

## 8.4 Multiply and Divide Rational Expressions

### Multiply Rational Expressions

Simplify the following:

$$\frac{3}{5} \cdot \frac{15}{2} = \frac{45}{10} = \frac{\cancel{3} \cdot 9}{\cancel{5} \cdot 2} = \boxed{\frac{9}{2}}$$

$$\frac{3 \cdot \cancel{3}}{\cancel{5} \cdot 2} = \boxed{\frac{9}{2}}$$

$$\frac{(x)(x-3)}{(3x-9)(2)} = \frac{(x)(x-3)}{3(x-3)(2)} = \frac{(x)(\cancel{x-3})}{3(\cancel{x-3})(2)} = \boxed{\frac{x}{6}}$$

**EXAMPLE 3**

What is a simplified form of  $\frac{8x^3y}{2xy^2} \cdot \frac{7x^4y^3}{4y}$ ?

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

$$\frac{56x^7y^4}{8xy^3}$$

$$\boxed{7x^6y}$$

$$\frac{\cancel{8}x^{\cancel{3}}y^{\cancel{1}} \cdot \cancel{7}x^{\cancel{4}}y^{\cancel{3}}}{\cancel{2}xy^{\cancel{2}} \cdot \cancel{4}y^{\cancel{1}}}$$

$$\boxed{7x^6y}$$

**EXAMPLE 4** Multiply rational expressions

Multiply:  $\frac{(3x - 3x^2)(x^2 + x - 20)}{(x^2 + 4x - 5)(3x)}$

$$\frac{(3x - 3x^2)(x^2 + x - 20)}{(x^2 + 4x - 5)(3x)}$$

$$\frac{\cancel{3x}(-1)(x-1)(x+5)(x-4)}{\cancel{(x+5)}\cancel{(x-1)}\cancel{3x}(x-4)}$$

$$-(x-4)$$

**EXAMPLE 5** Multiply a rational expression by a polynomial

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

$$(x)^3 - (3)^3$$

$$\frac{(x+2)(x^2+3x+9)}{(x^3-27)}$$

$$(x^3-27)(x^2+3x+9)$$

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

$$\boxed{\frac{x+2}{x-3}}$$

### Dividing Rational Expressions

Simplify the following:

$$\frac{3}{5} \div \frac{15}{2} = \frac{\cancel{3}}{5} \cdot \frac{2}{\cancel{15}_5} = \boxed{\frac{2}{25}}$$

$$\frac{x}{2x+1} \div \frac{x-3}{2x+1} = \frac{\cancel{(x)} \cancel{(2x+1)}}{\cancel{(2x+1)} \cancel{(x-3)}} = \boxed{\frac{x}{x-3}}$$

**EXAMPLE 6** Divide rational expressions

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

$$\frac{(7x)(x^2-11x+30)}{(2x-10)(x^2-6x)}$$

$$\frac{\cancel{(7x)}(\cancel{x-6})(\cancel{x-5})}{2(\cancel{x-5})(\cancel{x})(\cancel{x-6})}$$

$$\boxed{\frac{7}{2}}$$

**EXAMPLE 7** Divide a rational expression by a polynomial

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

AC = -90  
 10 - 9  
 $6x^2 + 10x - 9x - 15$   
 $2x(3x + 5) - 3(3x + 5)$   
 $(3x + 5)(2x - 3)$

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

$$\frac{\cancel{(3x + 5)}(2x - 3)}{(4x^2)(x)\cancel{(3x + 5)}}$$

$2x - 3$
$4x^3$

**MULTIPLYING** Multiply the expressions. Simplify the result.

$$26. \frac{x(x-3)}{x-2} \cdot \frac{(x+3)(x-2)}{x}$$

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

$$\boxed{(x-3)(x+3)}$$

$$32. \frac{x^2+5x-36}{x^2-49} \cdot \frac{(x^2-11x+28)}{1}$$

$$\frac{(x^2+5x-36)(x^2-11x+28)}{(x^2-49)}$$

$$\frac{(x+9)(x-4)\cancel{(x-7)}(x-4)}{(x+7)\cancel{(x-7)}}$$

$$\boxed{\frac{(x+9)(x-4)^2}{(x+7)}}$$

or

$$\frac{(x+9)(x-4)(x-4)}{(x+7)}$$



**DIVIDING** Divide the expressions. Simplify the result.

$$34. \frac{5x^2y^3}{x^7} \div \frac{30xy^4}{y^3}$$

Handwritten solution for problem 34:

The original expression is  $\frac{5x^2y^3}{x^7} \div \frac{30xy^4}{y^3}$ . The student has crossed out the 5 and 30, and the 2 and 4. The 3 in the numerator and the 3 in the denominator are circled. The 7 in the denominator is circled. The final result is shown in a box as  $\frac{y^2}{6x^6}$ .

$$40. \frac{3x^2 + 13x + 4}{x^2 - 4} \div \frac{4x + 16}{x + 2}$$

$$\frac{(3x^2 + 13x + 4)(x + 2)}{(x^2 - 4)(4x + 16)}$$

$$\frac{(x+4)(3x+1)(x+2)}{(x+2)(x-2)(4)(x+4)}$$

$$\frac{3x+1}{4(x-2)}$$