Solving Systems of Two Equations

Systems: Intersections and Elimination

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

QUICK REVIEW

A solution of a two-equation system is an ordered pair satisfying both equations simultaneously. Eliminate a variable by adding or subtracting equivalent equations, then substitute the remaining value. For $x + y = 7$ and $x - y = 1$, addition gives $2x = 8$, so $(x, y) = (4, 3)$. A contradiction such as $0 = 3$ means no solution; an identity $0 = 0$ signals coincident lines and infinitely many solutions.

Worked example

Solve the system. $1x + 1y = 7$, $1x - 1y = 1$.

1. Eliminate x: multiply the first equation by 1 and the second by 1. The resulting x coefficients both equal 1.
2. The scaled equations are $1x + 1y = 7$ and $1x - 1y = 1$. Subtracting the second from the first gives $2y = 6$.
3. Divide to obtain $y = 3$. Substitute into the first equation: $1x + (1)(3) = 7$, giving $x = 4$.
4. Check: $(1)(4) + (1)(3) = 7$; $(1)(4) + (-1)(3) = 1$. Both constraints hold, so the pair is unique.
Answer: $(x, y) = (4, 3)$.

Practice Problems

Show your thinking.

1. Use elimination to solve. $1x + 1y = 9$, $1x - 1y = 3$.

2. Find the common ordered pair. $2x + 1y = 11$, $1x - 1y = 1$.

3. Solve, allowing a negative coordinate. $1x + 2y = 3$, $3x - 1y = -5$.

4. Solve exactly; do not round fractional coordinates. $2x + 1y = 4$, $1x - 1y = 0$.

5. Classify and solve this system. $1x + 1y = 4$, $2x + 2y = 10$.

6. Determine whether these equations specify one pair or more. $2x - 1y = 6$, $4x - 2y = 12$.

7. Rewrite the equations if useful and solve. $1x - 1y = 2$, $2x + 1y = 7$.

8. Do the two equations represent intersecting, parallel, or coincident lines? $3x + 2y = 8$, $6x + 4y = 16$.

9. Test the claim that this system has solution $(2, 1)$; find its actual solution. $1x + 1y = 6$, $2x - 1y = 3$.

10. Decide whether matching variable ratios guarantee a solution here. $2x + 3y = 5$, $4x + 6y = 13$.

Answer Key

1. $(x, y) = (6, 3)$.
2. $(x, y) = (4, 3)$.
3. $(x, y) = (-1, 2)$.
4. $(x, y) = (\frac{4}{3}, \frac{4}{3})$.
5. No solution.
6. Infinitely many solutions.
7. $(x, y) = (3, 1)$.
8. Infinitely many solutions.
9. $(x, y) = (3, 3)$.
10. No solution.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Eliminate x: multiply the first equation by 1 and the second by 1. The resulting x coefficients both equal 1.

2. The scaled equations are $1x + 1y = 9$ and $1x - 1y = 3$. Subtracting the second from the first gives $2y = 6$.

3. Divide to obtain $y = 3$. Substitute into the first equation: $1x + (1)(3) = 9$, giving $x = 6$.

4. Check: $(1)(6) + (1)(3) = 9$; $(1)(6) + (-1)(3) = 3$. Both constraints hold, so the pair is unique.

Problem 2

1. Eliminate x: multiply the first equation by 1 and the second by 2. The resulting x coefficients both equal 2.

2. The scaled equations are $2x + 1y = 11$ and $2x - 2y = 2$. Subtracting the second from the first gives $3y = 9$.

3. Divide to obtain $y = 3$. Substitute into the first equation: $2x + (1)(3) = 11$, giving $x = 4$.

4. Check: $(2)(4) + (1)(3) = 11$; $(1)(4) + (-1)(3) = 1$. Both constraints hold, so the pair is unique.

Problem 3

1. Eliminate x: multiply the first equation by 3 and the second by 1. The resulting x coefficients both equal 3.

2. The scaled equations are $3x + 6y = 9$ and $3x - 1y = -5$. Subtracting the second from the first gives $7y = 14$.

3. Divide to obtain $y = 2$. Substitute into the first equation: $1x + (2)(2) = 3$, giving $x = -1$.

4. Check: $(1)(-1) + (2)(2) = 3$; $(3)(-1) + (-1)(2) = -5$. Both constraints hold, so the pair is unique.

Problem 4

1. Eliminate x: multiply the first equation by 1 and the second by 2. The resulting x coefficients both equal 2.

2. The scaled equations are $2x + 1y = 4$ and $2x - 2y = 0$. Subtracting the second from the first gives $3y = 4$.

3. Divide to obtain $y = \frac{4}{3}$. Substitute into the first equation: $2x + (1)(\frac{4}{3}) = 4$, giving $x = \frac{4}{3}$.

4. Check: $(2)(\frac{4}{3}) + (1)(\frac{4}{3}) = 4$; $(1)(\frac{4}{3}) + (-1)(\frac{4}{3}) = 0$. Both constraints hold, so the pair is unique.

Problem 5

1. Eliminate x: multiply the first equation by 2 and the second by 1. The resulting x coefficients both equal 2.

2. The scaled equations are $2x + 2y = 8$ and $2x + 2y = 10$. Subtracting the second from the first gives $0y = -2$.

3. The result $0 = -2$ is false. No ordered pair can satisfy both equations, so the system has no solution.

Problem 6

1. Eliminate x: multiply the first equation by 4 and the second by 2. The resulting x coefficients both equal 8.

2. The scaled equations are $8x - 4y = 24$ and $8x - 4y = 24$. Subtracting the second from the first gives $0y = 0$.

3. The result $0 = 0$ is true. Both equations describe the same line; all pairs satisfying $2x - 1y = 6$ solve the system.

Problem 7

1. The first equation gives $y = x - 2$. Substitution into the second gives $2x + (x - 2) = 7$, so $3x = 9$ and $x = 3$.

2. The scaled equations are $2x - 2y = 4$ and $2x + 1y = 7$. Subtracting the second from the first gives $-3y = -3$.

3. Divide to obtain $y = 1$. Substitute into the first equation: $1x + (-1)(1) = 2$, giving $x = 3$.

4. Check: $(1)(3) + (-1)(1) = 2$; $(2)(3) + (1)(1) = 7$. Both constraints hold, so the pair is unique.

Problem 8

1. Eliminate x: multiply the first equation by 6 and the second by 3. The resulting x coefficients both equal 18.

2. The scaled equations are $18x + 12y = 48$ and $18x + 12y = 48$. Subtracting the second from the first gives $0y = 0$.

3. The result $0 = 0$ is true. Both equations describe the same line; all pairs satisfying $3x + 2y = 8$ solve the system.

Problem 9

1. The proposed pair gives $2 + 1 = 3 \neq 6$ in the first equation. Thus $(2, 1)$ fails, and elimination is needed to find the actual pair.

2. The scaled equations are $2x + 2y = 12$ and $2x - 1y = 3$. Subtracting the second from the first gives $3y = 9$.

3. Divide to obtain $y = 3$. Substitute into the first equation: $1x + (1)(3) = 6$, giving $x = 3$.

4. Check: $(1)(3) + (1)(3) = 6$; $(2)(3) + (-1)(3) = 3$. Both constraints hold, so the pair is unique.

Problem 10

1. The second equation has twice each variable coefficient of the first, but $13 \neq 2(5) = 10$. Matching variable ratios alone do not guarantee compatibility.

2. The scaled equations are $8x + 12y = 20$ and $8x + 12y = 26$. Subtracting the second from the first gives $0y = -6$.

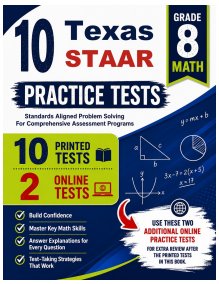
3. The result $0 = -6$ is false. No ordered pair can satisfy both equations, so the system has no solution.

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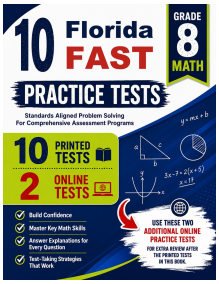
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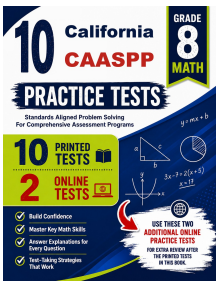
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