, and shade between them.

6 Is it a solution?



(a) $3 + (-2) = 1$ and $2(3) - (-2) = 8$. Both equations hold, so **(3, -2)** is a solution.

(b) $1 + 0 = 1$ holds, but $2(1) - 0 = 2 \neq 8$. The pair fails the second equation, so **(1, 0)** is not a solution.

7 Substitution warm-up



Replace **y** in the second equation: $2x + 3x - 4 = 11$, so $5x = 15$ and $x = 3$.

Then $y = 3(3) - 4 = 5$. Check: $2(3) + 5 = 11$. The solution is **(3, 5)**.

8 A parallel line



Parallel lines have the same slope, so $m = -\frac{1}{2}$.

Point-slope form: $y + 2 = -\frac{1}{2}(x - 3)$, so $y = -\frac{1}{2}x + \frac{3}{2} - 2 = -\frac{1}{2}x - \frac{1}{2}$.

Check: at $x = 3$, $-\frac{3}{2} - \frac{1}{2} = -2$.

9 An absolute value inequality



Rewrite as an and statement: $-10 \leq 4 - 3x \leq 10$.

Subtract 4: $-14 \leq -3x \leq 6$. Divide by -3 and reverse both signs: $\frac{14}{3} \geq x \geq -2$.

So $-2 \leq x \leq \frac{14}{3}$, that is $\left[-2, \frac{14}{3}\right]$. Check: $x = 0$ gives $4 \leq 10$, while $x = 5$ gives $|-11| = 11 > 10$, which is outside.

10 An or compound inequality



First: $2x < -8$, so $x < -4$.

Second: $-x \leq -3$; dividing by -1 reverses the sign, so $x \geq 3$.

The solution is $x < -4$ or $x \geq 3$, that is $(-\infty, -4) \cup [3, \infty)$.

11 Elimination practice



Multiply the first equation by 5 and the second by 3: $20x - 15y = -5$ and $18x + 15y = 81$.

Add: $38x = 76$, so $x = 2$. Then $8 - 3y = -1$, so $y = 3$.

Check in the second equation: $12 + 15 = 27$. The solution is $(2, 3)$.

12 Movie theater tickets



Let a be the number of adult tickets and c the number of child tickets. Then $a + c = 150$ and $12a + 8c = 1448$.

Substitute $c = 150 - a$: $12a + 1200 - 8a = 1448$, so $4a = 248$ and $a = 62$. Then $c = 88$.

Check: $12(62) + 8(88) = 744 + 704 = 1448$. The theater sold 62 adult tickets and 88 child tickets.

13 No solution or infinitely many?



(a) Multiplying the second equation by 3 gives $6x - 9y = 12$, the first equation. The lines coincide: **infinitely many solutions**.

(b) Both lines have slope 2 but different y-intercepts (1 and -5). They are parallel and distinct: **no solution**. Algebraically, $2x + 1 = 2x - 5$ simplifies to $1 = -5$, which is false.

14 Inverse of a 2 by 2 matrix



(a) $\det A = 2 \cdot 3 - 5 \cdot 1 = 1$, so $A^{-1} = \begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$.

(b) $X = A^{-1}B = \begin{bmatrix} 3 \cdot 9 - 5 \cdot 5 \\ -9 + 2 \cdot 5 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$.

Check: $2(2) + 5(1) = 9$ and $2 + 3(1) = 5$. So $x = 2$ and $y = 1$.

15 A system with three unknowns



Add the first and third equations to remove z : $5x + 3y = 7$.

Double the first equation and add the second: $4x + 2y - 2z + x - y + 2z = 9$, so $5x + y = 9$.

Subtract: $2y = -2$, so $y = -1$. Then $5x - 1 = 9$ gives $x = 2$. From the first equation, $z = 2x + y = 3$.

Check the second equation: $2 + 1 + 6 = 9$; the third: $6 - 2 + 3 = 7$. The solution is $(2, -1, 3)$.

16 The coin jar



Let n, d, q be the numbers of nickels, dimes and quarters. In cents: $n + d + q = 30$, $5n + 10d + 25q = 330$, and $d = 2q$.

From the first equation, $n = 30 - 3q$. Substitute into the value equation:

$5(30 - 3q) + 20q + 25q = 330$, so $150 + 30q = 330$ and $q = 6$.

Then $d = 12$ and $n = 12$. Check: $60 + 120 + 150 = 330$ cents. The jar has 12 nickels, 12 dimes and 6 quarters.

17 Planting plan



The axes intersections: $(0, 0)$; $(40, 0)$, since $2(40) = 80 \leq 90$; and $(0, 30)$, since $3(30) = 90$ and $30 \leq 40$.

The two boundary lines meet where $y = 40 - x$ and $2x + 3(40 - x) = 90$, so $120 - x = 90$, $x = 30$, $y = 10$: the vertex $(30, 10)$.

Profit: $(0, 0)$ gives 0; $(40, 0)$ gives 4800; $(30, 10)$ gives $3600 + 1500 = 5100$; $(0, 30)$ gives 4500.

The maximum profit is 5,100 dollars, with 30 acres of corn and 10 acres of soybeans.

18 Minimizing a cost



Corner points: on the y-axis, $3x + y = 15$ gives $(0, 15)$; on the x-axis, $x + 2y = 10$ gives $(10, 0)$.

Intersection of the two lines: $y = 15 - 3x$, so $x + 30 - 6x = 10$, $x = 4$, $y = 3$.

Costs: $(0, 15)$ gives 45; $(4, 3)$ gives $16 + 9 = 25$; $(10, 0)$ gives 40.

The minimum cost is 25, reached with 4 kg of A and 3 kg of B.

19 Tolerance with absolute value



(a) $|v - 500| \leq 6$, so $-6 \leq v - 500 \leq 6$ and $494 \leq v \leq 506$. Only 505.9 mL is accepted; 493.5 is too low and 506.2 is too high.

(b) The midpoint is $\frac{68 + 76}{2} = 72$ and the distance from the midpoint to each end is 4. So $|T - 72| \leq 4$.

20 Boat and current



Let b be the boat speed and c the current speed, in miles per hour. Upstream:

$$b - c = \frac{36}{3} = 12. \text{ Downstream: } b + c = \frac{36}{2} = 18.$$

Add the equations: $2b = 30$, so $b = 15$. Then $c = 3$.

The boat goes 15 mph in still water and the current flows at 3 mph.

21 Parameter in a system



(a) $\det = 2 \cdot 6 - k \cdot 3 = 12 - 3k$. It equals 0 when $k = 4$. For every other value, the system has exactly one solution.

(b) With $k = 4$, the first equation is $2x + 4y = 8$. Dividing the second equation by 3 gives $x + 2y = 4$, and dividing the first by 2 gives the same equation. The two equations describe the same line, so there are infinitely many solutions.



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