

# 1. Systems of linear equations

SAT Clarity teaching kit

Original supplementary instruction

## Teaching notes

Introduce the skill. These materials are independent of College Board.

## 2. Learning goal

Choose substitution or elimination, interpret intersections, and distinguish one, no and infinitely many solutions.

Before starting: Solve one-variable equations and distribute factors

### Teaching notes

Ask learners to restate the goal. Check the prerequisite before proceeding.

### 3. Diagnostic

Solve  $x + y = 7$  and  $x - y = 1$ . What is  $x$ ?

- A. 3
- B. 4
- C. 6
- D. 8

#### Teaching notes

Allow quiet thinking before sharing. Record reasoning rather than just the letter.

## 4. Diagnostic reasoning

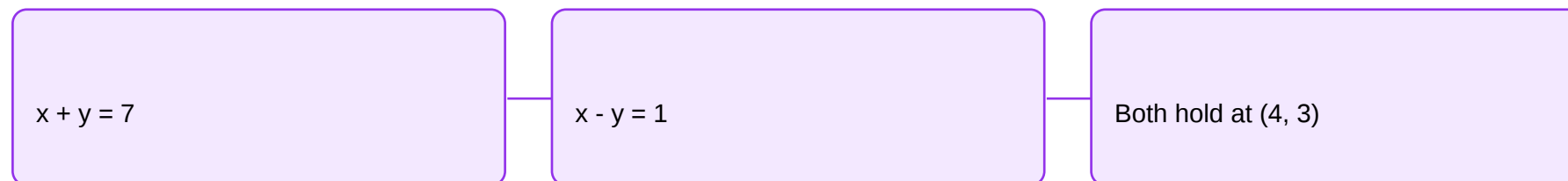
Add equations:  $2x = 8$ , so  $x = 4$ .

### Teaching notes

Answer: B. A: 3 is y in the solution. B: Add equations:  $2x = 8$ , so  $x = 4$ . C: 6 is neither the x nor the y value. D: 8 is  $2x$ , not x.

## 5. A simultaneous solution

A solution must satisfy both equations. For  $x + y = 7$  and  $x - y = 1$ ,  $(4, 3)$  satisfies each.



### Teaching notes

Ask for an explanation in the learner's own words. Connect this concept to the next worked example.

## 6. Substitution

When one variable is isolated, replace that variable in the other equation with its equal expression.

$$y = 2x + 1$$

$$x + (2x + 1) = 10$$

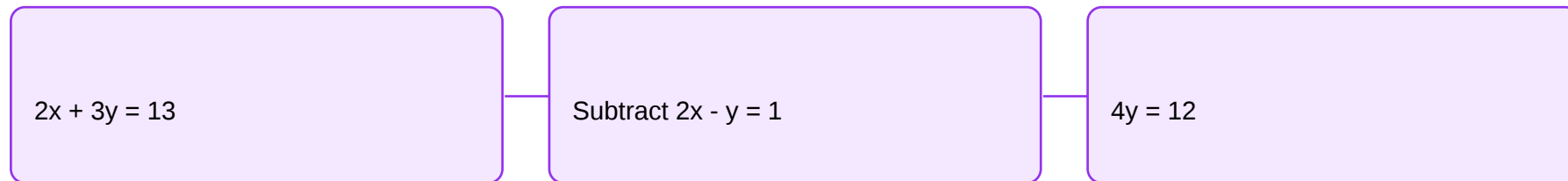
$$x = 3 \text{ and } y = 7$$

### Teaching notes

Ask for an explanation in the learner's own words. Connect this concept to the next worked example.

## 7. Elimination

Add or subtract equations to cancel a variable. Multiply an entire equation first when coefficients need to match.

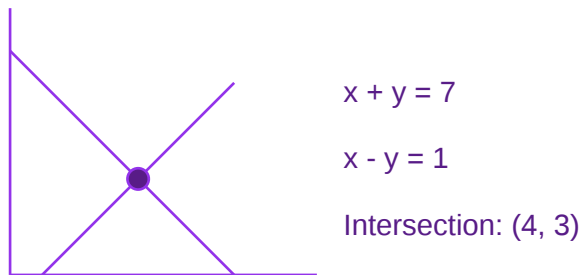


### Teaching notes

Ask for an explanation in the learner's own words. Connect this concept to the next worked example.

## 8. Graphical interpretation

Two lines with different slopes intersect once. Parallel distinct lines have no intersection. Coincident lines represent infinitely many solutions.



### Teaching notes

Ask for an explanation in the learner's own words. Connect this concept to the next worked example.

## 9. Applications

Define variables with units. A count equation and a cost equation constrain the same quantities.

$$a + s = 10$$

$$8a + 5s = 65$$

$$a = 5 \text{ and } s = 5$$

### Teaching notes

Ask for an explanation in the learner's own words. Connect this concept to the next worked example.

## 10. Worked example 1

Solve  $y = 2x + 1$  and  $x + y = 10$ . What is  $x$ ?

- A. 2
- B. 3
- C. 4
- D. 9

### Teaching notes

Model reading the prompt and identifying the requested quantity or relationship before solving.

## 11. Example 1 reasoning

Substitute:  $x + 2x + 1 = 10$ .  $3x = 9$ , so  $x = 3$ .

### Teaching notes

Answer: B. A: 2 gives  $x + y = 7$ . B: Substitute:  $x + 2x + 1 = 10$ .  $3x = 9$ , so  $x = 3$ . C: 4 gives  $x + y = 13$ . D: 9 is  $3x$  before division.

## 12. Worked example 2

For  $2x + 3y = 13$  and  $2x - y = 1$ , what is  $y$ ?

- A. 2
- B. 3
- C. 4
- D. 12

### Teaching notes

Model reading the prompt and identifying the requested quantity or relationship before solving.

## 13. Example 2 reasoning

Subtract the second equation:  $4y = 12$ , so  $y = 3$ .

### Teaching notes

Answer: B. A: 2 makes the equation difference 8 instead of 12. B: Subtract the second equation:  $4y = 12$ , so  $y = 3$ . C: 4 is the coefficient of  $y$  after subtraction. D: 12 is  $4y$ , not  $y$ .

## 14. Worked example 3

An event sells 10 tickets. Adult tickets cost \$8, student tickets cost \$5, and revenue is \$65. How many adult tickets were sold?

- A. 3
- B. 5
- C. 8
- D. 10

### Teaching notes

Model reading the prompt and identifying the requested quantity or relationship before solving.

## 15. Example 3 reasoning

$a + s = 10$  and  $8a + 5s = 65$ . Substitute  $s = 10 - a$ :  $3a = 15$ , so  $a = 5$ .

### Teaching notes

Answer: B. A: 3 adults and 7 students give \$59. B:  $a + s = 10$  and  $8a + 5s = 65$ . Substitute  $s = 10 - a$ :  $3a = 15$ , so  $a = 5$ . C: 8 adults and 2 students give \$74. D: 10 adults give \$80.

## 16. Partial multiplication

Multiplying an equation by 2 requires multiplying every term on both sides.

### Teaching notes

Ask students to explain how the error changes the result. Use a counterexample if needed.

## 17. Sign errors

Subtracting an equation changes every sign in that equation.

### Teaching notes

Ask students to explain how the error changes the result. Use a counterexample if needed.

## 18. One-equation checking

A point on one line can fail the other equation. Check both.

### Teaching notes

Ask students to explain how the error changes the result. Use a counterexample if needed.

## 19. Intersection versus intercept

An axis intercept is not necessarily the intersection of the two given lines.

### Teaching notes

Ask students to explain how the error changes the result. Use a counterexample if needed.

## 20. Guided practice 1

How many solutions do  $y = 2x + 1$  and  $y = 2x - 3$  have?

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

### Teaching notes

Learners solve first. Ask partners to justify a choice and reject an alternative.

## 21. Guided practice 1 reasoning

Equal slopes and different intercepts describe distinct parallel lines.

### Teaching notes

Answer: A. A: Equal slopes and different intercepts describe distinct parallel lines. B: The lines never intersect. C: Two straight lines cannot have exactly two intersections. D: Different intercepts mean the lines are not coincident.

## 22. Guided practice 2

How many solutions do  $x + y = 4$  and  $2x + 2y = 8$  have?

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

### Teaching notes

Learners solve first. Ask partners to justify a choice and reject an alternative.

## 23. Guided practice 2 reasoning

Dividing the second equation by 2 gives the first equation.

### Teaching notes

Answer: D. A: The equations are consistent. B: The second equation repeats the first constraint. C: Every point on the line works, not exactly two. D: Dividing the second equation by 2 gives the first equation.

## 24. Guided practice 3

For  $x + y = 9$  and  $2x - y = 6$ , what is  $x + 2y$ ?

- A. 5
- B. 8
- C. 13
- D. 18

### Teaching notes

Learners solve first. Ask partners to justify a choice and reject an alternative.

## 25. Guided practice 3 reasoning

Add equations:  $3x = 15$ ,  $x = 5$ .  $y = 4$ .  $x + 2y = 13$ .

### Teaching notes

Answer: C. A: 5 is  $x$ , not the requested expression. B: 8 is  $2y$ , without  $x$ . C: Add equations:  $3x = 15$ ,  $x = 5$ .  $y = 4$ .  $x + 2y = 13$ . D: 18 doubles the first equation total rather than the requested expression.

## 26. Independent practice 1

Which ordered pair satisfies  $x - y = 2$  and  $3x + y = 10$ ?

- A. (3, 1)
- B. (1, 3)
- C. (2, 0)
- D. (4, 2)

### Teaching notes

Answer: A. A:  $3 - 1 = 2$  and  $9 + 1 = 10$ . B:  $1 - 3$  is  $-2$ , not  $2$ . C: The first equation works but  $6 + 0$  is not  $10$ . D: The first equation works but  $12 + 2$  is not  $10$ .

## 27. Independent practice 2

For  $x/2 + y = 5$  and  $x - y = 1$ , what is  $x$ ?

- A. 2
- B. 3
- C. 4
- D. 6

### Teaching notes

Answer: C. A: 2 gives  $y = 1$  and the first side 2, not 5. B: 3 gives  $y = 2$  and the first side 3.5. C: Substitute  $y = x - 1$ :  $1.5x - 1 = 5$ . Thus  $x = 4$ . D: 6 is  $1.5x$ , not  $x$ .

## 28. Independent practice 3

For  $2x + ky = 6$  and  $4x + 6y = 12$ , which  $k$  gives infinitely many solutions?

- A. 1
- B. 2
- C. 3
- D. 6

### Teaching notes

Answer: C. A: Doubling gives  $y$  coefficient 2, not 6. B: Doubling gives  $y$  coefficient 4, not 6. C: Doubling the first equation gives  $4x + 2ky = 12$ . Set  $2k = 6$ , so  $k = 3$ . D: 6 forgets that the first equation must be doubled.

## 29. Exit ticket

For  $y = x + 2$  and  $y = -x + 6$ , what is their intersection?

- A. (2, 4)
- B. (4, 2)
- C. (0, 2)
- D. (0, 6)

### Teaching notes

Answer: A. A: Equate expressions:  $x + 2 = -x + 6$ .  $x = 2$  and  $y = 4$ . B: This reverses  $x$  and  $y$  and fails  $y = x + 2$ . C: This is only the first line's  $y$ -intercept. D: This is only the second line's  $y$ -intercept. Ask the learner to name one remaining uncertainty.

## 30. Review and next practice

Independent answers: 1: A, 2: C, 3: C

Return to the concept behind each missed item.

Use the extension question in the worksheet.

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### Teaching notes

Review the separate teacher edition for all distractor explanations. Domain mapping source: <https://satsuite.collegeboard.org/higher-ed-professionals/sat-validity/content-domains> . Difficulty estimates are instructional, not empirically calibrated.