Simplifying Rational Expressions - Quick Guide

Use the same process every time: Restrict -> Factor -> Cancel -> Rewrite -> Check

1 Find restrictions first

Set the ORIGINAL denominator equal to zero. Keep those values excluded even if a factor cancels.

2 Factor completely

Look for GCF, difference of squares, trinomials, grouping, and sign reversal such as 2 - x = -(x - 2).

3 Cancel common factors only

Cancel factors that multiply the whole numerator and denominator. Never cancel individual terms in a sum or difference.

4 Rewrite the simplified form

Write the remaining expression cleanly. Reduce numerical coefficients when possible.

5 Keep every original restriction

A cancelled factor creates a hole; it does not make the excluded x-value valid again.

Worked example

Simplify and keep restrictions:

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

Restrictions:	x != 3, -3
Factor:	(x - 2)(x - 3) / [(x - 3)(x + 3)]
Cancel:	the common factor (x - 3)
Final:	(x - 2)/(x + 3), with x != 3, -3

Common mistake: cancelling terms instead of factors

In (x + 3)/x, the x does not cancel because x + 3 is a sum, not a product containing x as a factor.

Factoring reminders

- GCF: $6x^2 + 9x = 3x(2x + 3)$
- Difference of squares: $a^2 - b^2 = (a - b)(a + b)$
- Trinomial: $x^2 + bx + c = (x + m)(x + n)$ when $m+n=b$ and $mn=c$
- Sign reversal: 2 - x = -(x - 2)

Simplifying Rational Expressions

Factor completely, cancel common factors, and keep all original restrictions.

Name: _____ Date: _____

Simplify each expression completely. State all excluded values.

Factor first. Cancel factors only — never terms across addition or subtraction.

Part A — GCF & Common Factors

1. $\frac{6x^2}{9x}$

Excluded values: _____

2. $\frac{x^2 + 5x}{x}$

Excluded values: _____

3. $\frac{2x^2 + 8x}{2x}$

Excluded values: _____

4. $\frac{3x^2 - 12x}{6x}$

Excluded values: _____

Part B — Difference of Squares & Repeated Factors

5. $\frac{x^2 - 9}{x + 3}$

Excluded values: _____

6. $\frac{x^2 - 16}{x^2 - 8x + 16}$

Excluded values: _____

7. $\frac{3x^2 - 12}{x^2 + x - 6}$

Excluded values: _____

8. $\frac{x^3 - 9x}{x^2 - 6x + 9}$

Excluded values: _____

9. $\frac{2x^2 - 18}{x^2 + 6x + 9}$

Excluded values: _____

Simplifying Rational Expressions

Factor completely, cancel common factors, and keep all original restrictions.

Worksheet — continued

Simplify each expression completely. State all excluded values.

Factor first. Cancel factors only — never terms across addition or subtraction.

Part C — Trinomial & Non-Monic Factoring

10. $\dfrac{x^2 - 4}{x^2 + x - 6}$

Excluded values: _____

11. $\dfrac{x^2 - 5x + 6}{x^2 - 9}$

Excluded values: _____

12. $\dfrac{x^2 + 7x + 12}{x^2 + 5x + 4}$

Excluded values: _____

13. $\dfrac{2x^2 + x - 3}{2x^2 - 5x + 3}$

Excluded values: _____

14. $\dfrac{4x^2 - 25}{2x^2 + 7x + 5}$

Excluded values: _____

Part D — Grouping & Sign Reversal

15. $\dfrac{x^3 - 4x}{x^2 - x - 6}$

Excluded values: _____

16. $\dfrac{x^2 - 4}{2 - x}$

Excluded values: _____

17. $\dfrac{x^3 + 2x^2 - 9x - 18}{x^2 + 5x + 6}$

Excluded values: _____

18. $\dfrac{x^3 - 4x^2 - x + 4}{x^2 - 1}$

Excluded values: _____

Simplifying Rational Expressions — Answers

Factored form, simplified form, and restrictions from the original denominator.

Answer Key

A cancelled denominator factor still creates an excluded value.

Part A — GCF & Common Factors

1. $\frac{6x^2}{9x}$

Factor: (3x)(2x) / [(3x)(3)]

Simplified: 2x/3

x ≠ 0

2. $\frac{x^2 + 5x}{x}$

Factor: x(x + 5) / x

Simplified: x + 5

x ≠ 0

3. $\frac{2x^2 + 8x}{2x}$

Factor: 2x(x + 4) / 2x

Simplified: x + 4

x ≠ 0

4. $\frac{3x^2 - 12x}{6x}$

Factor: 3x(x - 4) / 6x

Simplified: (x - 4)/2

x ≠ 0

Part B — Difference of Squares & Repeated Factors

5. $\frac{x^2 - 9}{x + 3}$

Factor: (x - 3)(x + 3) / (x + 3)

Simplified: x - 3

x ≠ -3

6. $\frac{x^2 - 16}{x^2 - 8x + 16}$

Factor: (x - 4)(x + 4) / (x - 4)²

Simplified: (x + 4)/(x - 4)

x ≠ 4

7. $\frac{3x^2 - 12}{x^2 + x - 6}$

Factor: 3(x - 2)(x + 2) / [(x - 2)(x + 3)]

Simplified: 3(x + 2)/(x + 3)

x ≠ 2, -3

8. $\frac{x^3 - 9x}{x^2 - 6x + 9}$

Factor: x(x - 3)(x + 3) / (x - 3)²

Simplified: x(x + 3)/(x - 3)

x ≠ 3

9. $\frac{2x^2 - 18}{x^2 + 6x + 9}$

Factor: 2(x - 3)(x + 3) / (x + 3)²

Simplified: 2(x - 3)/(x + 3)

x ≠ -3

Simplifying Rational Expressions — Answers

Factored form, simplified form, and restrictions from the original denominator.

Answer Key

A cancelled denominator factor still creates an excluded value.

Part C — Trinomial & Non-Monic Factoring

10. $\dfrac{x^2 - 4}{x^2 + x - 6}$

Factor: (x - 2)(x + 2) / [(x - 2)(x + 3)]

Simplified: (x + 2)/(x + 3)

x ≠ 2, -3

11. $\dfrac{x^2 - 5x + 6}{x^2 - 9}$

Factor: (x - 2)(x - 3) / [(x - 3)(x + 3)]

Simplified: (x - 2)/(x + 3)

x ≠ 3, -3

12. $\dfrac{x^2 + 7x + 12}{x^2 + 5x + 4}$

Factor: (x + 3)(x + 4) / [(x + 1)(x + 4)]

Simplified: (x + 3)/(x + 1)

x ≠ -4, -1

13. $\dfrac{2x^2 + x - 3}{2x^2 - 5x + 3}$

Factor: (2x + 3)(x - 1) / [(2x - 3)(x - 1)]

Simplified: (2x + 3)/(2x - 3)

x ≠ 1, 3/2

14. $\dfrac{4x^2 - 25}{2x^2 + 7x + 5}$

Factor: (2x - 5)(2x + 5) / [(2x + 5)(x + 1)]

Simplified: (2x - 5)/(x + 1)

x ≠ -5/2, -1

Part D — Grouping & Sign Reversal

15. $\dfrac{x^3 - 4x}{x^2 - x - 6}$

Factor: x(x - 2)(x + 2) / [(x - 3)(x + 2)]

Simplified: x(x - 2)/(x - 3)

x ≠ -2, 3

16. $\dfrac{x^2 - 4}{2 - x}$

Factor: (x - 2)(x + 2) / [-(x - 2)]

Simplified: -(x + 2)

x ≠ 2

17. $\dfrac{x^3 + 2x^2 - 9x - 18}{x^2 + 5x + 6}$

Factor: (x + 2)(x - 3)(x + 3) / [(x + 2)(x + 3)]

Simplified: x - 3

x ≠ -2, -3

18. $\dfrac{x^3 - 4x^2 - x + 4}{x^2 - 1}$

Factor: (x - 4)(x - 1)(x + 1) / [(x - 1)(x + 1)]

Simplified: x - 4

x ≠ -1, 1