MATHEMATICS · GRADES 10-12

Solving two-variable systems graphically

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you find the point where two plans agree, like the number of tickets where two phone plans cost exactly the same, by seeing where their graphs cross. Each plan is a line, and where the lines cross, both plans cost the same for the same amount. To one side of that point one plan is cheaper, and to the other side the other one wins. Drawing it makes the break even point visible, so you can see the answer instead of just calculating it.



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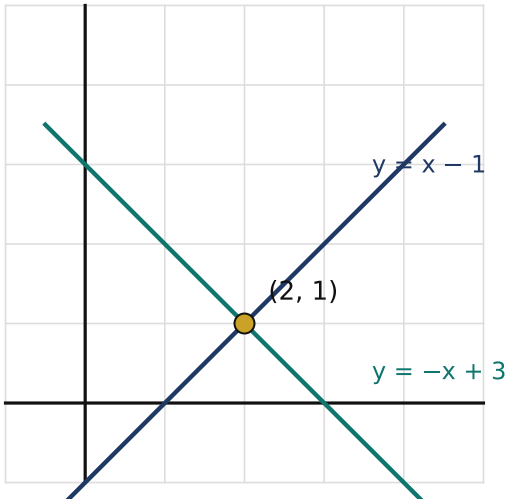
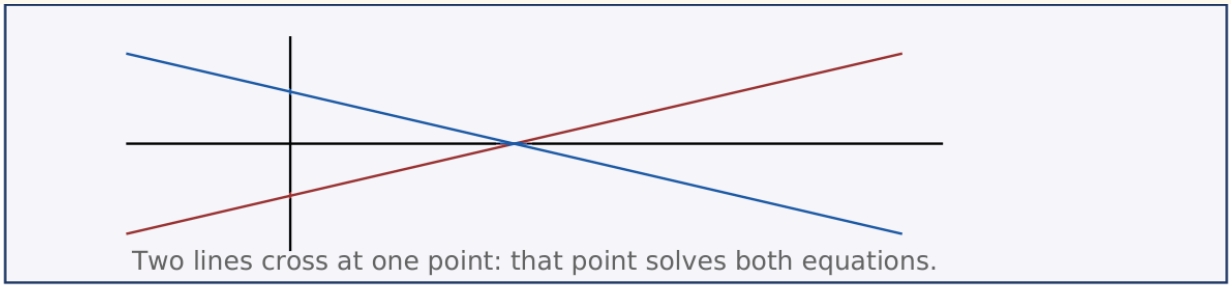


Rule

Solving systems graphically: the solution is the point where the two graphs cross.

At that point both equations are true at once.



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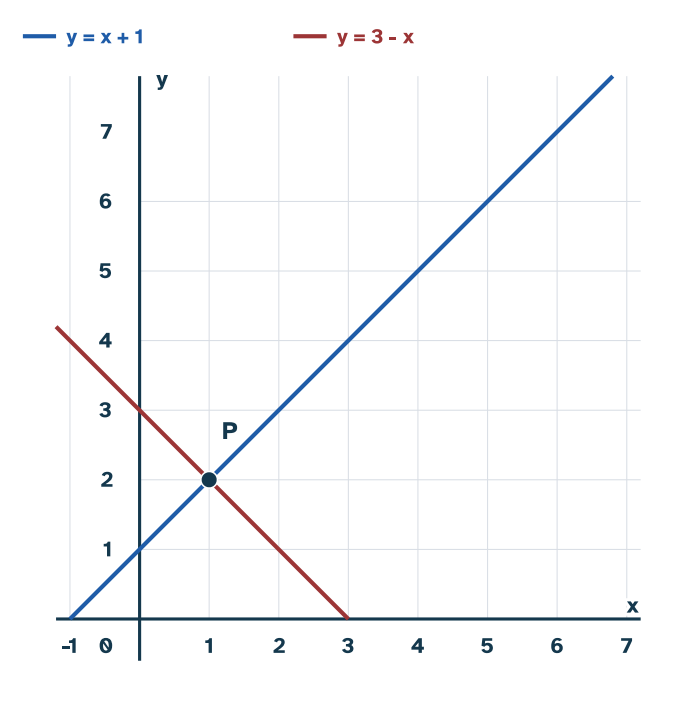
Worked examples

EXAMPLE 1

Q Solve $y = x + 1$ and $y = 3 - x$ by graphing.



SOLUTION

Graph $y = x + 1$: it crosses the y-axis at 1 and rises by 1 each step right.

Graph $y = 3 - x$: it crosses the y-axis at 3 and falls by 1 each step right.

The lines cross at (1, 2), so $x = 1$, $y = 2$.

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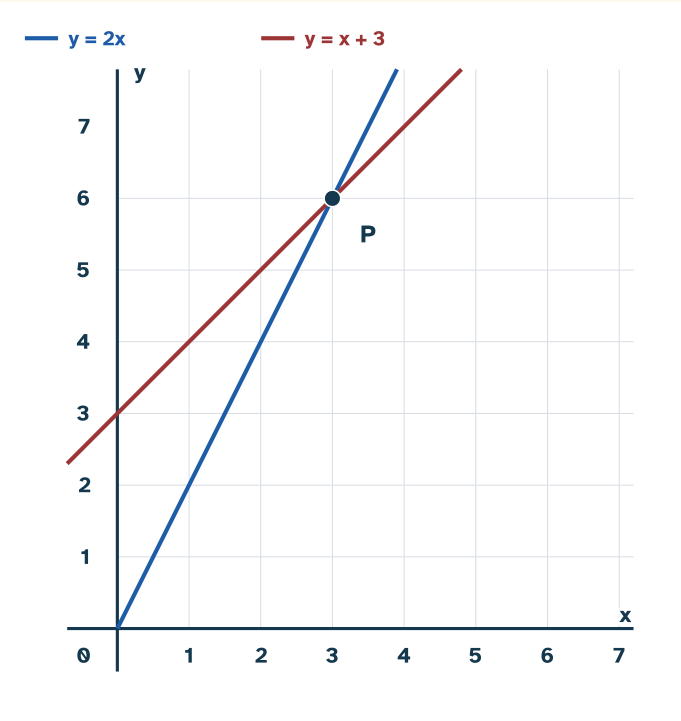
EXAMPLE 2

Q Solve y = 2x and y = x + 3 by graphing.



SOLUTION

Graph y = 2x: it passes through (0, 0) and (1, 2).

Graph y = x + 3: it passes through (0, 3) and (1, 4).

The lines cross at (3, 6), so x = 3, y = 6.

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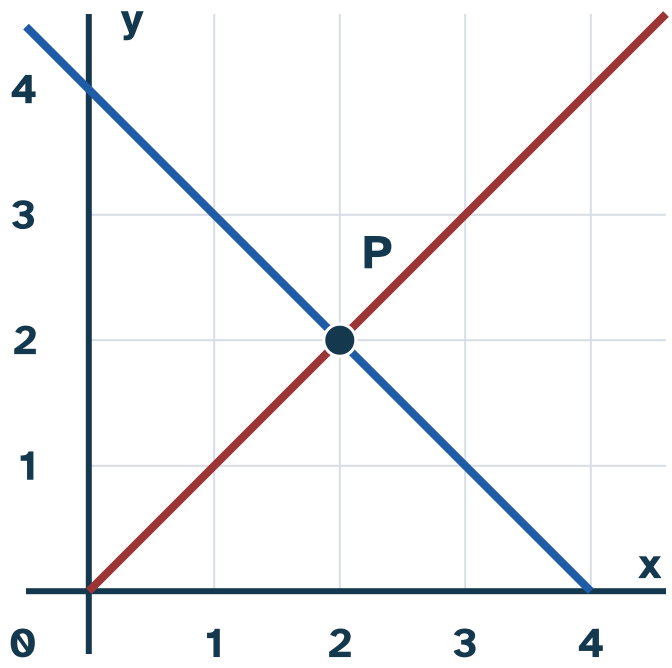
Practice questions

1 The lines cross at P. Read P from the grid.



A (2, 0)

B (2, 2)

C (0, 2)

D (1, 2)

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2 Two lines lie exactly on top of each other. How many solutions does the system have?

- **A** Infinitely many
- **B** One
- **C** None
- **D** Two

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3 Two lines cross at (2, 2). Why is that point the solution of the system?

- **A** It is where the lines are steepest
- **B** It is the pair that satisfies both equations
- **C** It is the point where x is biggest
- **D** It is the y-intercept of both lines

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4 The point (2, 3) is claimed to solve the system $y = x + 1$ and $y = 2x - 1$. Check it: does (2, 3) satisfy both equations?

- **A** Yes, it satisfies both
- **B** No, it fails the first equation
- **C** No, it fails the second equation
- **D** No, it fails both equations

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5 The solution of a system is (1, 2). Which pair of equations has this solution?

- **A** $y = x + 1$ and $y = 3 - x$
- **B** $y = x + 1$ and $y = x + 3$
- **C** $y = 2x$ and $y = x + 3$
- **D** $y = 3x$ and $y = x - 1$

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6 Two lines never meet. Does the system have a solution?

- **A** Yes, the lines meet at (0, 0)
- **B** No, there are no solutions
- **C** Yes, every system has one solution
- **D** No, there are infinitely many solutions

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7 Two parallel lines, $y = x + 5$ and $y = x + 1$. Where do the lines meet?

- **A** At (0, 5)
- **B** At (5, 1)
- **C** They never meet, so there is no solution
- **D** At (1, 5)

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8 **A student reads a crossing point as (1, 4) but the correct point is (4, 1). What mistake did the student make?**

- **A** Mixed up the x and y coordinates
- **B** Read the wrong grid line
- **C** Swapped the two lines
- **D** Added the coordinates together

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9 **The horizontal line y = 4 and the vertical line x = 2 cross. What point is that?**

- **A** (2, 4)
- **B** (4, 2)
- **C** (2, 0)
- **D** (0, 4)

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10

A crossing point reads as (2, 5) on one graph, but algebra gives (2, 6). Which should you trust, and why?

A. The graph, because you can see the point

B. Algebra, a graph reading is only approximate

C. Neither: both must be wrong

D. The graph, because algebra rounds the answer

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ANSWER KEY

1. (2, 2)

2. Infinitely many

3. It is the pair that satisfies both equations

4. Yes, it satisfies both

5. $y = x + 1$ and $y = 3 - x$

6. No, there are no solutions

7. They never meet, so there is no solution

8. Mixed up the x and y coordinates

9. (2, 4)

10. Algebra, a graph reading is only approximate

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