Factoring Special Products

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Quick Review

Three patterns to recognize and reverse: **(1) Difference of squares**: $a^2 - b^2 = (a + b)(a - b)$. Look for two perfect squares separated by a minus sign. **(2) Perfect square trinomial** (sum form): $a^2+2ab+b^2 = (a+b)^2$. Check that the first and last terms are perfect squares and the middle is $2ab$. **(3) Perfect square trinomial (difference form)**: $a^2 - 2ab + b^2 = (a - b)^2$. Same as above but the middle term is negative. **Sum of squares** $(a^2 + b^2)$ does *not* factor over the reals — it's prime. Recognizing these patterns saves you the AC-method work.

PRACTICE

Factor each expression using a special-product pattern.

1. $x^2 - 9$ _____

2. $x^2 - 25$ _____

3. $4x^2 - 1$ _____

4. $x^2 + 10x + 25$ _____

5. $x^2 - 6x + 9$ _____

6. $9x^2 + 6x + 1$ _____

7. $x^2 - 12x + 36$ _____

8. $16x^2 - 9$ _____

9. $x^2 - 49$ _____

10. $x^2 + 8x + 16$ _____

11. $4x^2 - 12x + 9$ _____

12. $x^2 + 16$ _____

13. $100 - x^2$ _____

14. $25x^2 - 16$ _____

15. $x^2 - \frac{1}{4}$ _____

16. $x^4 - 1$ _____

17. $49 - 4x^2$ _____

18. $x^2 + 2x + 1$ _____

19. $16x^4 - 1$ _____

20. $36x^2 - 25y^2$ _____

Word Problems

21. A rectangular garden has area $x^2 - 16$ square meters, and one side is $x + 4$ meters. Factor the expression to find the other side.

_____

22. A square garden has area $x^2 + 10x + 25$ ft^2. Factor the perfect-square trinomial to find its side length.

_____

23. A square courtyard has area 25 m^2. Use factoring on $x^2 - 25 = 0$ to find the possible side lengths, then choose the realistic one.

_____

24. A stage backdrop has area model $4x^2 - 9$. Factor the model, then find the values of x that make the area expression equal zero.

_____

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Answer Keys

1. $(x+3)(x-3)$
2. $(x+5)(x-5)$
3. $(2x+1)(2x-1)$
4. $(x+5)^2$
5. $(x-3)^2$
6. $(3x+1)^2$
7. $(x-6)^2$
8. $(4x+3)(4x-3)$
9. $(x+7)(x-7)$
10. $(x+4)^2$
11. $(2x-3)^2$
12. prime
13. $(10+x)(10-x)$
14. $(5x+4)(5x-4)$
15. $(x+\frac{1}{2})(x-\frac{1}{2})$
16. $(x^2+1)(x+1)(x-1)$
17. $(7+2x)(7-2x)$
18. $(x+1)^2$
19. $(4x^2+1)(2x+1)(2x-1)$
20. $(6x+5y)(6x-5y)$
21. $x-4$
22. $x+5$
23. $x=5$
24. $x=\pm\frac{3}{2}$

Step-by-Step Tutor Notes

1. Focus on the main idea of the problem, then simplify carefully. Difference of squares: x and 3. So the answer is $(x+3)(x-3)$.
2. Take it one clear step at a time and keep the original question in mind. x and 5. So the answer is $(x+5)(x-5)$.
3. This is a good place to slow down, check the notation, and simplify cleanly. $2x$ and 1. So the answer is $(2x+1)(2x-1)$.
4. Take it one clear step at a time and keep the original question in mind. Perfect square sum: middle $2(x)(5)=10x$. So the answer is $(x+5)^2$.
5. Take it one clear step at a time and keep the original question in mind. This is a perfect-square trinomial. So the answer is $(x-3)^2$.
6. Use the clue in the question first, then let the arithmetic finish the job. $(3x)^2+2(3x)(1)+1^2$. So the answer is $(3x+1)^2$.
7. Take it one clear step at a time and keep the original question in mind. Middle: $2(x)(6)=12x$, with minus. So the answer is $(x-6)^2$.
8. Take it one clear step at a time and keep the original question in mind. $4x$ and 3. So the answer is $(4x+3)(4x-3)$.
9. Focus on the main idea of the problem, then simplify carefully. x and 7. So the answer is $(x+7)(x-7)$.
10. Take it one clear step at a time and keep the original question in mind. $(x+4)^2$ checks: $x^2+8x+16$. So the answer is $(x+4)^2$.
11. Start with the definition the problem is testing, then apply it directly. $(2x)^2-2(2x)(3)+3^2$. So the answer is $(2x-3)^2$.
12. Use the structure of the expression to find the important point, then check that it fits the context. Sum of squares doesn't factor. That leads to prime.
13. Focus on the main idea of the problem, then simplify carefully. Difference: 10^2-x^2. So the answer is $(10+x)(10-x)$.
14. Focus on the main idea of the problem, then simplify carefully. $5x$ and 4. So the answer is $(5x+4)(5x-4)$.
15. Use the clue in the question first, then let the arithmetic finish the job. Difference of squares with $\frac{1}{2}$. So the answer is $(x+\frac{1}{2})(x-\frac{1}{2})$.
16. First $(x^2)^2-1^2=(x^2+1)(x^2-1)$, then factor x^2-1 further.
17. Focus on the main idea of the problem, then simplify carefully. Difference: $7^2-(2x)^2$. So the answer is $(7+2x)(7-2x)$.
18. Use the clue in the question first, then let the arithmetic finish the job. Middle $2(x)(1)$. So the answer is $(x+1)^2$.
19. First identify the feature of the graph or equation that matches the wording of the question. $(4x^2)^2-1^2=(4x^2+1)(4x^2-1)$, then factor the second. That leads to $(4x^2+1)(2x+1)(2x-1)$.
20. Take it one clear step at a time and keep the original question in mind. Two-variable difference of squares. So the answer is $(6x+5y)(6x-5y)$.
21. x^2-16 is a difference of squares: $(x+4)(x-4)$. If one side is $x+4$, the other side is $x-4$.
22. Name the quantities first so the model is easy to read. Perfect square: $x^2+10x+25=(x+5)^2$. Side $=x+5$.
23. Factoring gives $(x+5)(x-5)=0$, so the model has solutions $x=-5$ and $x=5$. A side length must be positive, so $x=5$ meters.
24. Use the labels on the display first; they tell you which count or total belongs in the answer. $(2x+3)(2x-3)=0 \Rightarrow x=-\frac{3}{2}$ or $x=\frac{3}{2}$. This gives $x=\pm\frac{3}{2}$.

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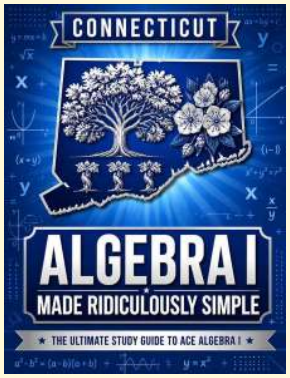

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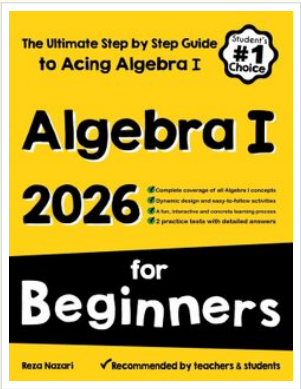

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