

Ⓑ $(y^2 + y - 1) - (-2y^2 + y + 1)$

$(y^2 + y - 1) + (\square 2y^2 \square y \square 1)$

Rewrite subtraction as addition of the opposite.

Use the vertical method.

+

Combine like terms and simplify.

Simplify.

Reflect

2. Is the difference of two polynomials always another polynomial? Explain.

Your Turn

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Find the difference using a vertical format.

3. $(4x^2 - x) - (-x^2 - 1)$

4. $(-z^3 - 2z - 1) - (-z^3 + 2z + 1)$

5. $(8y - 7) - (1 - 3y)$

$4x^2 - x + x^2 + 1$

$-z^3 - 2z - 1 + z^3 - 2z - 1$

$8y - 7 - 1 + 3y$

$5x^2 - 1x + 1$

$-4z - 2$ Degree: 1

$11y - 8$

Degree: 2

LC: -4

Explain 2 Subtracting Polynomials Using a Horizontal Format

Once the subtraction problem has been rewritten as a sum, the polynomials can be added using the horizontal method. Recall that this method uses the Associative, Commutative, and Distributive properties to group and combine like terms.

Example 2 Find the difference of the polynomials horizontally.

Ⓐ $(2q^2 - q - 8) - (2q^2 + q - 4)$

$= (2q^2 - q - 8) + (-2q^2 - q + 4)$

Rewrite subtraction as addition of the opposite.

$= (2q^2 - 2q^2) + (-q - q) + (-8 + 4)$

Group like terms together.

$= -2q - 4$

Simplify.

B $(2ab - b + a) - (2b^2 + b + a + 4)$

$= (2ab - b + a) + \underline{\hspace{2cm}}$

Rewrite subtraction as addition of the opposite.

$= \underline{\hspace{2cm}}$ Group like terms together.

$= \underline{\hspace{2cm}}$ Simplify.

Your Turn

Find each difference.

6. $(-x^3 + y^2 + y - x) - (-x^3 + y + x)$

7. $(18z + 12) - (11z - 5)$

$$-x^3 + y^2 + y - x + x^3 - y - x$$

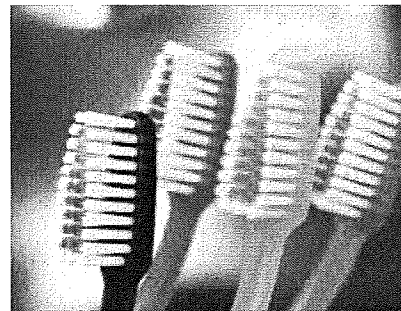
$$y^2 - 2x$$

Explain 3 Modeling with Polynomials

Some scenarios can be modeled by the difference of two polynomials.

Example 3 Find the difference between two polynomials to solve a real-world problem.

A The cost in dollars of producing x toothbrushes is given by the polynomial $400,000 + 3x$, and the revenue generated from sales is given by the polynomial $20x - 0.00004x^2$. Write a polynomial expression for the profit from making and selling x toothbrushes. Then find the profit for selling 200,000 toothbrushes.



Use the formula: Profit = revenue - cost

$(20x - 0.00004x^2) - (400,000 + 3x)$

$= (20x - 0.00004x^2) + (-400,000 - 3x)$ Add the opposite.

$= -0.00004x^2 + 17x - 400,000$ Combine like terms.

To find the profit for selling 200,000 toothbrushes, evaluate the polynomial when $x = 200,000$.

$-0.00004x^2 + 17x - 400,000$

$= -0.00004(200,000)^2 + 17(200,000) - 400,000 = 1,400,000$

The company will make \$1.4 million from the sale of 200,000 toothbrushes.

2. James was solving a subtraction problem using algebra tiles, and he ended with 1 x^2 -tile, 2 $-x^2$ -tiles, 3 1-tiles, and 1 -1 -tile. Model these results with algebra tiles. Assuming James' steps were correct up to that point, explain his mistake. Write the algebraic expression and draw the tiles that should be his result.

Model	Algebra
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Find each difference vertically.

3. $(2x^2 - 2x^4) - (x^4 - x^2)$

4. $(y^2 - x^4) - (-x^4 - x^2)$

5. $(0.75x + 2) - (2.75x + x^2)$

6. $(x^2 + y^2x + z) - (-x + xy^2 - z)$

7. $(m + x + 2z) - (x - y)$

8. $-a^5 - (b^2 + a^2b^2) - (-a^5 - a^2b^2)$

Handwritten work for problem 8:

$$\begin{array}{r}
 \downarrow \\
 -a^5 - b^2 - a^2b^2 + a^5 + a^2b^2 \\
 \hline
 -b^2 \quad LC: -1
 \end{array}$$

Find each difference horizontally.

9. $(-2x^2 + x + 1) - (2x^2 - x - 1)$

10. $(a + b - 2c) - (a + b + 2c)$

11. $(-2cab^2 + ab^2 + b^2) - (-b^2)$

12. $(-2cab^2 + ab^2 + b^2) - [-(b^2)]$

13. $(4^{10}a + ab^3\sqrt{2}) - (ab^3\sqrt{2} + ab + 4^{10}a)$

Handwritten work for problem 13: $4^{10}a + ab^3\sqrt{2} - ab^3\sqrt{2} - ab - 4^{10}a = -ab$

14. $(q^3r^2 - 6qr^2 - 21q) - (-qr^2 - 6qr^2 - 11q - 3q^3r^2)$

Model various situations with the difference of polynomials.

Simplify.

15. A bicycle company produces y bicycles at a cost represented by the polynomial $y^2 + 10y + 100,000$. The revenue for y bicycles is represented by $2y^2 + 10y + 500$. Find a polynomial that represents the company's profit. If the company only has enough materials to make 300 bicycles, should it make the bicycles?

16. Budget planners in two towns, Alphaville and Betaville, developed models to determine the budget surplus (in dollars) for a year based on the tax revenue (in thousands of dollars) for the year. Using historical data, Alphaville's planner produced the model $-2x^2 + 500x$, while Betaville's planner produced the model $x^2 - 100x + 10,000$. What expression gives how much greater Alphaville's annual budget surplus is than Betaville's for a particular amount of tax revenue? If the tax revenue that year in each town is \$75,000, how much greater is Alphaville's budget surplus than Betaville's that year?