# Equations with Variables on Both Sides

| Name: _____ | Date: _____ | Score: _____ / 24 |
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## Quick Review

When you see a variable on *both* sides of the equals sign, the goal is to collect all the variable terms on one side and all the constants on the other. The strategy: (1) distribute and combine like terms on each side first; (2) add or subtract to move all variable terms to one side; (3) add or subtract to move constants to the other; (4) divide to finish. The two "weird" outcomes still apply here: if the variable disappears and leaves a **true** statement like $5 = 5$, every real number works (infinitely many solutions). If it leaves a **false** statement like $3 = 7$, no value works (no solution). Pro tip: move variables to whichever side will leave a positive coefficient — easier to work with.

## PRACTICE

*Solve each equation. State if no solution or infinitely many.*

**1.** $4x + 1 = x + 13$ _____

**2.** $7n - 5 = 3n + 11$ _____

**3.** $6a + 2 = 2a - 10$ _____

**4.** $5(y - 1) = 3y + 7$ _____

**5.** $2(m + 4) = 2m + 8$ _____

**6.** $9 - 3k = 6k + 9$ _____

**7.** $8p + 3 = 8p - 5$ _____

**8.** $3(2x - 1) = 4x + 5$ _____

**9.** $7 + 2n = 5n - 8$ _____

**10.** $-4(x + 2) = -4x + 1$ _____

**11.** $10 - x = 3x - 6$ _____

**12.** $2(3w + 5) = 3(2w + 4)$ _____

**13.** $9x - 4 = 5x + 12$ _____

**14.** $6 - 2x = 3x + 1$ _____

**15.** $3(x + 2) + x = 4(x + 1) + 2$ _____

**16.** $\frac{x + 5}{2} = x - 3$ _____

**17.** $5(x - 1) - 2x = 3x - 5$ _____

**18.** $2x + 11 = -3(x - 2)$ _____

**19.** $\frac{x}{3} + 5 = \frac{2x}{3} - 1$ _____

**20.** $4(x + 1) = 2(2x + 3)$ _____

## Word Problems

**21.** Gym A charges $\$20$ per month plus a $\$50$ sign-up fee. Gym B charges $\$30$ per month with no sign-up fee. After how many months will the total cost be the same?

_____

**22.** Aiden has $\$100$ and saves $\$15$ per week. Bella has $\$40$ and saves $\$25$ per week. After how many weeks will they have the same amount?

_____

**23.** Two car rental companies: Speedy charges $\$45$ a day plus $\$0.20$ per mile. QuickCar charges $\$30$ a day plus $\$0.35$ per mile. At how many miles will both companies cost the same for a one-day rental?

_____

**24.** Jordan's age is $4$ years more than $3$ times his sister's age. The sum of their ages is $32$. Find both ages.

_____

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# Answer Keys

1. $x = 4$
2. $n = 4$
3. $a = -3$
4. $y = 6$
5. all reals
6. $k = 0$
7. no solution
8. $x = 4$
9. $n = 5$
10. no solution
11. $x = 4$
12. no solution
13. $x = 4$
14. $x = 1$
15. all reals
16. $x = 11$
17. all reals
18. $x = -1$
19. $x = 18$
20. no solution
21. $m = 5$
22. $w = 6$
23. $m = 100$ miles
24. sister $7$, Jordan $25$

## Step-by-Step Tutor Notes

1. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract $x$: $3x + 1 = 13$. Subtract $1$: $3x = 12$. Divide by $3$: $x = 4$. After simplifying, the answer is $x = 4$.
2. Work one inverse operation at a time and keep both sides balanced. Subtract $3n$: $4n - 5 = 11$. Add $5$: $4n = 16$. Divide by $4$: $n = 4$. After simplifying, the answer is $n = 4$.
3. Keep the order of operations in view, then simplify without skipping the sign check. Subtract $2a$: $4a + 2 = -10$. Subtract $2$: $4a = -12$. Divide by $4$: $a = -3$. After simplifying, the answer is $a = -3$.
4. Distribute the left: $5y-5 = 3y+7$. Subtract $3y$: $2y-5 = 7$. Add $5$: $2y = 12$. Divide by $2$: $y = 6$.
5. Take it one clear step at a time and keep the original question in mind. Distribute: $2m + 8 = 2m + 8$. Both sides identical — infinitely many solutions. So the answer is all reals.
6. Add $3k$ to both sides: $9 = 9k + 9$. Subtract $9$: $0 = 9k$. Divide by $9$: $k = 0$. (Zero is a real, valid answer.).
7. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract $8p$ from both sides: $3 = -5$. False, so no solution. After simplifying, the answer is no solution.
8. Distribute the left: $6x-3 = 4x+5$. Subtract $4x$: $2x-3 = 5$. Add $3$: $2x = 8$. Divide by $2$: $x = 4$.
9. Keep the order of operations in view, then simplify without skipping the sign check. Subtract $2n$: $7 = 3n - 8$. Add $8$: $15 = 3n$. Divide by $3$: $n = 5$. After simplifying, the answer is $n = 5$.
10. Distribute the left: $-4x - 8 = -4x + 1$. Add $4x$ to both sides: $-8 = 1$. False, so no solution.
11. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Add $x$: $10 = 4x - 6$. Add $6$: $16 = 4x$. Divide by $4$: $x = 4$. After simplifying, the answer is $x = 4$.
12. Keep the order of operations in view, then simplify without skipping the sign check. Distribute both: $6w + 10 = 6w + 12$. Subtract $6w$: $10 = 12$. False, so no solution. After simplifying, the answer is no solution.
13. Work one inverse operation at a time and keep both sides balanced. Subtract $5x$: $4x - 4 = 12$. Add $4$: $4x = 16$. Divide by $4$: $x = 4$. After simplifying, the answer is $x = 4$.
14. Keep the order of operations in view, then simplify without skipping the sign check. Add $2x$: $6 = 5x + 1$. Subtract $1$: $5 = 5x$. Divide by $5$: $x = 1$. After simplifying, the answer is $x = 1$.
15. Distribute both sides and combine like terms: the left becomes $4x + 6$, and the right also becomes $4x + 6$. Since the two sides match exactly, every real value of $x$ makes the equation true.
16. Multiply both sides by $2$: $x + 5 = 2(x - 3)$. Distribute: $x + 5 = 2x - 6$. Subtract $x$: $5 = x - 6$. Add $6$: $x = 11$.
17. Distribute: $5x - 5 - 2x = 3x - 5$. Combine left: $3x - 5 = 3x - 5$. Both sides identical, so infinitely many solutions.
18. Distribute the right: $2x + 11 = -3x + 6$. Add $3x$: $5x + 11 = 6$. Subtract $11$: $5x = -5$. Divide by $5$: $x = -1$.
19. Multiply everything by $3$ to clear fractions: $x + 15 = 2x - 3$. Subtract $x$: $15 = x - 3$. Add $3$: $x = 18$.
20. Keep the order of operations in view, then simplify without skipping the sign check. Distribute both: $4x + 4 = 4x + 6$. Subtract $4x$: $4 = 6$. False, so no solution. After simplifying, the answer is no solution.
21. Set the two costs equal: $20m + 50 = 30m$. Subtract $20m$: $50 = 10m$. Divide by $10$: $m = 5$ months. That's the break-even point — before $5$ months, Gym B is cheaper; after, Gym A wins.
22. Set savings equal: $100+15w = 40+25w$. Subtract $15w$: $100 = 40+10w$. Subtract $40$: $60 = 10w$. Divide by $10$: $w = 6$ weeks.
23. Set costs equal: $45 + 0.20m = 30 + 0.35m$. Subtract $0.20m$: $45 = 30 + 0.15m$. Subtract $30$: $15 = 0.15m$. Divide by $0.15$: $m = 100$ miles.
24. Let $s$ be sister's age. Jordan's age is $3s + 4$. Sum: $s + (3s + 4) = 32$. Combine: $4s + 4 = 32$. Subtract $4$: $4s = 28$. Divide by $4$: $s = 7$. Then Jordan is $3(7) + 4 = 25$.

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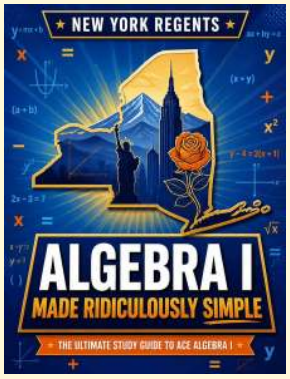


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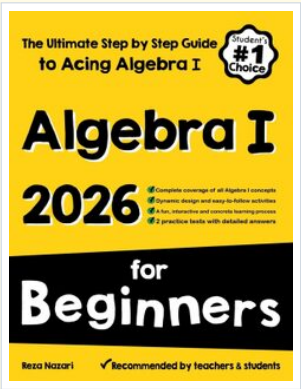


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