

Skill Builder: Multiplying & Dividing Rational Expressions

Recall: The procedure for **multiplying numeric fractions**

- **Check** all the numerators and all the denominators for common factors
- **Divide** out ALL common factors (“**Cancel out**” common factors)
- Multiply **numerator by numerator** and **denominator by denominator**.

Example:

$$\frac{10}{27} \times \frac{36}{35} = \frac{(2)(\cancel{5})}{(3)(\cancel{9})} \times \frac{(\cancel{4})(9)}{(\cancel{5})(7)}$$

$$= \frac{(2)(4)}{(3)(7)}$$

$$= \frac{8}{21}$$

$$\frac{5}{5} = 1$$

We can multiply rational expressions in a similar manner.

- **Factor** the numerator and the denominator of both rational expressions
- **Divide out** any factors common to the numerator and denominator (“**Cancel out**” all common factors)
- **Multiply** numerator by numerator and denominator by denominator.
 - You do NOT need to expand your final expressions. Leave final answers in factored form.

When asked for the **restrictions**, you must determine the **zeros of ALL** **ORIGINAL denominators.**

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Ex 1) Multiply. State any restrictions on the variables.

a) $\frac{9x^2}{4xy} \times \frac{12xy^2}{3x}$

$$= \frac{\cancel{108} x^3 y^2}{\cancel{12} x^2 y}$$

$$= 9xy$$

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$$b) \frac{2x^2 + 5x + 2}{4x^2 - 8x - 5} \times \frac{2x^2 - 11x + 15}{3x^2 + 7x + 2}$$

$$= \frac{(2x+1)(x+2)}{(2x+1)(2x-5)} \times \frac{(2x-5)(x-3)}{(3x+1)(x+2)}$$

$$= \frac{x-3}{3x+1} ; x \neq -\frac{1}{2}, \frac{5}{2}, -\frac{1}{3}, -2$$

Recall: The procedure for **dividing numeric fractions**

- Take the **reciprocal of the divisor** (the 2nd fraction, the one you are “dividing by”) and **change the “÷” to a “×”**.
- Proceed with the same steps as **multiplying**

Example:

$$\begin{aligned} \frac{8}{15} \div \frac{20}{9} &= \frac{8}{15} \times \frac{9}{20} \\ &= \frac{(2)(4)}{(3)(5)} \times \frac{(3)(3)}{(4)(5)} \\ &= \frac{(2)(3)}{(5)(5)} \\ &= \frac{6}{25} \end{aligned}$$

We can divide rational expressions in a similar manner.

- Take the **reciprocal of the divisor** (the 2nd rational expression) and change the “÷” to a “×”.
- **Factor** the numerator and the denominator of both rational expressions
- **Divide out** any factors common to the numerator and denominator (“**Cancel out**” all common factors)
- **Multiply** numerator by numerator and denominator by denominator.
 - You do NOT need to expand your final expressions. Leave final answers in factored form.

When asked for the **restrictions**, you must determine the **zeros of ALL ORIGINAL denominators**, and the **ORIGINAL numerator of the divisor**.

The **order of operations** still applies for rational expressions: Multiplication and division are done from **LEFT to RIGHT**.

Ex 2) Divide. State any restrictions on the variables.

$$\begin{aligned}
 & \frac{x^2 + 3x + 2}{x^4 - 4x^2} \div \frac{x^2 - x - 2}{5x^3 - 9x^2 - 2x} \quad \curvearrowright \\
 &= \frac{x^2 + 3x + 2}{x^4 - 4x^2} \times \frac{5x^3 - 9x^2 - 2x}{x^2 - x - 2} \\
 &= \frac{(x+2)(x+1)}{x^2(x-2)(x+2)} \times \frac{x(5x+1)(x-2)}{(x-2)(x+1)} \\
 &= \frac{5x+1}{x(x-2)}; x \neq 0, 2, -1, -\frac{1}{5}
 \end{aligned}$$

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Ex 3) Simplify. State any restrictions on the variables.

$$\begin{aligned}
 & \frac{3x^2 + 10x - 8}{5x^2 - 18x - 8} \div \frac{x^2 - 16}{2x^2 + 7x + 3} \times \frac{5x^2 + 17x + 6}{6x^2 - x - 2} \quad \curvearrowright \\
 &= \frac{(3x-2)(x+4)}{(5x+2)(x-4)} \times \frac{(2x+1)(x+3)}{(x+4)(x-4)} \times \frac{(5x+2)(x+3)}{(3x-2)(2x+1)} \\
 &= \frac{(x+3)^2}{(x-4)^2}; x \neq -\frac{2}{5}, 4, -4, -\frac{1}{2}, -3, \frac{2}{3}
 \end{aligned}$$

HW:

1. p. 122 #4-8, 11, 12a, (Try 13)
2. study for quiz tomorrow (day 2/3/4/5)