



Solving linear equations

GRADE 8 MATH

Answer keys for the exit ticket, practice worksheet, and homework, plus notes for the lesson slides. Each answer shows the steps and the most likely wrong answer ("If wrong"), so you can tell what a mistake means, not just that it is one. Questions go from **fluency** to **application** to **reasoning**.

Exit Ticket — answer key

Use: End of the linear equations lesson. 5–8 min, independent. Item 3 is the diagnostic and a blank counts the same as $x = 0$ — both mean the child does not yet believe 'no solution' is an answer they are allowed to give.

Timing: 5–8 min · independent. Insist on substitution checks.

1. $5(x - 2) = 20$ **FLUENCY**

Answer: $x = 6$

1. Expand: $5x - 10 = 20$.

2. $5x = 30$, so $x = 6$.

3. Check: $5(6 - 2) = 5 \times 4 = 20$. ✓

If wrong: Answered $x = 4$ by dividing 20 by 5 and stopping, or $x = 2$ by distributing only to the x .

2. $2x + 7 = 5x - 8$ **APPLICATION**

Answer: $x = 5$

1. Collect the x terms on one side: $7 + 8 = 5x - 2x$.

2. $15 = 3x$, so $x = 5$.

3. Check: $2(5) + 7 = 17$ and $5(5) - 8 = 17$. ✓

If wrong: Moved a term without changing its sign, giving $2x - 5x = -8 - 7$ handled wrongly. The substitution check catches every version of this.

3. $3x + 1 = 3x + 9$ REASONING

Answer: **no solution**

1. Subtract $3x$ from both sides: $1 = 9$.
2. That is false, and no value of x can change it — the x has gone.
3. So NO number satisfies the equation. “No solution” is the complete answer.
4. Test it: $x = 0$ gives 1 against 9. $x = 50$ gives 151 against 159. Always eight apart, never equal.

If wrong: Answered $x = 0$, or $x = 8$, or left it blank. Six years of solving have always produced a number, so a child supplies one rather than trusting the outcome — this is not carelessness, it is the format of every previous answer.

4. Correct Ravi REASONING

Answer: **$4(x + 3) = 4x + 12$**

1. The 4 multiplies EVERYTHING inside the bracket, not just the first term.
2. $4 \times x = 4x$ and $4 \times 3 = 12$, so $4x + 12$.
3. Test at $x = 1$: $4(4) = 16$, while his $4x + 3$ gives 7. Not close.
4. This is the same error as writing 7×8 as $7 \times 5 + 3$ — the multiplier fails to reach the second part.

If wrong: Corrected the number without naming what was dropped. Substituting a value is the check that always exposes it.

Quick answers for fast checking:

#	Level	Answer
1	fluency	$x = 6$
2	application	$x = 5$
3	reasoning	no solution
4	reasoning	$4x + 12$

Practice Worksheet — answer key

Use: In-class practice after the deck. Items 4 and 5 are the pair that matters: same cancelling x , opposite outcomes, decided entirely by whether the constants match. A child who gives the same answer to both has not seen the distinction, whichever answer it is.

Timing: 15–20 min · pairs · items 5 and 7 on the board.

1. $4x - 7 = 17$ **FLUENCY**

Answer: $x = 6$

1. $4x = 24$, so $x = 6$.
2. Check: $24 - 7 = 17$. ✓

If wrong: Added 7 to the wrong side.

2. $6(x + 5)$ and $6(x - 5)$ **FLUENCY**

Answer: $6x + 30$ and $6x - 30$

1. The 6 reaches both terms.
2. The sign inside travels with the term.

If wrong: Answered $6x + 5$ and $6x - 5$.

3. $3(x + 4) = 27$ **APPLICATION**

Answer: $x = 5$

1. $3x + 12 = 27$, so $3x = 15$ and $x = 5$.
2. Or divide first: $x + 4 = 9$, so $x = 5$. Both work.
3. Check: $3(9) = 27$. ✓

If wrong: Got $x = 9$ by dividing and forgetting to subtract 4, or $x = 7\frac{2}{3}$ by distributing to only the x .

4. $5x + 2 = 5x + 11$ **REASONING**

Answer: **no solution**

1. Subtract $5x$: $2 = 11$, which is false.
2. No value of x can help — x is gone from the statement.
3. The two sides are always nine apart.

If wrong: Answered $x = 0$ or $x = 9$.

5. $2(x + 3) = 2x + 6$ REASONING

Answer: **infinitely many solutions — every number works**

1. Expand the left: $2x + 6 = 2x + 6$.
2. Both sides are the SAME expression, so the equation is true whatever x is.
3. Test: $x = 0$ gives $6 = 6$. $x = -5$ gives $-4 = -4$. $x = 100$ gives $206 = 206$.
4. This is called an identity.

If wrong: Answered $x = 0$, or “no solution” by confusing this case with item 4. The distinction is whether the CONSTANTS agree once the x has cancelled — here they do.

6. $7x - 4 = 3x + 12$ APPLICATION

Answer: **$x = 4$**

1. $4x = 16$, so $x = 4$.
2. Check: $28 - 4 = 24$ and $12 + 12 = 24$. ✓

If wrong: Sign error when collecting.

7. Spotting no solution early REASONING

Answer: **an answer noting that the x terms are identical on both sides while the constants differ**

1. Look at the x terms first. If they are the same on both sides, the x will cancel.
2. Then look at the constants. Different → no solution. Same → every number works.
3. You can often see it before doing any algebra: $5x + 2 = 5x + 11$ has the same $5x$ and different constants.

If wrong: Described the whole solving process rather than the tell. The tell is one glance at the x terms, and it is worth having because it turns a surprise into a prediction.

8. $\frac{1}{2}x + 3 = 8$ APPLICATION

Answer: **$x = 10$**

1. $\frac{1}{2}x = 5$.
2. Multiplying by 2: $x = 10$.
3. Check: $\frac{1}{2}(10) + 3 = 8$. ✓

If wrong: Divided by 2 instead of multiplying, giving $x = 2.5$. A fractional coefficient reverses the operation and is worth a moment.

9. Make one with infinitely many REASONING

Answer: **any equation whose two sides are the same expression, such as $3(x + 2) = 3x + 6$, with a reason**

1. Write any expression, then write it a second way — expanded or factorised.
2. $3(x + 2) = 3x + 6$ works because both sides ARE the same thing.
3. Substituting anything gives a true statement.

If wrong: Wrote an equation with one solution, or wrote $x = x$ (which is correct and worth accepting, though the interesting versions disguise it). Writing one is much harder than recognising one.

Quick answers for fast checking:

#	Level	Answer
1	fluency	$x = 6$
2	fluency	$6x + 30$ and $6x - 30$
3	application	$x = 5$
4	reasoning	no solution
5	reasoning	infinitely many
6	application	$x = 4$
7	reasoning	identical x terms, different constants
8	application	$x = 10$
9	reasoning	an identity, with a reason

Homework — answer key

Use: Homework after the practice sheet. Item 8 is the whole lesson: the child in the question has made the right observation and drawn the wrong conclusion from it, so the correction has to credit the first half before fixing the second.

Timing: 20–25 min · independent · items 4, 5 and 8 first when marking.

1. $6x + 5 = 29$ FLUENCY

Answer: $x = 4$

1. $6x = 24$, $x = 4$.

If wrong: Sign slip.

2. $5(2x - 3)$ **FLUENCY**Answer: $10x - 15$ 1. $5 \times 2x = 10x$ and $5 \times -3 = -15$.**If wrong:** Answered $10x - 3$.**3. $4(x - 1) = 16$** **APPLICATION**Answer: $x = 5$ 1. $4x - 4 = 16$, so $4x = 20$ and $x = 5$.2. Check: $4(5) = 16$. ✓**If wrong:** Answered $x = 4$, dividing and forgetting the -1 .**4. $8x + 3 = 8x - 2$** **REASONING**Answer: **no solution**1. Subtract $8x$: $3 = -2$, which is false.

2. No number works.

If wrong: Answered $x = 0$ or $x = 5$.**5. $3(2x + 4) = 6x + 12$** **REASONING**Answer: **infinitely many solutions**1. Expand: $6x + 12 = 6x + 12$.

2. Identical expressions, so every number satisfies it.

If wrong: Answered no solution, confusing it with item 4.**6. $9x + 1 = 4x + 26$** **APPLICATION**Answer: $x = 5$ 1. $5x = 25$, so $x = 5$.2. Check: $46 = 46$. ✓**If wrong:** Collected wrongly.

7. $\frac{1}{3}x - 2 = 4$ APPLICATION

Answer: $x = 18$

1. $\frac{1}{3}x = 6$.
2. Multiply by 3: $x = 18$.
3. Check: $18 \div 3 - 2 = 4$. ✓

If wrong: Divided by 3 to get $x = 2$. A fractional coefficient reverses the operation.

8. Correct Nia REASONING

Answer: **infinitely many solutions — the constants also match**

1. She is right that the x cancels. That is the correct observation.
2. But then look at what is left: $2 = 2$, which is TRUE.
3. No solution happens when what remains is false. Here it is true, so every number works.
4. Cancelling x tells you the answer is not a single number. Whether it is none or all is decided by the constants.

If wrong: Agreed with her. Crediting the half she has right matters: she has spotted the cancelling, which is the hard part, and has drawn the wrong one of the two available conclusions.

Quick answers for fast checking:

#	Level	Answer
1	fluency	$x = 4$
2	fluency	$10x - 15$
3	application	$x = 5$
4	reasoning	no solution
5	reasoning	infinitely many
6	application	$x = 5$
7	application	$x = 18$
8	reasoning	infinitely many — the constants match

Lesson slides — teaching notes & timing

Mini-lesson slides, then the practice worksheet. Slide numbers match the deck.

Slide	~Time	Note
1/8	0:00	

		Announce the three outcomes at the start. Children who meet no-solution as a surprise mid-question assume they have made a mistake and start over.
2/8	1:00	The routine case, with the substitution check. Insist on the check now, because it is what makes the special cases recognisable later.
3/8	2:00	Distribution. Test both versions at $x = 4$ rather than asserting the rule — 18 against 14, and the missing 6 is visible. Same corrupted split as Grade 3.
4/8	3:30	Variables on both sides. Routine.
5/8	4:30	THE slide. Let the x vanish and stop. Ask what $3 = 5$ is telling them before supplying the words.
6/8	6:00	Name the answer explicitly: “no solution” is a complete answer. Then test two values so it is a demonstrated fact rather than a label.
7/8	7:30	The other special case. The distinction from slide 5 is whether the CONSTANTS also match — that is the whole difference.
8/8	9:00	Three to try, one of each kind, then the exit ticket.