Solving Quadratics by Completing the Square

Name: _____	Date: _____	Score: _____ / 24

Quick Review

Completing the square converts a quadratic into vertex form so you can solve by isolating a perfect square. Steps for $x^2 + bx + c = 0$: **(1)** move c to the other side; **(2)** add $\left(\frac{b}{2}\right)^2$ to both sides (this completes the square on the left); **(3)** factor the left as $(x + \frac{b}{2})^2$; **(4)** take square roots of both sides (don't forget the $\pm$); **(5)** solve for x. If the leading coefficient isn't 1, divide first or factor it out. Completing the square always works (unlike factoring), and it's how the quadratic formula is derived.

PRACTICE

Solve each by completing the square.

1. $x^2 + 4x + 3 = 0$ _____

2. $x^2 - 2x - 3 = 0$ _____

3. $x^2 + 6x = 0$ _____

4. $x^2 - 8x + 12 = 0$ _____

5. $x^2 + 2x - 15 = 0$ _____

6. $x^2 - 10x + 9 = 0$ _____

7. $x^2 + 4x - 5 = 0$ _____

8. $x^2 - 6x + 8 = 0$ _____

9. $x^2 + 2x = 24$ _____

10. $x^2 - 4x = 5$ _____

11. $x^2 + 10x + 21 = 0$ _____

12. $x^2 - 12x + 27 = 0$ _____

13. $x^2 + 8x + 7 = 0$ _____

14. $x^2 - 14x + 45 = 0$ _____

15. $x^2 + 6x + 2 = 0$ _____

16. $x^2 - 4x + 1 = 0$ _____

17. $x^2 + 2x + 2 = 0$ _____

18. $2x^2 + 8x - 10 = 0$ _____

19. $x^2 - 6x + 5 = 0$ _____

20. $x^2 + 2x - 8 = 0$ _____

Word Problems

21. A landscape designer's area model leads to $x^2 + 8x + 5 = 0$. Rewrite the equation in completed-square form so the shifted square is clear.

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22. A rectangular banner design leads to the equation $x^2 - 10x = -9$. Solve the equation by completing the square.

_____

23. A garden has area 80 m^2 and length 4 more than width. Find the dimensions using completing the square.

_____

24. A profit model is $y = x^2 - 6x + 4$. Convert the model to vertex form and identify the turning point from that

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Answer Keys

1. $x = -1, -3$
2. $x = 3, -1$
3. $x = 0, -6$
4. $x = 2, 6$
5. $x = 3, -5$
6. $x = 1, 9$
7. $x = 1, -5$
8. $x = 2, 4$
9. $x = 4, -6$
10. $x = 5, -1$
11. $x = -3, -7$
12. $x = 3, 9$
13. $x = -1, -7$
14. $x = 5, 9$
15. $x = -3 \pm \sqrt{7}$
16. $x = 2 \pm \sqrt{3}$
17. no real solution
18. $x = 1, -5$
19. $x = 1, 5$
20. $x = 2, -4$
21. $(x + 4)^2 = 11$
22. $x = 1, 9$
23. $w \approx 7.17$ m, $\ell \approx 11.17$ m
24. $y = (x - 3)^2 - 5$

Step-by-Step Tutor Notes

1. Keep the order of operations in view, then simplify without skipping the sign check. $x^2 + 4x = -3$. Add 4: $(x + 2)^2 = 1$. $x + 2 = \pm 1$. After simplifying, the answer is $x = -1, -3$.
2. Keep the order of operations in view, then simplify without skipping the sign check. $x^2 - 2x = 3$. Add 1: $(x - 1)^2 = 4$. $x - 1 = \pm 2$. After simplifying, the answer is $x = 3, -1$.
3. Read the table by matching the correct row and column first, then use the count or total that fits the question. $x^2 + 6x + 9 = 9 \Rightarrow (x + 3)^2 = 9 \Rightarrow x + 3 = \pm 3$. This gives $x = 0, -6$.
4. Use the labels on the display first; they tell you which count or total belongs in the answer. $x^2 - 8x = -12 \Rightarrow (x - 4)^2 = 4 \Rightarrow x - 4 = \pm 2$. This gives $x = 2, 6$.
5. For a table question, slow down and locate the exact row, column, or cell before calculating. $(x + 1)^2 = 16 \Rightarrow x + 1 = \pm 4$. This gives $x = 3, -5$.
6. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x - 5)^2 = 16 \Rightarrow x - 5 = \pm 4$. This gives $x = 1, 9$.
7. Use the labels on the display first; they tell you which count or total belongs in the answer. $(x + 2)^2 = 9 \Rightarrow x + 2 = \pm 3$. This gives $x = 1, -5$.
8. For a table question, slow down and locate the exact row, column, or cell before calculating. $(x - 3)^2 = 1 \Rightarrow x - 3 = \pm 1$. This gives $x = 2, 4$.
9. For a table question, slow down and locate the exact row, column, or cell before calculating. $(x + 1)^2 = 25 \Rightarrow x + 1 = \pm 5$. This gives $x = 4, -6$.
10. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x - 2)^2 = 9 \Rightarrow x - 2 = \pm 3$. This gives $x = 5, -1$.
11. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x + 5)^2 = 4 \Rightarrow x + 5 = \pm 2$. This gives $x = -3, -7$.
12. Use the labels on the display first; they tell you which count or total belongs in the answer. $(x - 6)^2 = 9 \Rightarrow x - 6 = \pm 3$. This gives $x = 3, 9$.
13. Use the labels on the display first; they tell you which count or total belongs in the answer. $(x + 4)^2 = 9 \Rightarrow x + 4 = \pm 3$. This gives $x = -1, -7$.
14. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x - 7)^2 = 4 \Rightarrow x - 7 = \pm 2$. This gives $x = 5, 9$.
15. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x + 3)^2 = 7 \Rightarrow x + 3 = \pm\sqrt{7}$. Irrational answer. This gives $x = -3 \pm \sqrt{7}$.
16. Focus on the main idea of the problem, then simplify carefully. $(x - 2)^2 = 3$. So the answer is $x = 2 \pm \sqrt{3}$.
17. Start with the definition the problem is testing, then apply it directly. $(x + 1)^2 = -1$. Can't take square root of a negative. So the answer is no real solution.
18. Use the labels on the display first; they tell you which count or total belongs in the answer. Divide by 2: $x^2 + 4x - 5 = 0 \Rightarrow (x + 2)^2 = 9$. This gives $x = 1, -5$.
19. Use the labels on the display first; they tell you which count or total belongs in the answer. $(x - 3)^2 = 4 \Rightarrow x - 3 = \pm 2$. This gives $x = 1, 5$.
20. Read the table by matching the correct row and column first, then use the count or total that fits the question. $(x + 1)^2 = 9 \Rightarrow x + 1 = \pm 3$. This gives $x = 2, -4$.
21. Work one inverse operation at a time and keep both sides balanced. Move 5: $x^2 + 8x = -5$. Add 16: $(x + 4)^2 = 11$. After simplifying, the answer is $(x + 4)^2 = 11$.
22. Use the labels on the display first; they tell you which count or total belongs in the answer. Add 25 to both sides: $(x - 5)^2 = 16 \Rightarrow x - 5 = \pm 4$. This gives $x = 1, 9$.
23. $w(w + 4) = 80 \Rightarrow w^2 + 4w - 80 = 0$. Complete: $(w + 2)^2 = 84 \Rightarrow w = -2 + \sqrt{84} \approx 7.17$ m. The length is about 11.17 m.
24. Set up the model from the story, then calculate carefully. $y = x^2 - 6x + 4 = (x^2 - 6x + 9) - 9 + 4 = (x - 3)^2 - 5$.

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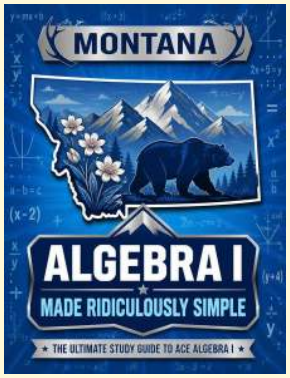

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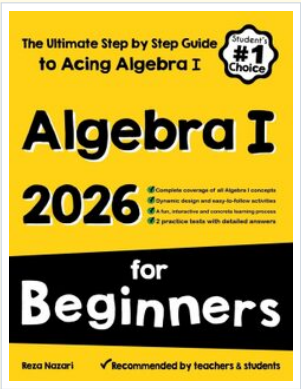

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