MATHEMATICS · GRADES 10-12

Factoring out a common variable factor

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you pull out a factor that every part shares. Factoring the same hourly rate out of a week's wages leaves the hours standing clear, and the same move works in algebra. Once the shared factor is out, the rest of the expression is simpler and easier to solve. It is the habit that keeps algebra tidy instead of messy.



Rule

Common factor: to factor an expression, pull out the greatest factor that every term shares, including the lowest power of the variable, and write what is left inside brackets.

The factor outside times the brackets gives back the original expression.

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Worked examples

EXAMPLE 1

Q Factor $x^2 + 3x$

SOLUTION

Both terms have x. The lowest power of x they share is x itself, so pull out x.

$x^2 \div x = x$

$3x \div x = 3$

Write the result as $x(x + 3)$

EXAMPLE 2

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

SOLUTION

4: 1, 2, 4

6: 1, 2, 3, 6

The numbers 4 and 6 share 2 as their greatest factor, and the lowest power of x both terms share is x^2. So the greatest common factor (GCF) is $2x^2$

$4x^3 \div 2x^2 = 2x$

$6x^2 \div 2x^2 = 3$

Write the result as $2x^2(2x + 3)$

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Practice questions

1 Factor $x^2 + 5x$.

- **A** $x(x + 5)$
- **B** $x(x - 5)$
- **C** $5x(x + 1)$
- **D** $x^2(x + 5)$

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2 Factor $3x^2 - 9x$.

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

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

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

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4 Factor $5x^2 + 10x$.

- **A** $5x(x - 2)$
- **B** $10x(x + 1)$
- **C** $5x^2(x + 2)$
- **D** $5x(x + 2)$

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5 Factor $6x^3 - 3x^2$

A $3x^2(2x - 1)$

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

C $6x^2(x - 1)$

D $3x^2(x - 1)$

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

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

B $x(x^2 + x)$

C $x^2(x + 1)$

D $x(x + 1)(x + 1)$

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The factored form is $5x(x - 4)$. What was the original expression?

A $5x^2 - 4x$

B $5x^2 - 20x$

C $5x^2 + 20x$

D $5x^2 - 20$

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8 **Why do you take out the lowest power of x when factoring $x^3 + 2x^2$?**

- **A** x^3 is the greatest common factor, because it is the biggest power
- **B** Both terms share x^2, but only the first has x^3, so x^2 is the greatest common factor
- **C** x is the greatest common factor, because both terms have an x
- **D** Take out x^3, because it is the highest power in the expression

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

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

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10 Which one does not have the factor $(x + 3)$?

- **A** $x(x + 3)$
- **B** $2x(x + 3)$
- **C** $3x(x + 3)$
- **D** $x(2x + 5)$

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ANSWER KEY

1. $x(x + 5)$

2. $3x(x - 3)$

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

4. $5x(x + 2)$

5. $3x^2(2x - 1)$

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

7. $5x^2 - 20x$

8. Both terms share x^2, but only the first has x^3, so x^2 is the greatest common factor

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

10. $x(2x + 5)$

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