

## 2.2

## Multiplying and Dividing Rational Expressions



Many problems require finding products and quotients of rational expressions.

**Essential Understanding** You can multiply and divide rational expressions using the same properties you use to multiply and divide numerical fractions.

If  $a$ ,  $b$ ,  $c$ , and  $d$  represent polynomials (where  $b \neq 0$  and  $d \neq 0$ ), then  $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$ .



### Problem 1 Multiplying Rational Expressions

**Got It?** What is the product? State any excluded values.

a.  $\frac{5}{y} \cdot \frac{3}{y^3}$

b.  $\frac{x}{x-2} \cdot \frac{x+1}{x-3}$



**Practice** Multiply. State any excluded values.

1.  $\frac{5}{3a^2} \cdot \frac{8}{a^3}$

2.  $\frac{m-2}{m+2} \cdot \frac{m}{m-1}$



### Problem 2 Using Factoring

**Got It?** a. What is the product  $\frac{3x^2}{x+2} \cdot \frac{x^2+3x+2}{x}$ ?



**Practice** Multiply.

3.  $\frac{t^2-t-12}{t+1} \cdot \frac{t+1}{t+3}$

4.  $\frac{4x+1}{5x+10} \cdot \frac{30x+60}{2x-2}$

You can also multiply a rational expression by a polynomial. Leave the product in factored form.



### Problem 3 Multiplying a Rational Expression by a Polynomial

**Got It?** What is the product?

a.  $\frac{2x-14}{4x-6} \cdot (6x^2 - 13x + 6)$

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



**Practice** Multiply.

5.  $\frac{h-1}{6h+3} \cdot (2h^2 + 9h + 4)$

6.  $(w^2 - 8w + 15) \cdot \frac{w+3}{4w-20}$

Recall that  $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$ , where  $b \neq 0$ ,  $c \neq 0$ , and  $d \neq 0$ . When you divide rational expressions, first rewrite the quotient as a product, using the reciprocal, before dividing out common factors.



### Problem 4 Dividing Rational Expressions

**Got It?** What is the quotient?

a.  $\frac{x}{x+y} \div \frac{xy}{x+y}$

b.  $\frac{4k+8}{6k-10} \div \frac{k^2+6k+8}{9k-15}$

**A Practice** Divide.

7.  $\frac{x-1}{x+4} \div \frac{x+3}{x+4}$

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

The reciprocal of a polynomial such as  $x^2 + 3x + 2$  is  $\frac{1}{x^2 + 3x + 2}$ .



**Problem 5** Dividing a Rational Expression by a Polynomial

**Got It?** What is the quotient  $\frac{z^2-2z+1}{z^2+2} \div (z-1)$ ?

**A Practice** Divide.

9.  $\frac{11k+121}{7k-15} \div (k+11)$

10.  $\frac{x^2+10x-11}{x^2+12x+11} \div (x-1)$

A **complex fraction** is a fraction that contains one or more fractions in its numerator, in its denominator, or in both. You can simplify a complex fraction by dividing its numerator by its denominator.

Any complex fraction of the form  $\frac{\frac{a}{b}}{\frac{c}{d}}$  (where  $b \neq 0$ ,  $c \neq 0$ , and  $d \neq 0$ ) can be expressed as  $\frac{a}{b} \div \frac{c}{d}$ .



## Problem 6 Simplifying a Complex Fraction

**Got It?** What is the simplified form of  $\frac{\frac{1}{q+4}}{\frac{2q^2}{2q+8}}$ ?

**A Practice** Simplify each complex fraction.

11.  $\frac{\frac{g+2}{3g-1}}{\frac{g^2+2g}{6g+2}}$

12.  $\frac{\frac{c+4}{c^2+5c+6}}{\frac{3c^2+12c}{2c^2+5c-3}}$