

Addition and Subtraction of Algebraic Expressions

► **GOAL**

Add and subtract algebraic expressions.

Learn about the Math

Jordan's family is buying new carpet for two rectangular rooms. Jordan's father has challenged him to figure out the total area to be carpeted using an algebraic expression. The area of the largest room in square metres can be described by the expression $x^2 + 7 + 6x$, while the area of the smaller room in square metres is given by the expression $x^2 - 3$.

Jordan's father also states that the x -values in these expressions is equal to 3. The total area can be found by adding these two expressions, then substituting 3 into the expression for x .

? How do you add the algebraic expressions $x^2 + 7 + 6x$ and $x^2 - 3$ to determine the total area of the two rooms to be carpeted?

- A. Draw a diagram representing the area of the two rectangular rooms, one large and one small.
- B. Label the larger rectangle with the expression $x^2 + 7 + 6x$.
- C. Label the smaller rectangle with the expression $x^2 - 3$.
- D. Write an expression for the sum of the areas of the two rectangles.
- E. Group like terms.
- F. Combine like terms. You now have an expression in simplest form to describe the total area to be carpeted.
- G. Substitute 3 into your expression for x .
- H. Simplify the expression. The value will be the total number of square metres to be carpeted.

Reflecting

1. Explain how to arrange the terms in $x^2 + 7 + 6x$ in descending order.
2. Describe what is meant by like terms.
3. Can the sum of two expressions each containing two terms equal an expression with three terms? Explain.
4. For numbers, you can subtract by adding the opposite number. Do you expect the same to be true for variable terms? Explain.

Work with the Math

Example 1: Adding algebraic expressions

Add $(3x^3 + 2x - 5) + (2x^2 + x + 9)$.

Raven's Solution

$$\begin{array}{l} 3x^3 + 2x^2 + \\ (2 + 1)x + (-5 + 9) \end{array}$$

The terms in each expression are already in descending order, so I group together like terms. There is no coefficient in front of the x -term in the second expression, so the coefficient is understood to be 1.

$$3x^3 + 2x^2 + 3x + 4$$

Finally, I combine like terms to arrive at the solution.

$$(3x^3 + 2x - 5) + (2x^2 + x + 9) = 3x^3 + 2x^2 + 3x + 4$$



Example 2: Subtracting algebraic expressions

Subtract $(5x^3 + 7x^2 - 2x) - (3x^3 - 7x + 4)$.

Angele's Solution

$$\begin{array}{l} (5x^3 + 7x^2 - 2x) \\ - (3x^3 - 7x + 4) \end{array}$$

I know that you can subtract by adding the opposite.



$$5x^3 + 7x^2 - 2x - 3x^3 + 7x - 4$$

$$(5 - 3)x^3 + 7x^2 + (-2 + 7)x - 4$$

$$2x^3 + 7x^2 + 5x - 4$$

$$(5x^3 + 7x^2 - 2x) - (3x^3 - 7x + 4) = 2x^3 + 7x^2 + 5x - 4$$

I determine the opposite of all terms that are being subtracted.

Then, I group together like terms.

Finally, I combine like terms to arrive at the solution.

A Checking

5. Add $(3x^2 + 7x + 7) + (9x^2 - 2x + 5)$.

6. Subtract

$$(4x^3 + 6x^2 + x) - (x^3 - 7x^2 + 2).$$

B Practising

7. Find the opposite of each expression.

- a) $28x^2 - 4$
- b) $35x^3 + 4x - 17$
- c) $20x^2 - 11x + 5$
- d) $46x^4 - 38x^3 + 10x^2 + x - 1$
- e) $145x^2 - 77x + 28$

8. Group like terms in each expression.

- a) $(14x^2 - 6) + (7x^2 - 5)$
- b) $(20x^3 + 7x + 1) + (2x^3 - 7x + 10)$
- c) $(18x^2 + 9x + 24) + (12x^2 + 21x + 3)$
- d) $(x^4 + 8x^3 + 11x^2 + 14x - 3) + (2x^4 - 5x^3 + 9x^2 + 22x + 11)$
- e) $(128x^2 + 99x + 82) + (91x^2 + 101x + 66)$

9. Find each sum. Write your answers in simplest form.

- a) $(2x^2 + 4x - 8) + (x^2 - 3)$
- b) $(10x^3 - 4x + 11) + (9x^3 + 3x^2 - 2x + 4)$
- c) $(20x^4 - 3x^3 + 2x^2 + x - 5) + (14x^4 - 7x^3 + 12x^2 + 2x - 9)$
- d) $(x^3 - 20x + 1) + (17x^3 + 2x^2 - x + 21)$
- e) $(2x^4 + 15x^2 + 7x - 1) + (4x^4 - x^3 + 9x^2 + 2x + 11)$
- f) $(x^2 - 8x) + (3x^2 - 5)$

10. Find each difference. Write your answers in simplest form.

- a) $(11x^2 + 2x + 16) - (2x^2 + x + 2)$
- b) $(26x^2 + 11x - 4) - (13x^2 - 1)$
- c) $(35x^2 + 30x - 14) - (x^2 + 10x + 28)$
- d) $(54x^4 - 33x^3 - 28x^2 + 7x - 6) - (44x^4 + 17x^3 + 2x^2 + x - 19)$
- e) $(62x^2 + x - 4) - (11x^2 - 33)$
- f) $(62x^2 - 32x + 45) - (24x^2 + 19x - 12)$
- g) $(10x^2 + 6x) - (4x^2 - 3)$

© Extending

11. Simplify. Write your answers in simplest form.

a) $(10x^2 + 14) + (9x^2 + 3) - (8x^2 - 6)$

b) $(29x^3 - 11x + 30) - (17x^3 - 8x - 22) + (37x^2 + 2)$

c) $(77x^4 + 48x^3 + 28x^2 + 62x - 1) + (54x^4 + 20x^3 + 7x^2 - 13x + 38) - (10x^2 - 17x - 23)$

d) $(142x^2 - 101x + 78) + (99x^2 + 94x + 80) - (62x^3 + 57x + 20)$

e) $(76x^2 - 54x + 31) - (26x^2 - 17x + 8) - (24x^2 + 3)$

12. Colin is painting the four walls of his bedroom. Each wall has an area of $x^2 + 3x + 2$ square metres. Included in the total area of the walls is one window with an area of x^2 square metres and a door with an area of $x^2 + x$ square metres, neither of which will be painted. How much area will Colin be painting?

13. Simplify $(ax^2 + bx + c) + (dx^2 + ex + f)$.