MATHEMATICS · GRADES 10-12

Factoring rational expressions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you simplify a fraction made of formulas so it is easier to work with. A complicated rate often hides a simple one underneath, and factoring the top and bottom reveals it. Once the shared factors are cancelled, the part that actually matters is clear. It turns a messy formula into one you can use.



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Worked examples

EXAMPLE 1

Q Simplify $\frac{(x^2 + 5x + 6)}{(x^2 - 9)}$

SOLUTION

Factor the top: $(x + 2)(x + 3)$. Factor the bottom: $(x - 3)(x + 3)$

Note the excluded values: x is not 3 and x is not -3.

Cancel the shared bracket $(x + 3)$: $\frac{(x + 2)}{(x - 3)}$

EXAMPLE 2

Q Simplify $\frac{(x^2 - 10x + 25)}{(x^2 - 25)}$

SOLUTION

Factor the top: $(x - 5)(x - 5)$. Factor the bottom: $(x - 5)(x + 5)$

Note the excluded values: x is not 5 and x is not -5.

Cancel one shared bracket: $\frac{(x - 5)}{(x + 5)}$

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Practice questions

1 Write $\frac{x^2 + 7x + 12}{x^2 - 16}$ in simplest form.

A $\frac{(x - 3)}{(x - 4)}$

B $\frac{(x + 3)}{(x + 4)}$

C $\frac{(x + 3)}{(x - 4)}$

D $\frac{(x - 3)}{(x + 4)}$

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2 Reduce $\frac{x^2 - 6x + 9}{x^2 - 9}$ to lowest terms.

A $\frac{(x + 3)}{(x - 3)}$

B $\frac{(x - 3)}{(x + 3)}$

C $\frac{(x + 3)}{(x + 3)}$

D $\frac{(x - 3)}{(x - 3)}$

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3 Simplify $\frac{x^2 + 3x - 10}{x^2 - 25}$

A $\frac{(x + 2)}{(x - 5)}$

B $\frac{(x - 2)}{(x + 5)}$

C $\frac{(x + 2)}{(x + 5)}$

D $\frac{(x - 2)}{(x - 5)}$

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4 Cancel common factors in $\frac{x^2 - 8x + 16}{x^2 - 16}$

A $\frac{(x - 4)}{(x + 4)}$

B $\frac{(x + 4)}{(x - 4)}$

C $\frac{(x + 4)}{(x + 4)}$

D $\frac{(x - 4)}{(x - 4)}$

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5 Write $\frac{x^2 + 9x + 20}{x^2 - 25}$ in simplest form.

A $\frac{(x - 4)}{(x - 5)}$

B $\frac{(x + 4)}{(x + 5)}$

C $\frac{(x - 4)}{(x + 5)}$

D $\frac{(x + 4)}{(x - 5)}$

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6 Simplify $\frac{x^2 + 5x + 6}{x^2 - 9}$

A $\frac{(x - 2)}{(x - 3)}$

B $\frac{(x + 2)}{(x - 3)}$

C $\frac{(x + 2)}{(x + 3)}$

D $\frac{(x - 2)}{(x + 3)}$

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7 A fraction simplifies to $\frac{(x + 1)}{(x - 2)}$. Its numerator was $x^2 - x - 2$. What was its denominator?

A $x^2 - 4x + 4$

B $x^2 - 4x - 4$

C $x^2 + 4x + 4$

D $x^2 - 2x + 1$

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8 Ada simplifies $\frac{x^2 - 9}{x^2 - 6x + 9}$ and writes $\frac{(x - 3)}{(x - 3)} = 1$. What did she do wrong?

A. She cancelled the (x + 3) factor, but it has no matching factor in the bottom

B. She forgot to factor the top and the bottom first

C. She should have added the top and bottom instead of cancelling

D. The top and bottom are equal, so the answer really is 1

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9 Simplify $\frac{x^2 - 16}{x^2 + 8x + 16}$

A $\frac{(x + 4)}{(x - 4)}$

B $\frac{(x - 4)}{(x + 4)}$

C $\frac{(4 - x)}{(x + 4)}$

D $\frac{(x + 4)}{(x + 4)}$

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10 Which one is not equal to 1?

A $\frac{x^2 - 1}{x^2 - 1}$

B $\frac{x^2 - 4}{x^2 - 4}$

C $\frac{x^2 - 9}{x^2 - 9}$

D $\frac{x^2 - 16}{x^2 - 25}$

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ANSWER KEY

1. $\frac{(x + 3)}{(x - 4)}$

2. $\frac{(x - 3)}{(x + 3)}$

3. $\frac{(x - 2)}{(x - 5)}$

4. $\frac{(x - 4)}{(x + 4)}$

5. $\frac{(x + 4)}{(x - 5)}$

6. $\frac{(x + 2)}{(x - 3)}$

7. $x^2 - 4x + 4$

8. She cancelled the (x + 3) factor, but it has no matching factor in the bottom

9. $\frac{(x - 4)}{(x + 4)}$

10. $\frac{x^2 - 16}{x^2 - 25}$

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