

# Special Products of Polynomials

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 24

## Q 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.

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

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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?

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

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## Answer Keys

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