

# Solving Linear-Quadratic Systems

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 26

## Quick Review

A **linear-quadratic system** has one linear equation and one quadratic equation. Solve by substitution: solve the linear equation for one variable, substitute into the quadratic, and solve the resulting quadratic (factor, quadratic formula, or completing the square). The system can have **2, 1, or 0** real solutions, corresponding to the line crossing the parabola in two places, being tangent (one place), or missing it entirely. Find each  $x$  from the quadratic, then substitute back into the linear equation to get the matching  $y$ . Check by substituting both into both original equations.

## PRACTICE

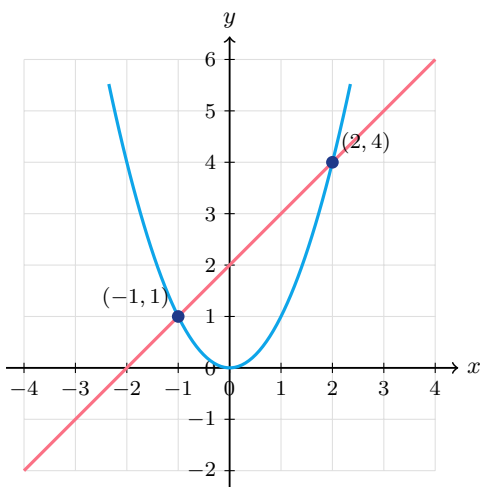
Solve each linear-quadratic system.

- |                              |       |                                 |       |
|------------------------------|-------|---------------------------------|-------|
| 1. $y = x^2, y = x + 2$      | _____ | 11. $y = x^2, y = 9$            | _____ |
| 2. $y = x^2 - 1, y = 3$      | _____ | 12. $y = x^2 + 2x, y = 8$       | _____ |
| 3. $y = x^2 + 1, y = 2x$     | _____ | 13. $y = x^2 - 6x + 9, y = 0$   | _____ |
| 4. $y = x^2, y = -1$         | _____ | 14. $y = 2x^2, y = 8$           | _____ |
| 5. $y = x^2 - 4, y = 0$      | _____ | 15. $y = x^2 + 3x, y = 10$      | _____ |
| 6. $y = x^2 + x, y = 2x + 2$ | _____ | 16. $y = x^2, y = -x + 6$       | _____ |
| 7. $y = x^2 - 2x, y = 3$     | _____ | 17. $y = x^2 - 9, y = 7$        | _____ |
| 8. $y = x^2 + 4, y = x$      | _____ | 18. $y = -(x - 1)^2 + 4, y = 0$ | _____ |
| 9. $y = x^2, y = 4x - 4$     | _____ | 19. $y = x^2, y = 2x - 1$       | _____ |
| 10. $y = -x^2 + 5, y = 1$    | _____ | 20. $y = x^2 + 1, y = x + 3$    | _____ |

## VISUAL PRACTICE

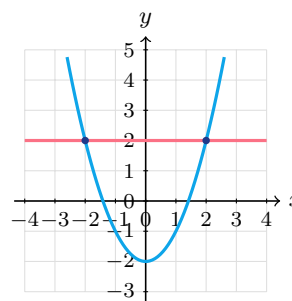
Use the graph, table, chart, or diagram to answer the question.

21. Use the graph to find the solution points.



Answer: \_\_\_\_\_

22. Use the graph to find the solution points.



Answer: \_\_\_\_\_



**◆ Word Problems**

23. A ball is thrown so its height is  $h = -16t^2 + 48t + 4$ . A bird flies at constant  $h = 36$ . When are they at the same height?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

24. A circular fountain is modeled by  $x^2 + y^2 = 25$ . A straight walkway follows  $y = x + 1$ . Does the walkway cross the fountain boundary, and at what points?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

25. A projectile's path is modeled by  $y = -x^2 + 10x$ . A drone flies level at  $y = 21$ . Do their paths meet, and if so, where?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

26. A company's profit is modeled by  $P = -x^2 + 12x - 20$  thousand dollars, where  $x$  is hundreds of units sold. When is the profit exactly \$15 thousand?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_



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## Answer Keys

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. <math>(2, 4), (-1, 1)</math></li> <li>2. <math>(\pm 2, 3)</math></li> <li>3. <math>(1, 2)</math></li> <li>4. no real solution</li> <li>5. <math>(\pm 2, 0)</math></li> <li>6. <math>(2, 6), (-1, 0)</math></li> <li>7. <math>(3, 3), (-1, 3)</math></li> <li>8. none</li> <li>9. <math>(2, 4)</math></li> <li>10. <math>(\pm 2, 1)</math></li> <li>11. <math>(\pm 3, 9)</math></li> <li>12. <math>(2, 8), (-4, 8)</math></li> <li>13. <math>(3, 0)</math></li> </ol> | <ol style="list-style-type: none"> <li>14. <math>(\pm 2, 8)</math></li> <li>15. <math>(2, 10), (-5, 10)</math></li> <li>16. <math>(2, 4), (-3, 9)</math></li> <li>17. <math>(\pm 4, 7)</math></li> <li>18. <math>(3, 0), (-1, 0)</math></li> <li>19. <math>(1, 1)</math></li> <li>20. <math>(2, 5), (-1, 2)</math></li> <li>21. <math>(-1, 1)</math> and <math>(2, 4)</math></li> <li>22. <math>(-2, 2), (2, 2)</math></li> <li>23. <math>t = 1</math> and <math>t = 2</math></li> <li>24. <math>(3, 4), (-4, -3)</math></li> <li>25. <math>(3, 21), (7, 21)</math></li> <li>26. <math>x = 5</math> or <math>x = 7</math></li> </ol> |
|--|--|

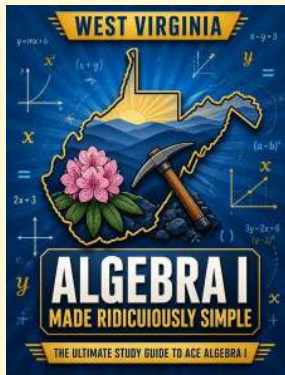
### Step-by-Step Tutor Notes

1. For a table question, slow down and locate the exact row, column, or cell before calculating.  $x^2 = x + 2 \Rightarrow x^2 - x - 2 = 0 \Rightarrow (x - 2)(x + 1) = 0$ . This gives  $(2, 4), (-1, 1)$ .
2. For a table question, slow down and locate the exact row, column, or cell before calculating.  $x^2 - 1 = 3 \Rightarrow x^2 = 4 \Rightarrow x = \pm 2$ . This gives  $(\pm 2, 3)$ .
3.  $x^2 + 1 = 2x \Rightarrow x^2 - 2x + 1 = 0 \Rightarrow (x - 1)^2 = 0$ . One solution (tangent):  $x = 1$ .
4. This is a good place to slow down, check the notation, and simplify cleanly.  $x^2 = -1$  has no real  $x$ . So the answer is no real solution.
5. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $x^2 = 4 \Rightarrow x = \pm 2$ . This gives  $(\pm 2, 0)$ .
6. For a table question, slow down and locate the exact row, column, or cell before calculating.  $x^2 + x = 2x + 2 \Rightarrow x^2 - x - 2 = 0 \Rightarrow (x - 2)(x + 1) = 0$ . This gives  $(2, 6), (-1, 0)$ .
7. For a table question, slow down and locate the exact row, column, or cell before calculating.  $x^2 - 2x - 3 = 0 \Rightarrow (x - 3)(x + 1) = 0$ . This gives  $(3, 3), (-1, 3)$ .
8. This is a good place to slow down, check the notation, and simplify cleanly.  $x^2 - x + 4 = 0$ . Discriminant  $1 - 16 < 0$ . No real solution. So the answer is none.
9. Use the labels on the display first; they tell you which count or total belongs in the answer.  $x^2 = 4x - 4 \Rightarrow x^2 - 4x + 4 = 0 \Rightarrow (x - 2)^2 = 0$ . Tangent. This gives  $(2, 4)$ .
10. Use the labels on the display first; they tell you which count or total belongs in the answer.  $-x^2 + 5 = 1 \Rightarrow x^2 = 4 \Rightarrow x = \pm 2$ . This gives  $(\pm 2, 1)$ .
11. Focus on the main idea of the problem, then simplify carefully.  $x^2 = 9$ . So the answer is  $(\pm 3, 9)$ .
12. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $x^2 + 2x - 8 = 0 \Rightarrow (x + 4)(x - 2) = 0$ . This gives  $(2, 8), (-4, 8)$ .
13. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $(x - 3)^2 = 0 \Rightarrow x = 3$  (double root). This gives  $(3, 0)$ .
14. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $2x^2 = 8 \Rightarrow x^2 = 4$ . This gives  $(\pm 2, 8)$ .
15. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $x^2 + 3x - 10 = 0 \Rightarrow (x + 5)(x - 2) = 0$ . This gives  $(2, 10), (-5, 10)$ .
16. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $x^2 = -x + 6 \Rightarrow x^2 + x - 6 = 0 \Rightarrow (x + 3)(x - 2)$ . This gives  $(2, 4), (-3, 9)$ .
17. Focus on the main idea of the problem, then simplify carefully.  $x^2 = 16$ . So the answer is  $(\pm 4, 7)$ .
18. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $(x - 1)^2 = 4 \Rightarrow x - 1 = \pm 2 \Rightarrow x = 3$  or  $-1$ . This gives  $(3, 0), (-1, 0)$ .
19. Use the labels on the display first; they tell you which count or total belongs in the answer.  $x^2 - 2x + 1 = 0 \Rightarrow (x - 1)^2 = 0$ . Tangent. This gives  $(1, 1)$ .
20. Use the labels on the display first; they tell you which count or total belongs in the answer.  $x^2 + 1 = x + 3 \Rightarrow x^2 - x - 2 = 0 \Rightarrow (x - 2)(x + 1)$ . This gives  $(2, 5), (-1, 2)$ .
21. Focus on the main idea of the problem, then simplify carefully. The solutions are the intersection points of the line and parabola. So the answer is  $(-1, 1)$  and  $(2, 4)$ .
22. Focus on the main idea of the problem, then simplify carefully. The line and parabola meet at  $(-2, 2)$  and  $(2, 2)$ . So the answer is  $(-2, 2), (2, 2)$ .
23.  $-16t^2 + 48t + 4 = 36 \Rightarrow -16t^2 + 48t - 32 = 0 \Rightarrow t^2 - 3t + 2 = 0 \Rightarrow (t - 1)(t - 2) = 0$ .
24. Substitute:  $x^2 + (x + 1)^2 = 25 \Rightarrow 2x^2 + 2x + 1 = 25 \Rightarrow 2x^2 + 2x - 24 = 0 \Rightarrow x^2 + x - 12 = 0 \Rightarrow (x + 4)(x - 3) = 0$ . So  $x = 3, y = 4$  and  $x = -4, y = -3$ .
25. Use the labels on the display first; they tell you which count or total belongs in the answer.  $-x^2 + 10x = 21 \Rightarrow x^2 - 10x + 21 = 0 \Rightarrow (x - 3)(x - 7) = 0$ . This gives  $(3, 21), (7, 21)$ .
26. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $-x^2 + 12x - 20 = 15 \Rightarrow x^2 - 12x + 35 = 0 \Rightarrow (x - 5)(x - 7) = 0$ . This gives  $x = 5$  or  $x = 7$ .



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