### Warm Up

**Lesson Presentation** 

Lesson Quiz

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### Warm Up Simplify each expression. Assume all variables are nonzero.

**1.**  $x^5 \bullet x^2 \quad x^7$  **2.**  $y^3 \bullet y^3 \quad y^6$  **3.**  $\frac{x^6}{x^2} \quad x^4$ **4.**  $\frac{y^2}{y^5} \quad \frac{1}{y^3}$ 

### Factor each expression.

- **5.**  $x^2 2x 8$  (x 4)(x + 2)
- 6.  $x^2 5x$  x(x 5)
- 7.  $x^5 9x^3$   $x^3(x-3)(x+3)$



Simplify rational expressions.

Multiply and divide rational expressions.

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rational expression

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A <u>rational expression</u> is a quotient of two polynomials. Other examples of rational expressions include the following:

$$\frac{x^2 - 4}{x + 2} \qquad \frac{10}{x^2 - 6} \qquad \frac{x + 3}{x - 7}$$

Because rational expressions are ratios of polynomials, you can simplify them the same way as you simplify fractions. Recall that to write a fraction in simplest form, you can divide out common factors in the numerator and denominator.

$$\frac{9}{24} = \frac{3 \cdot \cancel{3}}{8 \cdot \cancel{3}} = \frac{3}{8}$$

### **Caution!**

When identifying values for which a rational expression is undefined, identify the values of the variable that make the original denominator equal to 0.

### **Example 1A: Simplifying Rational Expressions**

# Simplify. Identify any *x*-values for which the expression is undefined.

$$\frac{10x^8}{6x^4}$$

$$\frac{510x^{8-4}}{36} = \frac{5}{3}x^4$$
Quotient of Powers Property

The expression is undefined at x = 0 because this value of x makes  $6x^4$  equal 0.

### **Example 1B: Simplifying Rational Expressions**

# Simplify. Identify any *x*-values for which the expression is undefined.

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

$$\frac{(x+2)(x-1)}{(x-1)(x+3)} = \frac{(x+2)}{(x+3)}$$
Factor; then divide out common factors.

The expression is undefined at x = 1 and x = -3 because these values of x make the factors (x - 1) and (x + 3) equal 0.



### You Try! Example 1A

# Simplify. Identify any *x*-values for which the expression is undefined.

$$\frac{16x^{11}}{8x^2}$$

$$\frac{{}^28x^{11-2}}{{}_18} = 2x^9$$
Quotient of Powers Property

The expression is undefined at x = 0 because this value of x makes  $8x^2$  equal 0.



### You Try! Example 1B

Simplify. Identify any *x*-values for which the expression is undefined.

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

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

The expression is undefined at x = 1 and  $x = -because \frac{4}{3}$ these values of *x* make the factors (x - 1) and (3x + 4)equal 0.

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### Example 1C

Simplify. Identify any *x*-values for which the expression is undefined.

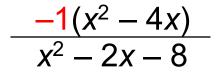
$$6x^2 + 7x + 2$$
  
 $6x^2 - 5x - 6$ 

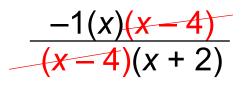
$$\frac{(2x+1)(3x+2)}{(3x+2)(2x-3)} = \frac{(2x+1)}{(2x-3)}$$
Factor; then divide out common factors.

The expression is undefined at  $x = and 2x = because \frac{3}{2}$ these values of x make the factors (3x + 2) and  $(2x - 3)^2$ equal 0.

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**Example 2: Simplifying by Factoring by –1** Simplify  $4x - x^2$ . Identify any x values for which  $x^2 - 2x - 8$ the expression is undefined.





Factor out -1 in the numerator so that  $x^2$  is positive, and reorder the terms.

Factor the numerator and denominator. Divide out common factors.

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

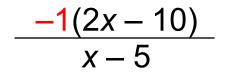
Simplify.

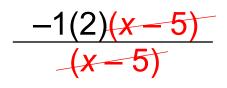
The expression is undefined at x = -2 and x = 4.

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### You Try! Example 2A

# Simplify 10 - 2x Identify any x values for which x = 5 the expression is undefined.





<u>-2</u> 1 Factor out –1 in the numerator so that x is positive, and reorder the terms.

Factor the numerator and denominator. Divide out common factors.

Simplify.

### The expression is undefined at x = 5.

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You can multiply rational expressions the same way that you multiply fractions.

Multiplying Rational Expressions

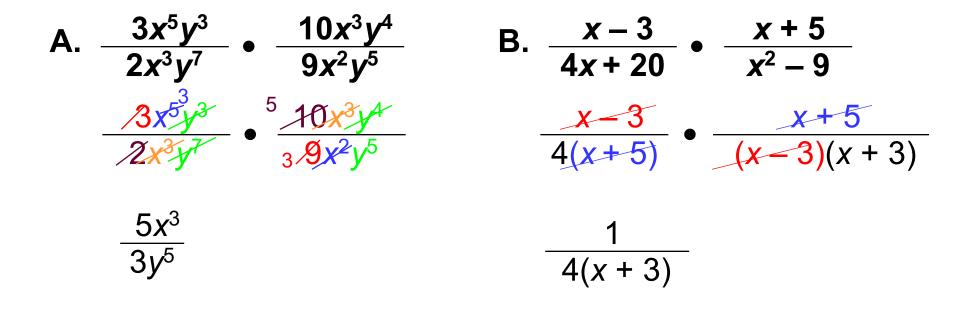
1. Factor all numerators and denominators completely.

Divide out common factors of the numerators and denominators.

3. Multiply numerators. Then multiply denominators.

4. Be sure the numerator and denominator have no common factors other than 1.

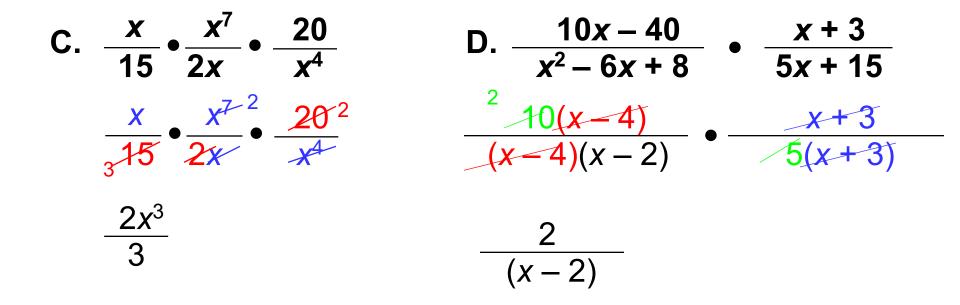
### **Example 3: Multiplying Rational Expressions** Multiply. Assume that all expressions are defined.



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### You Try! Example 3

Multiply. Assume that all expressions are defined.

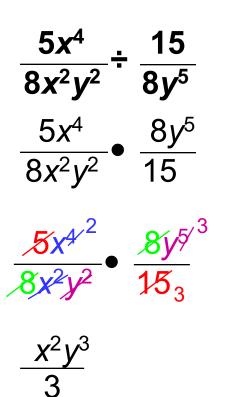


You can also divide rational expressions. Recall that to divide by a fraction, you multiply by its reciprocal.

$$\frac{1}{2} \div \frac{3}{4} = \frac{1}{2} \bullet \frac{4^2}{3} = \frac{2}{3}$$

### **Example 4A: Dividing Rational Expressions**

Divide. Assume that all expressions are defined.

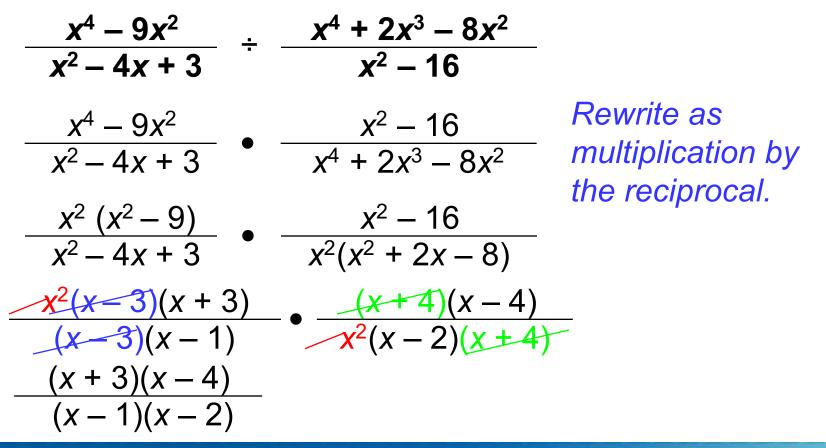


Rewrite as multiplication by the reciprocal.

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### **Example 4B: Dividing Rational Expressions**

Divide. Assume that all expressions are defined.



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### You Try! Example 4A

Divide. Assume that all expressions are defined.

$$\frac{x^2}{4} \div \frac{x^4y}{12y^2}$$

$$\frac{x^2}{4} \cdot \frac{12y^2}{x^4y}$$

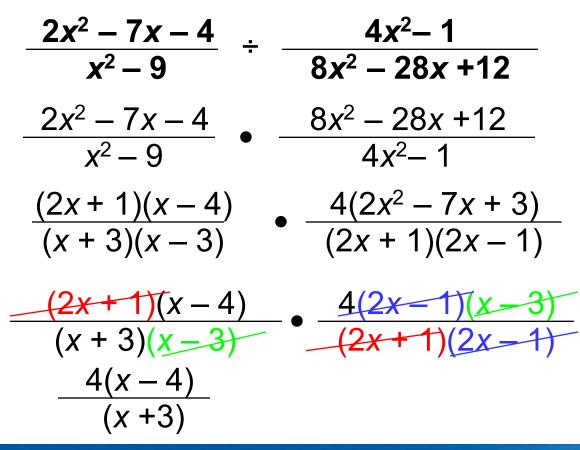
$$\frac{x^2}{x^4y} \cdot \frac{x^4y}{x^4y}$$

Rewrite as multiplication by the reciprocal.

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### You Try! Example 4B

Divide. Assume that all expressions are defined.



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### **Note Card Check: Part I**

Simplify. Identify any *x*-values for which the expression is undefined.

1. 
$$\frac{x^2 - 6x + 5}{x^2 - 3x - 10}$$
  $\frac{x - 1}{x + 2}$   $x \neq -2, 5$   
2.  $\frac{6x - x^2}{x^2 - 7x + 6}$   $\frac{-x}{x - 1}$   $x \neq 1, 6$ 

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### **Note Card Check: Part II**

Multiply or divide. Assume that all expressions are defined.

3. 
$$\frac{x+1}{3x+6} \cdot \frac{6x+12}{x^2-1}$$
  $\frac{2}{x-1}$   
4.  $\frac{x^2+4x+3}{x^2-4} \div \frac{x^2+2x-3}{x^2-6x+8}$   $\frac{(x+1)(x-4)}{(x+2)(x-1)}$ 

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# Homework TEXTBOOK : pg. 190-191

## #3-7 ODD, 8-14 ALL 19 & 21, 28-31 ALL

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