MATHEMATICS · GRADES 10-12

Factoring by grouping

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is a way to break a four-part expression into pairs you can handle. Splitting a complicated bill into smaller parts lets you check it one piece at a time, and grouping does the same thing for algebra. Each pair gives you a factor, and the two pairs then share a factor you can pull out. It turns a problem that looks too big into two small ones.



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Worked examples

EXAMPLE 1

Q Factor $x^3 + 2x^2 + 3x + 6$

SOLUTION

Group the first two terms and the last two terms: $(x^3 + 2x^2) + (3x + 6)$

Factor each group: $x^2(x + 2) + 3(x + 2)$

Factor out the common bracket $(x + 2)$: $(x + 2)(x^2 + 3)$

EXAMPLE 2

Q Factor $2x^3 + 4x^2 + 3x + 6$

SOLUTION

Group: $(2x^3 + 4x^2) + (3x + 6)$

Factor each group: $2x^2(x + 2) + 3(x + 2)$

Factor out the common bracket: $(x + 2)(2x^2 + 3)$

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Practice questions

1 Factor $x^3 + 3x^2 + 2x + 6$

- **A** $(x + 2)(x^2 + 3)$
- **B** $(x - 3)(x^2 + 2)$
- **C** $(x + 3)(x^2 + 2)$
- **D** $(x + 3)(x^2 + 6)$

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2 Factor $2x^3 + 6x^2 + x + 3$

- **A** $(x + 3)(2x^2 + 3)$
- **B** $(x + 3)(2x^2 + 1)$
- **C** $(x + 1)(2x^2 + 3)$
- **D** $(x - 3)(2x^2 + 1)$

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3 Factor $x^3 - x^2 + 4x - 4$

A $(x + 1)(x^2 + 4)$

B $(x - 1)(x^2 - 4)$

C $(x - 4)(x^2 + 1)$

D $(x - 1)(x^2 + 4)$

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4 Factor $3x^3 + 9x^2 + 2x + 6$

A $(x + 3)(3x^2 + 2)$

B $(x + 3)(3x^2 + 6)$

C $(x + 2)(3x^2 + 3)$

D $(x - 3)(3x^2 + 2)$

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5 Factor $2x^3 + 6x^2 + 4x + 12$ by grouping.

- **A** $2(x + 3)(x^2 + 2)$
- **B** $(x + 3)(2x^2 + 4)$
- **C** $2(x + 3)(x^2 + 6)$
- **D** $(x + 2)(2x^2 + 6)$

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6 Factor $x^3 + 2x^2 - 9x - 18$ completely by grouping.

- **A** $(x + 2)(x - 3)(x + 3)$
- **B** $(x + 2)(x^2 - 9)$
- **C** $(x - 2)(x^2 + 9)$
- **D** $(x + 2)(x^2 + 9)$

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7 The factored form is $(x + 4)(x^2 + 5)$. What was the original polynomial?

- **A** $x^3 + 4x^2 + 5x + 5$
- **B** $x^3 + 4x^2 + 5x + 20$
- **C** $x^3 + 5x^2 + 4x + 20$
- **D** $x^3 + 4x^2 + 9x + 20$

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8 Ria factors $x^3 + 2x^2 + 5x + 10$ as $(x + 2)(x^2 + 5x)$. What is the correct factorization?

- **A** $(x + 2)(x^2 + 5)$
- **B** $(x + 2)(x^2 - 5)$
- **C** $(x + 5)(x^2 + 2)$
- **D** $(x - 2)(x^2 + 5)$

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9 Factor $x^3 + 3x + 2x^2 + 6$ by grouping.

- **A** $(x + 2)(x^2 + 3)$
- **B** $(x + 3)(x^2 + 2)$
- **C** $(x + 2)(x^2 + 6)$
- **D** $(x + 6)(x^2 + 3)$

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10 Which one does not factor by grouping?

- **A** $x^3 + 2x^2 + 3x + 6$
- **B** $x^3 + 3x^2 + 2x + 6$
- **C** $x^3 + x^2 + 2x + 2$
- **D** $x^3 + 2x^2 + x + 5$

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ANSWER KEY

1. $(x + 3)(x^2 + 2)$

2. $(x + 3)(2x^2 + 1)$

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

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

5. $2(x + 3)(x^2 + 2)$

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

7. $x^3 + 4x^2 + 5x + 20$

8. $(x + 2)(x^2 + 5)$

9. $(x + 2)(x^2 + 3)$

10. $x^3 + 2x^2 + x + 5$

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