MATHEMATICS · GRADES 10-12

Simplifying rational expressions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you reduce a complicated fraction with letters in it to its shortest form, just as you would reduce an ordinary fraction to its simplest terms. A fraction with letters on top and bottom can look far harder than it is, because the same factor is often hiding in both parts. Cancelling what is common leaves a shorter fraction that means exactly the same thing wherever it is defined. That shorter version is easier to use when the fraction has to be added, multiplied, or put into an equation.



Rule

Simplifying rational expressions: factor the top and the bottom, then cancel any factor that appears in both.

Any value that would make the original bottom zero is still not allowed, even after cancelling.

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Worked examples

EXAMPLE 1

Q Simplify $\frac{(x^2 - 9)}{(x - 3)}$

SOLUTION

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

Note the excluded value from the original bottom: x is not 3.

Cancel the shared bracket $(x - 3)$: the result is $x + 3$, with x not 3.

EXAMPLE 2

Q Simplify $\frac{(6x^2)}{(3x)}$

SOLUTION

Factor the top and bottom: $6x^2 = 6 \times x \times x$ and $3x = 3 \times x$.

Cancel the shared factors 3 and one x:

$$\frac{6 \times x \times x}{3 \times x} = 2x$$

The result is $2x$, with x not 0.

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Practice questions

1 Write $\frac{(x^2 - 4)}{(x - 2)}$ in simplest form.

- **A** $x + 2$
- **B** $x - 2$
- **C** $x + 4$
- **D** $x - 4$

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2 Which one simplifies to $x + 3$?

- **A** $\frac{(x^2 + 6x + 9)}{(x + 3)}$
- **B** $\frac{(x^2 - 6x + 9)}{(x - 3)}$
- **C** $\frac{(x^2 + 6x - 9)}{(x + 3)}$

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3 Cancel the shared factors in $\frac{(4x^2)}{(2x)}$.

- **A** 2x
- **B** $2x^2$
- **C** 2
- **D** 8x

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4 For $\frac{(x^2 - 36)}{(x + 6)}$, which value of x is not allowed?

- **A** -6
- **B** 6
- **C** 0
- **D** 36

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5 Simplify $\frac{(3x + 6)}{3}$.

- **A** x + 2
- **B** 3x + 2
- **C** x + 6
- **D** x + 3

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6 Write $\frac{(x^2 - 5x + 6)}{(x - 2)}$ in simplest form.

- **A** x - 3
- **B** x - 2
- **C** x + 3
- **D** x + 2

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7 Simplify $\frac{2x}{x^2}$.

A $\frac{2}{x}$

B 2x

C 2

D $\frac{x}{2}$

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8 Simplify $\frac{(x+2)}{(x+2)}$.

A 1

B x + 2

C 0

D 2

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9 Simplify $\frac{(2x^2 - 8)}{(2x + 4)}$.

- **A** x - 2
- **B** x + 2
- **C** 2x - 4
- **D** x - 4

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10 Write $\frac{(x^2 + 8x + 16)}{(x + 4)}$ in simplest form.

- **A** x + 4
- **B** x - 4
- **C** x + 16
- **D** x + 8

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ANSWER KEY

1. $x + 2$

2. $\dfrac{(x^2 + 6x + 9)}{(x + 3)}$

3. $2x$

4. -6

5. $x + 2$

6. $x - 3$

7. $\dfrac{2}{x}$

8. 1

9. $x - 2$

10. $x + 4$

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