PC11 Lesson 6.3

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6.3 Adding and Subtracting Rational Expressions

Warm Up *Common denominator to add/subtract fractions*

Add or Subtract the following:

a) $\frac{4}{5}+\frac{3}{5}$

$= \frac{7}{5}$

b) $\frac{3}{7}+\frac{3}{14}$

$= \frac{6}{14}+\frac{3}{14}$

$= \frac{9}{14}$

c) $\frac{1}{6}-\frac{2}{9}$ ($\times 3$, $\times 2$)

$= \frac{3}{18}-\frac{4}{18}$

$= -\frac{1}{18}$

d) $\frac{21}{8}-\frac{11}{3}$ ($\times 3$, $\times 8$)

$= \frac{63}{24}-\frac{88}{24} = -\frac{25}{24}$

Rational expressions are added and subtracted the same way that fractions are. You must have a **common denominator** in order to combine rational expressions. You can use any equivalent common denominator, but it is usually easier to use the **lowest common denominator (LCD)**.

Example 1: Simplify:

a. $\frac{4}{3x}-\frac{7x}{6}$

LCD : $6x$

NPV $x \neq 0$

$= \frac{4}{3x}\frac{\times 2}{\times 2} - \frac{7x}{6}\frac{\times x}{\times x}$

$= \frac{8}{6x} - \frac{7x^2}{6x}$

$= \frac{8-7x^2}{6x}$

d. $\frac{2a+1}{2a^2b}-\frac{b-3}{9ab^2}$

LCD: $18a^2b^2$

NPV

$a \neq 0$

$b \neq 0$

$= \frac{(2a+1)(9b)}{(2a^2b)(9b)} - \frac{(b-3)(2a)}{9ab^2(2a)}$

$= \frac{18ab+9b}{18a^2b^2} - \frac{2ab-6a}{18a^2b^2}$

$= \frac{18ab+9b-(2ab-6a)}{18a^2b^2}$

$= \frac{18ab+9b-2ab+6a}{18a^2b^2}$

$= \frac{16ab+9b+6a}{18a^2b^2}$

Example 2: Simplify:

a. $\frac{m-4}{m-2}-\frac{m-10}{m-2}$

LCD: $m-2$

NPV

$m \neq 2$

$$= \frac{m-4-(m-10)}{m-2}$$

$$= \frac{m-4-m+10}{m-2}$$

$$= \frac{6}{m-2}$$

b. $\frac{5}{x}+\frac{6x}{x+4}$

LCD: $x(x+4)$

NPV

$x \neq 0, -4$

$$= \frac{5(x+4)}{x(x+4)} + \frac{6x(x)}{(x+4)(x)}$$

$$= \frac{5x+20+6x^2}{x(x+4)}$$

d. $\frac{5}{x-1}-\frac{12}{x^2-1}$

LCD: x^2-1

NPV

$x \neq \pm 1$

$$= \frac{5(x+1)}{(x-1)(x+1)} - \frac{12}{x^2-1}$$

$$= \frac{5x+5-12}{x^2-1}$$

$$= \frac{5x-7}{x^2-1}$$

f. $\frac{x}{x^2-9x+18}-\frac{x-2}{x^2-10x+24}$

Factor 1st

$$= \frac{x}{(x-6)(x-3)} - \frac{x-2}{(x-6)(x-4)}$$

LCD: $(x-6)(x-4)(x-3)$

NPV $x \neq 6, 4, 3$

$$= \frac{x(x-4)}{(x-6)(x-3)(x-4)} - \frac{(x-2)(x-3)}{(x-6)(x-3)(x-4)}$$

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

$$= \frac{\cancel{x-6}}{\cancel{(x-6)}(x-3)(x-4)}$$

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

Sometimes we have a fraction within a fraction. Eg. $\frac{2+\frac{3}{4}}{5-\frac{1}{3}}$.

This is called a **complex fraction**. To simplify a complex fraction, we must multiply the numerator and denominator by the common denominator of the internal fractions.

Example 3: Simplify:

a. $\frac{\left(\frac{1}{2}+x\right)6}{\left(\frac{1}{3}-x\right)6}$

LCD: 6

NPV $x \neq \frac{1}{3}$

$= \frac{\frac{6}{2}+6x}{\frac{6}{3}-6x}$

$= \frac{3+6x}{2-6x}$

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

b. $\frac{\left(\frac{1}{x}+2\right)x}{\left(\frac{1}{x}-3\right)x}$

LCD: x

NPV $x \neq \frac{1}{3}$

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

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

c. $\frac{\left(2-\frac{4}{y}\right)y}{\left(y-\frac{4}{y}\right)y}$

LCD: y

$y \neq \pm 2$

$y-\frac{4}{y} \neq 0$

$y \neq \frac{4}{y}$

$y^2 \neq 4$

$= \frac{2y-4}{y^2-4} = \frac{2\cancel{(y-2)}}{(y+2)\cancel{(y-2)}} = \frac{2}{y+2}$