

Systems of Linear Equations: practice solutions, Grade 9 – download the PDF

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

1 Is it a solution?



(a) Test $(2, 5)$. First equation: $3(2) - 1 = 5$, true. Second equation: $2 + 5 = 7$, true. So $(2, 5)$ is a solution.

(b) Test $(3, 4)$. First equation: $3(3) - 1 = 8 \neq 4$, false. So $(3, 4)$ is **not** a solution (it fails the first equation, even though $3 + 4 = 7$).

2 Table of values



For $y = x + 2$: 2, 3, 4, 5, 6. For $y = -x + 6$: 6, 5, 4, 3, 2.

x	0	1	2	3	4
$y = x + 2$	2	3	4	5	6
$y = -x + 6$	6	5	4	3	2

Both lines have $y = 4$ when $x = 2$. The solution is $(2, 4)$.

3 A quick substitution



Replace y by $2x$ in the second equation: $x + 2x = 12$, so $3x = 12$ and $x = 4$.

Then $y = 2(4) = 8$. Check: $4 + 8 = 12$. The solution is $(4, 8)$.

4 A quick elimination



Add the equations: $2x = 18$, so $x = 9$. The y terms cancel because they are opposites.

Substitute in the first equation: $9 + y = 15$, so $y = 6$. Check: $9 - 6 = 3$. The solution is $(9, 6)$.

5 How many solutions?



(a) Both slopes are 4, the intercepts 1 and -5 differ: parallel lines, **no solution**.

(b) The slopes -1 and 1 differ: the lines cross once, **one solution**. (They share the intercept 2, so the solution is $(0, 2)$.)

(c) Solve the first equation for y : $2y = -2x + 6$, so $y = -x + 3$. It is the same line: **infinitely many solutions**.

6 Chess club



Let b be the number of boys and g the number of girls. Then $b + g = 31$ and $b - g = 9$.

Add the equations: $2b = 40$, so $b = 20$. Then $g = 31 - 20 = 11$.

The club has 20 boys and 11 girls. Check: $20 - 11 = 9$.

7 Test points in a region



$(1, 2)$: $2 \geq 2$ is true and $2 < 4$ is true, so it is a solution.

$(2, 3)$: $3 \geq 4$ is false, so it is not a solution.

$(0, 0)$: $0 \geq 0$ is true and $0 < 3$ is true, so it is a solution. (Points on a solid boundary count, so $(1, 2)$ and $(0, 0)$ are fine.)

8 Substitution with negatives



Replace y : $5x + 2(3x - 9) = 4$. Distribute: $5x + 6x - 18 = 4$, so $11x = 22$ and $x = 2$.

Then $y = 3(2) - 9 = -3$. Check: $5(2) + 2(-3) = 10 - 6 = 4$. The solution is $(2, -3)$.

9 Isolate first



From the first equation, $x = 11 - 3y$. Substitute in the second: $2(11 - 3y) - 5y = 0$, so $22 - 6y - 5y = 0$ and $11y = 22$, so $y = 2$.

Then $x = 11 - 3(2) = 5$. Check: $2(5) - 5(2) = 0$. The solution is $(5, 2)$.

10 Elimination, one multiplier



Multiply the second equation by 3: $6x - 3y = 15$. Add it to the first:

$4x + 3y + 6x - 3y = 25 + 15$, so $10x = 40$ and $x = 4$.

From the second equation, $y = 2x - 5 = 3$. Check in the first: $4(4) + 3(3) = 25$. The solution is $(4, 3)$.

11 Elimination, two multipliers



To cancel y , make $12y$ and $-12y$: multiply the first equation by 3 and the second by 2. This gives $9x + 12y = 3$ and $10x - 12y = 54$.

Add: $19x = 57$, so $x = 3$. Then $3(3) + 4y = 1$ gives $4y = -8$, so $y = -2$.

Check: $5(3) - 6(-2) = 15 + 12 = 27$. The solution is $(3, -2)$.

12 Reading a graph



(a) The lines cross at P , which appears to be $(4, 3)$.

(b) Set the expressions for y equal: $0.5x + 1 = -x + 7$, so $1.5x = 6$ and $x = 4$. Then $y = 0.5(4) + 1 = 3$. The second line gives $-4 + 7 = 3$, so the solution is $(4, 3)$, which matches the graph.

13 Pool tickets



Let a be the adult price and c the child price, in dollars: $4a + 3c = 41$ and $2a + 5c = 31$.

Multiply the second equation by 2: $4a + 10c = 62$. Subtract the first equation: $7c = 21$, so $c = 3$. Then $4a + 9 = 41$, so $a = 8$.

An adult ticket costs 8 dollars and a child ticket costs 3 dollars. Check: $2(8) + 5(3) = 31$.

14 A parameter



(a) The first line has slope 3 and intercept 2. If $k = 3$, the second line is parallel (slope 3, intercept -5 different), so there is **no solution**. For every other k the slopes differ, so there is exactly one solution.

(b) With $k = 2$: $3x + 2 = 2x - 5$, so $x = -7$. Then $y = 3(-7) + 2 = -19$. Check: $2(-7) - 5 = -19$. The solution is $(-7, -19)$.

15 Finding the missing constant



(a) Multiply the first equation by 2: $4x + 6y = 24$. If $c = 24$ the two equations describe the same line, so there are **infinitely many solutions**.

(b) If $c = 20$, the second equation says $4x + 6y = 20$, while the first says $4x + 6y = 24$. The same expression cannot equal two different numbers, so no pair works. Subtracting gives $0 = 4$, a false statement: **no solution**. (Both lines have slope $-\frac{2}{3}$ but different intercepts, so they are parallel.)

16 Kayak trip



Downstream the speeds add: $b + c = 12 \div 2 = 6$. Upstream they subtract:

$$b - c = 12 \div 3 = 4.$$

Add the equations: $2b = 10$, so $b = 5$. Then $c = 6 - 5 = 1$.

The kayaker paddles at 5 mph in still water and the current flows at 1 mph. Check:

$$5 + 1 = 6 \text{ and } 5 - 1 = 4.$$

17 Juice mixture



Let x be the gallons of the 15% drink and y the gallons of the 40% drink. The total volume gives $x + y = 10$. The amount of pure juice gives $0.15x + 0.40y = 0.25(10) = 2.5$.

Substitute $x = 10 - y$: $0.15(10 - y) + 0.40y = 2.5$, so $1.5 + 0.25y = 2.5$ and $y = 4$.

Then $x = 6$.

The shop needs 6 gallons of the 15% drink and 4 gallons of the 40% drink. Check:

$$0.15(6) + 0.40(4) = 0.9 + 1.6 = 2.5.$$

18 Fractions as coefficients



Multiply the first equation by 6: $3x + 2y = 24$. From the second equation, $x = y + 3$.

Substitute: $3(y + 3) + 2y = 24$, so $5y + 9 = 24$ and $y = 3$. Then $x = 6$.

Check in the original first equation: $\frac{6}{2} + \frac{3}{3} = 3 + 1 = 4$. The solution is $(6, 3)$.

19 Ages



Let m be Mia's age and l Leo's age now. Then $m = 3l$. In 6 years: $m + 6 = 2(l + 6)$.

Substitute: $3l + 6 = 2l + 12$, so $l = 6$ and $m = 18$.

Mia is 18 and Leo is 6. Check: in 6 years they will be 24 and 12, and $24 = 2(12)$.

20 Shopping constraints



(a) Cost: $2n + p \leq 30$. Number of items: $n + p \geq 5$. Plus $n \geq 0$ and $p \geq 0$.

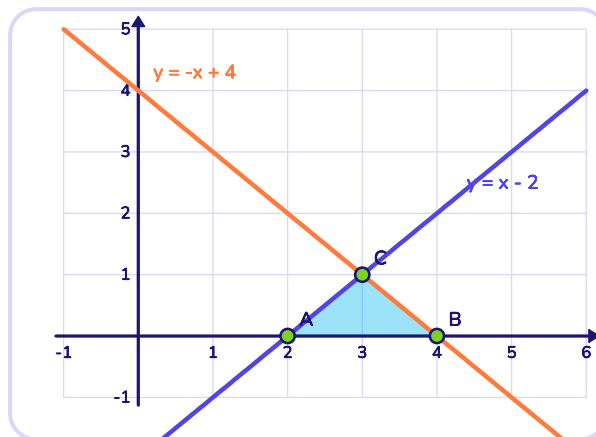
(b) For $(n, p) = (8, 10)$: $2(8) + 10 = 26 \leq 30$ and $8 + 10 = 18 \geq 5$, so it is possible. For $(12, 8)$: $2(12) + 8 = 32 > 30$, so it is not possible.

(c) From $2n + p \leq 30$ we get $n + p \leq 30 - n \leq 30$ because $n \geq 0$. The value 30 is reached with $n = 0$ and $p = 30$. The greatest number of items is 30 (all pens).

21 A triangular region



(a) The two slanted lines meet where $x - 2 = -x + 4$, so $x = 3$ and $y = 1$: corner $C(3, 1)$. The line $y = x - 2$ meets $y = 0$ at $A(2, 0)$. The line $y = -x + 4$ meets $y = 0$ at $B(4, 0)$.



(b) The region is triangle ABC with base $AB = 4 - 2 = 2$ and height 1 (the y -coordinate of C). Its area is $\frac{1}{2} \times 2 \times 1 = 1$ square unit.



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