Solving Two-Step Equations

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Undo addition or subtraction on both sides, then undo multiplication or division on both sides. To solve $3x + 4 = 19$, subtract 4 to get $3x = 15$, then divide by 3 to get $x = 5$. Check by substituting into the original equation.

Worked example

Equation: solve $3x + 4 = 19$ and check.

1. Subtract (4) from both sides: $3x + 4 - (4) = 19 - (4)$, so $3x = 15$.
2. Divide by (3): $x = 15 \div (3) = 5$.
3. Check: $3(5) + (4) = 19$.
Answer: $x = 5$.

Practice Problems

Show your thinking.

1. From $6x + 8 = 26$, Ana writes $6x = 34$. Identify the sign mistake, then solve.

2. From $-5x + 4 = 14$, Bo reaches $-5x = 10$ but reports $x = 2$. Check his answer and repair the final step.

3. Mei obtains $\frac{2}{3}x = 6$ from $\frac{2}{3}x - 1 = 5$, then multiplies by $\frac{2}{3}$. Explain which multiplier works and solve.

4. Rui divides $9x - 6 = 30$ by 9 and writes $x - 6 = \frac{10}{3}$. Repair his divide-first equation and solve.

5. In $3x - 8 = -14$, one student says $x = 2$ and another says $x = -2$. Test both and justify which can work.

6. From $7x + 12 = 26$, Pat subtracts 12 only on the left. Why does $7x = 26$ no longer represent the same balance? Find x.

7. Kim solves $4x - 11 = 9$ by adding 11, then dividing by 4. Jo adds 11 but multiplies by 4. Compare the methods and solve.

8. Marc changes $-2x + \frac{5}{2} = -1$ to $-2x = -1 - \frac{5}{2} = -\frac{3}{2}$. Find the fraction error and solve.

9. Test whether every equation $8x + B = C$ has a positive solution. Build a counterexample using $B = -3$ and $C = -35$.

10. Write an equation from a balance with $6 - \frac{x}{4}$ on one side and 1 on the other. Name a legal first move on both sides and solve.

Answer Key

1. $x = 3$.
2. $x = -2$.
3. $x = 9$.
4. $x = 4$.
5. $x = -2$.
6. $x = 2$.
7. $x = 5$.
8. $x = \frac{7}{4}$.
9. $x = -4$. No; $8x - 3 = -35$ is a counterexample.
10. $x = 20$. First subtract 6 from both sides.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Ana added 8 to 26 while dropping 8 on the left. Subtract 8 on both sides: $26 - 8 = 18$, not 34.
2. Subtract (8) from both sides: $6x + 8 - (8) = 26 - (8)$, so $6x = 18$.
3. Divide by (6): $x = 18 \div (6) = 3$.
4. Check: $6(3) + (8) = 26$.

Problem 2

1. Testing $x = 2$ gives $-5(2) + 4 = -6$, not 14. The coefficient is -5, not 5.
2. Subtract (4) from both sides: $-5x + 4 - (4) = 14 - (4)$, so $-5x = 10$.
3. Divide by (-5): $x = 10 \div (-5) = -2$.
4. Check: $-5(-2) + (4) = 14$.

Problem 3

1. $\frac{2}{3} \cdot \frac{2}{3} = \frac{4}{9}$, not 1. Multiply by the reciprocal $\frac{3}{2}$.
2. Subtract (-1) from both sides: $\frac{2}{3}x - 1 - (-1) = 5 - (-1)$, so $\frac{2}{3}x = 6$.
3. Divide by $(\frac{2}{3})$: $x = 6 \div (\frac{2}{3}) = 9$.
4. Check: $\frac{2}{3}(9) + (-1) = 5$.

Problem 4

1. Divide every term: $x - \frac{6}{9} = \frac{30}{9}$, or $x - \frac{2}{3} = \frac{10}{3}$. Adding $\frac{2}{3}$ gives $x = 4$.
2. Subtract (-6) from both sides: $9x - 6 - (-6) = 30 - (-6)$, so $9x = 36$.
3. Divide by (9): $x = 36 \div (9) = 4$.
4. Check: $9(4) + (-6) = 30$.

Problem 5

1. The left sides are $3(2) - 8 = -2$ and $3(-2) - 8 = -14$. Only -2 produces the required output.
2. Subtract (-8) from both sides: $3x - 8 - (-8) = -14 - (-8)$, so $3x = -6$.
3. Divide by (3): $x = -6 \div (3) = -2$.
4. Check: $3(-2) + (-8) = -14$.

Problem 6

1. Taking 12 off just one side changes the balance. Subtract on both sides to leave $26 - 12 = 14$ on the right.
2. Subtract (12) from both sides: $7x + 12 - (12) = 26 - (12)$, so $7x = 14$.
3. Divide by (7): $x = 14 \div (7) = 2$.
4. Check: $7(2) + (12) = 26$.

Problem 7

1. After adding 11, $4x = 20$. Dividing by 4 turns $4x$ into x; multiplying by 4 would give $16x = 80$.
2. Subtract (-11) from both sides: $4x - 11 - (-11) = 9 - (-11)$, so $4x = 20$.
3. Divide by (4): $x = 20 \div (4) = 5$.
4. Check: $4(5) + (-11) = 9$.

Problem 8

1. Write $-1 = -\frac{2}{2}$. Then $-\frac{2}{2} - \frac{5}{2} = -\frac{7}{2}$, not $-\frac{3}{2}$.
2. Subtract $(\frac{5}{2})$ from both sides: $-2x + \frac{5}{2} - (\frac{5}{2}) = -1 - (\frac{5}{2})$, so $-2x = -\frac{7}{2}$.
3. Divide by (-2): $x = -\frac{7}{2} \div (-2) = \frac{7}{4}$.
4. Check: $-2(\frac{7}{4}) + (\frac{5}{2}) = -1$.

Problem 9

1. The proposed equation is $8x - 3 = -35$. A single negative solution disproves the claim.
2. Subtract (-3) from both sides: $8x - 3 - (-3) = -35 - (-3)$, so $8x = -32$.
3. Divide by (8): $x = -32 \div (8) = -4$.
4. Check: $8(-4) + (-3) = -35$.

Problem 10

1. Start with $6 - \frac{x}{4} = 1$. Subtract 6 from both sides to remove the added 6.
2. Subtract (6) from both sides: $-\frac{1}{4}x + 6 - (6) = 1 - (6)$, so $-\frac{1}{4}x = -5$.
3. Divide by $(-\frac{1}{4})$: $x = -5 \div (-\frac{1}{4}) = 20$.
4. Check: $-\frac{1}{4}(20) + (6) = 1$.

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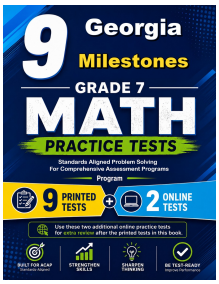

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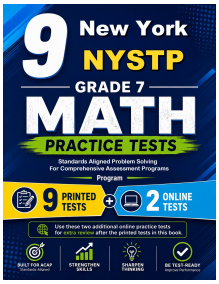

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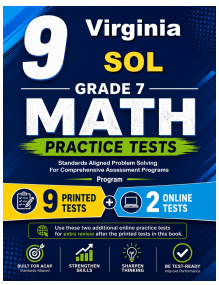

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