Steps to Multiply or Divide Rational Expressions

1. Write original problem.

2. Prep each fraction (See *Steps to Simplify a Rational Expression*), but do not cancel factors.

$$\frac{x^2 - 4}{(x + 3)} \div \frac{(x + 7)}{x^2 + x - 12} = \frac{(x + 2)(x - 2)}{(x + 3)} \div \frac{(x + 7)}{(x + 4)(x - 3)}$$

3. If problem is a division problem, notice the factors in the denominator of the divisor. Put these in the area for possible **Restrictions?** For example:

$$= \frac{(x + 2)(x - 2)}{(x + 3)} \div \frac{(x + 7)}{(x + 4)(x - 3)}, \text{ notice}(x + 4) \text{ and}(x + 3).$$

Put these in the **Restrictions?**

> **Restrictions?**
> $(x + 4), (x - 3)$

4. If problem is a division problem, the problem becomes a multiplication problem with the divisor being replaced by its reciprocal. For example:

$$= \frac{(x + 2)(x - 2)}{(x + 3)} \cdot \frac{(x + 4)(x + 3)}{(x + 7)}$$

5. Make one fraction containing the factors of all of the fractions. We are multiplying fractions and watch the signs in front of fractions. For example:

$$\frac{(x + 2)(x - 2)(x + 4)(x + 3)}{(x + 3)(x + 7)}$$

6. Follow the procedure to cancel and write restrictions from, Steps *to Simplify a Rational Expression*.:

7. Other restrictions will probably exist in division problems. The factors noted on above on Step 3, will have to be set equal to zero if copies of the factors do not remain in final denominator.

Examples follow:

Example 1: $\dfrac{x^2 - 2x - 24}{x + 3} \bullet \dfrac{x^2 - 9}{x^2 - 16}$ and write restricted domain.

Notes:	Problem
Write original problem and factor all fractions.	$\dfrac{x^2 - 2x - 24}{x + 3} \bullet \dfrac{x^2 - 9}{x^2 - 16} = \dfrac{(x + 4)(x - 6)}{(x + 3)} \bullet \dfrac{(x + 3)(x - 3)}{(x + 4)(x - 4)}$ **Restrictions?**
Put all factors in one fraction. Cancel like factors.	$= \dfrac{(x + 4)(x - 6)(x + 3)(x - 3)}{(x + 3)(x + 4)(x - 4)}$ $\qquad (x + 4), (x - 3)$
Copy canceled factors into **Restrictions?** Area.	$= \dfrac{(x - 6)(x - 3)}{(x - 4)}; x \neq -4, x \neq -3$
Write remaining factors. The factors, $(x + 3)$ and $(x + 4)$ are no longer in problem so this has to be noted.	Factors cannot be zero. Find these values. $\begin{aligned} x + 4 &\neq 0 & x + 3 &\neq 0 \\ x + 4 - 4 &\neq 0 - 4 & x + 3 - 3 &\neq 0 - 3 \\ x &\neq -4 & x &\neq -3 \end{aligned}$

Example 2: $\dfrac{x^2 - 2x - 15}{x + 3} \div \dfrac{x^2 - 9}{x^2 - 25}$ and write restricted domain.

Notes:	Problem
Factor all fractions. Note the factors in denominator of divisor, $(x+5)(x-5)$ and put these in area of **Restrictions?** Change problem from division to multiplication. Put all factors in on fraction. Cancel like factors. The canceled factor is added to the area for **Restrictions?** Write remaining factors. Find and write restrictions. A factor of $(x+3)$ was canceled, but there is another copy in the final denominator, thus there is no restriction for the factor. The factors $(x+5)$ and $(x-5)$ do not remain in problem so specific restrictions on x are noted.	$\dfrac{x^2 - 2x - 15}{x + 3} \div \dfrac{x^2 - 9}{x^2 - 25} = \dfrac{(x+3)(x-5)}{(x+3)} \div \dfrac{(x+3)(x-3)}{(x+5)(x-5)}$ **Restrictions?** $(x + 5)$ $(x - 5)$ $(x + 3)$ $= \dfrac{(x+3)(x-5)}{(x+3)} \cdot \dfrac{(x+5)(x-5)}{(x+3)(x-3)}$ $= \dfrac{(x+3)(x-5)(x+5)(x-5)}{(x+3)(x+3)(x-3)}$ $= \dfrac{(x-5)(x+5)(x-5)}{(x+3)(x-3)}; \; x \neq -5, \, x \neq 5$ $\begin{array}{ll} x + 5 \neq 0 & x - 5 \neq 0 \\ x + 5 - 5 \neq 0 - 5 & x - 5 + 5 \neq 0 + 5 \\ x \neq -5 & x \neq 5 \end{array}$