

KEY CONCEPT

For Your Notebook

Multiplying Rational Expressions

The rule for multiplying rational expressions is the same as the rule for multiplying numerical fractions: multiply numerators, multiply denominators, and write the new fraction in simplified form.

Let a , b , c , and d be expressions with $b \neq 0$ and $d \neq 0$.

Property $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$ Simplify $\frac{ac}{bd}$ if possible.

Example $\frac{5x^2}{2xy^2} \cdot \frac{6xy^3}{10y} = \frac{30x^3y^3}{20xy^3} = \frac{10 \cdot 3 \cdot x \cdot x^2 \cdot y^3}{10 \cdot 2 \cdot x \cdot y^3} = \frac{3x^2}{2}$

Multiply.

7. $\frac{8x^3y}{2xy^2} \cdot \frac{7x^4y^3}{4y} = 7x^6y$

8. $\frac{3x-3x^2}{x^2+4x-5} \cdot \frac{x^2+x-20}{3x}$
 $= \frac{3x(1-x)}{(x+5)(x-1)} \cdot \frac{(x+5)(x-4)}{3x}$
 $= -1(x-4) = \boxed{4-x}$

9. $\frac{3x^5y^2}{8xy} \cdot \frac{6xy^2}{9x^3y}$

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

11. $\frac{x+2}{x^3-27} \cdot \frac{(x^2+3x+9)}{1}$

12. $\frac{(x+5)}{x^3-1} \cdot \frac{(x^2+x+1)}{1}$

$= \frac{x+2}{(x-3)(x^2+3x+9)} \cdot (x^2+3x+9)$
 $= \frac{x+2}{x-3}$

$= \frac{x+5}{(x-1)(x^2+x+1)} \cdot (x^2+x+1)$
 $= \frac{x+5}{x-1}$

Objective: Multiply and divide rational expressions.

KEY CONCEPT**Simplifying Rational Expressions**Let a , b , and c be expressions with $b \neq 0$ and $c \neq 0$. Then the following property applies.

Property	$\frac{ac}{bc} = \frac{a}{b}$	Divide out the common factor c .
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Examples	$\frac{15}{65} = \frac{3 \cdot \cancel{5}}{13 \cdot \cancel{5}} = \frac{3}{13}$	Divide out the common factor 5.
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	$\frac{4(x+3)}{(x-5)(x+3)} = \frac{4}{x-5}$	Divide out the common factor $x+3$.
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Simplify.

$$1. \quad \frac{2(x+1)}{(x+1)(x+3)} = \frac{2}{x+3}$$

$$2. \quad \frac{x+4}{x^2-16} = \frac{\cancel{x+4}}{(\cancel{x+4})(x-4)} = \frac{1}{x-4}$$

$$3. \quad \frac{40x+20}{10x+30} = \frac{\cancel{10}(4x+2)}{\cancel{10}(x+3)} = \frac{4x+2}{x+3}$$

$$4. \quad \frac{x^2-2x-15}{x^2-9} = \frac{(\cancel{x+3})(x-5)}{(\cancel{x+3})(x-3)} = \frac{x-5}{x-3}$$

$$5. \quad \frac{x^2-2x-3}{x^2-x-6}$$

$$6. \quad \frac{2x^2+10x}{3x^2+16x+5}$$

$$\frac{3}{4} \div \frac{8}{9} = \frac{3}{4} \cdot \frac{9}{8}$$

KEY CONCEPT

Dividing Rational Expressions

To divide one rational expression by another, multiply the first rational expression by the reciprocal of the second rational expression.

Let a , b , c , and d be expressions with $b \neq 0$, $c \neq 0$ and $d \neq 0$.

Property $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c} = \frac{ad}{bc}$ Simplify $\frac{ad}{bc}$ if possible.

Examples $\frac{2}{5} \div \frac{7}{3} = \frac{2}{5} \cdot \frac{3}{7} = \frac{6}{35}$

$$\frac{7}{x+1} \div \frac{x+2}{2x-3} = \frac{7}{x+1} \cdot \frac{2x-3}{x+2} = \frac{7(2x-3)}{(x+1)(x+2)}$$

Divide.

13. $\frac{7x}{2x-10} \div \frac{x^2-6x}{x^2-11x+30}$

$$\begin{aligned} &= \frac{7x}{2x-10} \cdot \frac{x^2-11x+30}{x^2-6x} \\ &= \frac{7x}{2(x-5)} \cdot \frac{(x-5)(x-6)}{x(x-6)} \\ &= \frac{7}{2} \end{aligned}$$

14. $\frac{4x}{5x-20} \div \frac{x^2-2x}{x^2-6x+8}$

$$\begin{aligned} &= \frac{4x}{5x-20} \cdot \frac{x^2-6x+8}{x^2-2x} \\ &= \frac{4x}{5(x-4)} \cdot \frac{(x-4)(x-2)}{x(x-2)} \\ &= \frac{4}{5} \end{aligned}$$

15. $\frac{6x^2+x-15}{4x^2} \div \frac{(3x^2+5x)}{1}$

$$\begin{aligned} &= \frac{6x^2+x-15}{4x^2} \cdot \frac{1}{3x^2+5x} \\ &= \frac{(3x+5)(2x-3)}{4x^2} \cdot \frac{1}{x(3x+5)} \\ &= \frac{2x-3}{4x^3} \end{aligned}$$

16. $\frac{2x^2+3x-5}{6x} \div \frac{(2x^2+5x)}{1}$

$$\begin{aligned} &= \frac{(2x+5)(x-1)}{6x} \cdot \frac{1}{x(2x+5)} \\ &= \frac{x-1}{6x^2} \end{aligned}$$