

Special Products of Polynomials

Name: _____ Date: _____ Score: _____ / 24

Quick Review

Some products show up so often that memorizing them saves time: **Square of a sum:** $(a + b)^2 = a^2 + 2ab + b^2$. **Square of a difference:** $(a - b)^2 = a^2 - 2ab + b^2$. **Difference of squares:** $(a + b)(a - b) = a^2 - b^2$. The key word in the squares is the **middle term** ($2ab$) — that's the part students forget. $(x + 3)^2 \neq x^2 + 9$; the middle is $2(x)(3) = 6x$, giving $x^2 + 6x + 9$. Recognizing these patterns also helps with factoring later: any perfect square trinomial can be factored as a binomial squared, and any difference of two squares factors as $(a + b)(a - b)$.

PRACTICE

Expand each using the special products patterns.

- | | | | |
|--------------------------|-------|------------------------------------|-------|
| 1. $(x + 4)^2$ | _____ | 11. $(x - y)^2$ | _____ |
| 2. $(x - 6)^2$ | _____ | 12. $(a + b)(a - b)$ | _____ |
| 3. $(x + 5)(x - 5)$ | _____ | 13. $(4x + 5)(4x - 5)$ | _____ |
| 4. $(2x + 1)^2$ | _____ | 14. $(x^2 + 3)^2$ | _____ |
| 5. $(3x - 2)^2$ | _____ | 15. $(2x + 3)(2x + 3)$ | _____ |
| 6. $(2x + 3)(2x - 3)$ | _____ | 16. $(\sqrt{2} + x)(\sqrt{2} - x)$ | _____ |
| 7. $(x + a)^2$ | _____ | 17. $(x - 3)(x + 3)$ | _____ |
| 8. $(5x - 1)^2$ | _____ | 18. $(3x + y)^2$ | _____ |
| 9. $(x + \frac{1}{2})^2$ | _____ | 19. $(10 + 1)^2 = 11^2$ | _____ |
| 10. $(7 + x)(7 - x)$ | _____ | 20. $(x + y)^2 - (x - y)^2$ | _____ |

Word Problems

21. A square garden has side length $x + 5$ feet. Write its area in expanded form.

22. A display panel is 99 cm by 101 cm. Use the difference of squares pattern to find its area quickly.

23. A square patio has side length x ft. The owner adds a 3 ft strip along one side and another 3 ft strip along the adjacent side, making the new square side $x + 3$. By how much does the area increase?

24. A rectangular courtyard has length $x + y$ and width $x - y$. Use the difference of squares pattern to write its area.



Answer Keys

- | | |
|---|---|
| <p>1. $x^2 + 8x + 16$</p> <p>2. $x^2 - 12x + 36$</p> <p>3. $x^2 - 25$</p> <p>4. $4x^2 + 4x + 1$</p> <p>5. $9x^2 - 12x + 4$</p> <p>6. $4x^2 - 9$</p> <p>7. $x^2 + 2ax + a^2$</p> <p>8. $25x^2 - 10x + 1$</p> <p>9. $x^2 + x + \frac{1}{4}$</p> <p>10. $49 - x^2$</p> <p>11. $x^2 - 2xy + y^2$</p> <p>12. $a^2 - b^2$</p> | <p>13. $16x^2 - 25$</p> <p>14. $x^4 + 6x^2 + 9$</p> <p>15. $4x^2 + 12x + 9$</p> <p>16. $2 - x^2$</p> <p>17. $x^2 - 9$</p> <p>18. $9x^2 + 6xy + y^2$</p> <p>19. 121</p> <p>20. $4xy$</p> <p>21. $x^2 + 10x + 25$</p> <p>22. 9999 cm²</p> <p>23. $6x + 9$</p> <p>24. $x^2 - y^2$</p> |
|---|---|

Step-by-Step Tutor Notes

1. Take it one clear step at a time and keep the original question in mind. $a = x, b = 4$. Middle: $2(x)(4) = 8x$. So the answer is $x^2 + 8x + 16$.
2. Use the clue in the question first, then let the arithmetic finish the job. $2(x)(6) = 12x$, with $-$ sign. So the answer is $x^2 - 12x + 36$.
3. This is a good place to slow down, check the notation, and simplify cleanly. Difference of squares: $a^2 - b^2$ with $a = x, b = 5$. So the answer is $x^2 - 25$.
4. Take it one clear step at a time and keep the original question in mind. $(2x)^2 + 2(2x)(1) + 1 = 4x^2 + 4x + 1$. So the answer is $4x^2 + 4x + 1$.
5. This is a good place to slow down, check the notation, and simplify cleanly. $9x^2 - 2(3x)(2) + 4$. So the answer is $9x^2 - 12x + 4$.
6. Use the clue in the question first, then let the arithmetic finish the job. $(2x)^2 - 3^2 = 4x^2 - 9$. So the answer is $4x^2 - 9$.
7. Use the clue in the question first, then let the arithmetic finish the job. Pattern with general a . So the answer is $x^2 + 2ax + a^2$.
8. This is a good place to slow down, check the notation, and simplify cleanly. $25x^2 - 2(5x)(1) + 1$. So the answer is $25x^2 - 10x + 1$.
9. Focus on the main idea of the problem, then simplify carefully. Middle: $2(x)(\frac{1}{2}) = x$. So the answer is $x^2 + x + \frac{1}{4}$.
10. Take it one clear step at a time and keep the original question in mind. Order doesn't matter for the pattern: $7^2 - x^2$. So the answer is $49 - x^2$.
11. Start with the definition the problem is testing, then apply it directly. Two-variable version of difference squared. So the answer is $x^2 - 2xy + y^2$.
12. Focus on the main idea of the problem, then simplify carefully. The pattern itself. So the answer is $a^2 - b^2$.
13. Focus on the main idea of the problem, then simplify carefully. $(4x)^2 - 5^2$. So the answer is $16x^2 - 25$.
14. Start with the definition the problem is testing, then apply it directly. $a = x^2, b = 3$. $(x^2)^2 = x^4$; middle $6x^2$. So the answer is $x^4 + 6x^2 + 9$.
15. Start with the definition the problem is testing, then apply it directly. This is just $(2x + 3)^2$. So the answer is $4x^2 + 12x + 9$.
16. Focus on the main idea of the problem, then simplify carefully. $(\sqrt{2})^2 - x^2 = 2 - x^2$. So the answer is $2 - x^2$.
17. Use the clue in the question first, then let the arithmetic finish the job. Difference of squares. So the answer is $x^2 - 9$.
18. This is a good place to slow down, check the notation, and simplify cleanly. $(3x)^2 + 2(3x)(y) + y^2$. So the answer is $9x^2 + 6xy + y^2$.
19. Use the clue in the question first, then let the arithmetic finish the job. $100 + 2(10)(1) + 1 = 121$. (Cool mental-math trick.) So the answer is 121.
20. Expand both: $(x^2 + 2xy + y^2) - (x^2 - 2xy + y^2) = 4xy$. All the squared terms cancel; the middle terms combine.
21. Name the quantities first so the model is easy to read. $(x + 5)^2 = x^2 + 10x + 25$.
22. $99 \cdot 101 = (100 - 1)(100 + 1) = 100^2 - 1^2 = 10000 - 1 = 9999$. The panel's area is 9999 square centimeters.
23. Name the quantities first so the model is easy to read. $(x + 3)^2 - x^2 = (x^2 + 6x + 9) - x^2 = 6x + 9$.
24. Set up the model from the story, then calculate carefully. Difference of squares: $(x + y)(x - y) = x^2 - y^2$.



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