

Objective: Add and subtract rational expressions.

### KEY CONCEPT

#### Adding or Subtracting with Like Denominators

To add (or subtract) rational expressions with *like* denominators, simply add (or subtract) their numerators. Then place the result over the common denominator.

Let  $a$ ,  $b$ , and  $c$  be expressions with  $c \neq 0$ .

	<b>Addition</b>	
Properties	$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$	

	<b>Subtraction</b>
	$\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}$

Examples	$\frac{3x}{5x^2} + \frac{7}{5x^2} = \frac{3x+7}{5x^2}$
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	$\frac{9x^3}{x+1} - \frac{x^2}{x+1} = \frac{9x^3-x^2}{x+1}$
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Perform the indicated operation.

1.  $\frac{7}{4x} + \frac{3}{4x} = \frac{10}{4x} = \frac{5}{2x}$

2.  $\frac{2x}{x+6} - \frac{5}{x+6} = \frac{2x-5}{x+6}$

3.  $\frac{7}{12x} - \frac{5}{12x} = \frac{2}{12x} = \frac{1}{6x}$

4.  $\frac{4x}{x-2} - \frac{x}{x-2} = \frac{3x}{x-2}$

### KEY CONCEPT

#### Adding or Subtracting with Unlike Denominators

To add (or subtract) two rational expressions with *unlike* denominators, find a common denominator. Rewrite each rational expression using the common denominator. Then add (or subtract).

Let  $a$ ,  $b$ ,  $c$ , and  $d$  be expressions with  $c \neq 0$  and  $d \neq 0$ .

<b>Addition</b>	
$\frac{a}{c} + \frac{b}{d} = \frac{ad}{cd} + \frac{bc}{cd} = \frac{ad+bc}{cd}$	

<b>Subtraction</b>
$\frac{a}{c} - \frac{b}{d} = \frac{ad}{cd} - \frac{bc}{cd} = \frac{ad-bc}{cd}$

You can always find a common denominator of two rational expressions by multiplying their denominators, as shown above. However, if you use the least common denominator (LCD), which is the least common multiple (LCM) of the denominators, you may have less simplifying to do.

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Examples	$\frac{3x}{5x^2} + \frac{7}{5x^2} = \frac{3x+7}{5x^2}$	$\frac{9x^3}{x+1} - \frac{x^2}{x+1} = \frac{9x^3-x^2}{x+1}$

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$\frac{a}{c} + \frac{b}{d} = \frac{ad}{cd} + \frac{bc}{cd} = \frac{ad+bc}{cd}$	$\frac{a}{c} - \frac{b}{d} = \frac{ad}{cd} - \frac{bc}{cd} = \frac{ad-bc}{cd}$

You can always find a common denominator of two rational expressions by multiplying their denominators, as shown above. However, if you use the least common denominator (LCD), which is the least common multiple (LCM) of the denominators, you may have less simplifying to do.

## KEY CONCEPT

### Simplifying Complex Fractions

A complex fraction is a fraction that contains a fraction in its numerator or denominator. A complex fraction can be simplified using either of the methods below.

**Method 1:** If necessary, simplify the numerator and denominator by writing each as a single fraction. Then divide the numerator by the denominator.

**Method 2:** Multiply the numerator and the denominator by the least common denominator (LCD) of every fraction in the numerator and denominator. Then simplify.

Simplify the complex fraction.

11. 
$$\frac{\frac{5}{x+4}}{\frac{1}{x+4} + \frac{2}{x}} = \frac{5}{x+4} \div \left( \frac{1}{x+4} + \frac{2}{x} \right)$$

$$= \frac{5}{x+4} \div \left( \frac{x + 2(x+4)}{x(x+4)} \right)$$

$$= \frac{5}{x+4} \div \frac{3x+8}{x(x+4)}$$

$$= \frac{5}{x+4} \cdot \frac{x(x+4)}{3x+8} = \frac{5x}{3x+8}$$

LCD:  $x(x+4)$

12. 
$$\frac{\frac{x}{6} - \frac{x}{3}}{\frac{x}{5} - \frac{7}{10}} = \frac{x}{6} - \frac{x}{3} \div \frac{x}{5} - \frac{7}{10}$$

$$= \frac{x-2x}{6} \div \frac{2x-7}{10}$$

$$= \frac{-x}{3} \cdot \frac{10}{2x-7}$$

$$= \frac{-5x}{3(2x-7)}$$

13. 
$$\frac{\frac{2}{x} - 4}{\frac{2}{x} + 3} = \frac{2}{x} - \frac{4x}{x} \div \frac{2}{x} + \frac{3x}{x}$$

$$= \frac{2-4x}{x} \div \frac{2+3x}{x}$$

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

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

LCD:  $x$

14.

$$\frac{\frac{3}{x+5}}{\frac{2}{x-3} + \frac{1}{x+5}} = \frac{3}{x+5} \div \frac{2}{x-3} + \frac{1}{x+5}$$

$$= \frac{3}{x+5} \div \frac{2x+10+x-3}{(x-3)(x+5)}$$

$$= \frac{3}{x+5} \cdot \frac{(x-3)(x+5)}{3x+7}$$

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

LCD:  $(x-3)(x+5)$