EXAMPLE 2 Multiply rational expressions involving polynomials

Find the product $\dfrac{3x^2 + 3x}{4x^2 - 24x + 36} \cdot \dfrac{x^2 - 4x + 3}{x^2 - x}$.

$$\frac{3x^2 + 3x}{4x^2 - 24x + 36} \cdot \frac{x^2 - 4x + 3}{x^2 - x}$$

$$= \frac{(3x^2 + 3x)(x^2 - 4x + 3)}{(4x^2 - 24x + 36)(x^2 - x)}$$ Multiply numerators and denominators.

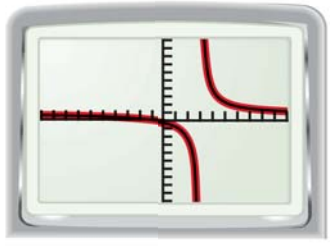
$$= \frac{3x(x + 1)(x - 3)(x - 1)}{4x(x - 3)(x - 3)(x - 1)}$$ Factor and divide out common factors.

$$= \frac{3(x + 1)}{4(x - 3)}$$ Simplify.

CHECK Check your simplification using a graphing calculator.

Graph $y_1 = \dfrac{3x^2 + 3x}{4x^2 - 24x + 36} \cdot \dfrac{x^2 - 4x + 3}{x^2 - x}$ and $y_2 = \dfrac{3(x + 1)}{4(x - 3)}$.

The graphs coincide. So, the expressions are equivalent for all values of x other than the excluded values (0, 1, and 3).



MULTIPLYING BY A POLYNOMIAL When you multiply a rational expression by a polynomial, first write the polynomial as a fraction with a denominator of 1.

EXAMPLE 3 Multiply a rational expression by a polynomial

Find the product $\dfrac{5x}{x^2 + 5x + 6} \cdot (x + 3)$.

$$\frac{5x}{x^2 + 5x + 6} \cdot (x + 3)$$

$$= \frac{5x}{x^2 + 5x + 6} \cdot \frac{x + 3}{1}$$ Rewrite polynomial as a fraction.

$$= \frac{5x(x + 3)}{x^2 + 5x + 6}$$ Multiply numerators and denominators.

$$= \frac{5x(x + 3)}{(x + 2)(x + 3)}$$ Factor and divide out common factor.

$$= \frac{5x}{x + 2}$$ Simplify.

GUIDED PRACTICE for Examples 2 and 3

Find the product.

3. $\dfrac{x^2 + x - 2}{x^2 + 2x} \cdot \dfrac{2x^2 + 2x}{5x^2 - 15x + 10}$

4. $\dfrac{2w^2}{w^2 - 7w + 12} \cdot (w - 4)$