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6–5 *Adding and Subtracting Fractions*

Objective: To add and subtract algebraic fractions.

Rules for Fractions

Addition Rule for Fractions

$$\frac{a}{c} + \frac{b}{c} = \frac{a + b}{c} \qquad \text{For example, } \frac{3}{5} + \frac{1}{5} = \frac{3 + 1}{5} = \frac{4}{5}$$

Subtraction Rule for Fractions

$$\frac{a}{c} - \frac{b}{c} = \frac{a - b}{c} \qquad \text{For example, } \frac{5}{9} - \frac{1}{9} = \frac{5 - 1}{9} = \frac{4}{9}$$

Example 1 Simplify: **a.** $\frac{5x}{12} + \frac{x}{12}$ **b.** $\frac{8x + 10}{9} - \frac{2x + 1}{9}$

Solution To add or subtract fractions with the same denominator, you add or subtract their numerators and write the result over the common denominator. Then simplify.

a. $\frac{5x}{12} + \frac{x}{12} = \frac{5x + x}{12}$

$= \frac{6x}{12}$

$= \frac{\cancel{6} \cdot x}{\cancel{6} \cdot 2}$

$= \frac{x}{2}$

b. $\frac{8x + 10}{9} - \frac{2x + 1}{9} = \frac{8x + 10 - (2x + 1)}{9}$

$= \frac{8x + 10 - 2x - 1}{9}$

$= \frac{6x + 9}{9}$

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

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

Simplify.

1. $\frac{x}{15} + \frac{4x}{15}$ **2.** $\frac{7x}{12} - \frac{5x}{12}$ **3.** $\frac{3}{x} - \frac{5}{x}$ **4.** $\frac{3}{5x} + \frac{4}{5x}$

5. $\frac{3x}{4} - \frac{x - 1}{4}$ **6.** $\frac{2a}{9} - \frac{4a + 5}{9}$ **7.** $\frac{y - 2}{3} - \frac{3y - 5}{3}$ **8.** $\frac{x + 5}{2} - \frac{7x + 1}{2}$

Example 2 Simplify: **a.** $\frac{2}{x + 3} + \frac{1}{x + 3}$ **b.** $\frac{3}{x - 2} + \frac{5}{2 - x}$

Solution **a.** $\frac{2}{x + 3} + \frac{1}{x + 3} = \frac{2 + 1}{x + 3}$ Add the numerators.

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

b. $\frac{3}{x - 2} + \frac{5}{2 - x} = \frac{3}{x - 2} + \frac{5}{-(x - 2)}$

$= \frac{3}{x - 2} - \frac{5}{x - 2}$ Since $2 - x = -(x - 2)$, the LCD is $x - 2$.

$= \frac{3 - 5}{x - 2}$ Subtract the numerators.

$= \frac{-2}{x - 2}$, or $-\frac{2}{x - 2}$

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6–5 *Adding and Subtracting Fractions* *(continued)*

Simplify.

9. $\frac{3}{x+4} + \frac{2}{x+4}$ **10.** $\frac{8}{y-4} - \frac{6}{y-4}$ **11.** $\frac{x}{x-1} + \frac{2}{x-1}$ **12.** $\frac{n}{n-3} - \frac{2n-1}{n-3}$

13. $\frac{4}{x-3} + \frac{2}{3-x}$ **14.** $\frac{7}{2x-3} - \frac{2}{3-2x}$ **15.** $\frac{3x}{x-y} + \frac{3y}{y-x}$ **16.** $\frac{4a}{a-b} + \frac{4b}{b-a}$

Example 3 Simplify: **a.** $\frac{5}{2m} - \frac{1}{6m^2}$ **b.** $\frac{a}{6} - \frac{4+3a}{10}$

Solution To add or subtract fractions with different denominators, first rewrite the fractions using their least common denominator.

a. $\frac{5}{2m} - \frac{1}{6m^2} = \frac{5 \cdot 3m}{2m \cdot 3m} - \frac{1}{6m^2}$

$= \frac{15m}{6m^2} - \frac{1}{6m^2}$

$= \frac{15m - 1}{6m^2}$

b. $\frac{a}{6} - \frac{4+3a}{10} = \frac{a \cdot 5}{6 \cdot 5} - \frac{(4+3a) \cdot 3}{10 \cdot 3}$

$= \frac{5a - 3(4+3a)}{30}$

$= \frac{5a - 12 - 9a}{30}$

$= \frac{-4a - 12}{30}$

$= \frac{-4(a+3)}{30}$

$= \frac{-2(a+3)}{15}$, or $-\frac{2(a+3)}{15}$

Simplify.

17. $\frac{3}{n^2} + \frac{2}{n}$ **18.** $\frac{6}{x^2y} - \frac{4}{xy}$ **19.** $\frac{5}{2x} - \frac{1}{4x^2}$ **20.** $\frac{1}{3x^2} + \frac{5}{6x}$

21. $\frac{1+4x}{6} + \frac{1-x}{8}$ **22.** $\frac{4b+1}{8} + \frac{2b-3}{10}$ **23.** $\frac{a-6}{6} - \frac{5-a}{15}$

24. $\frac{1+3x}{2} - \frac{6x-1}{6}$ **25.** $\frac{5}{3(x+1)} - \frac{x}{(x+1)}$ **26.** $\frac{3x}{x-2} - \frac{1}{2(x-2)}$

27. $\frac{3}{4(x+1)} + \frac{x}{x+1}$ **28.** $\frac{2x}{x-1} + \frac{3}{2(x-1)}$ **29.** $\frac{4n-3}{15} - \frac{3(n-2)}{10}$

30. $\frac{3(a-6)}{10} - \frac{4(a+6)}{6}$ **31.** $\frac{3x+4}{4} - \frac{4x}{5} + \frac{x-2}{10}$ **32.** $\frac{3n}{4} + \frac{n+2}{3} - \frac{1-n}{6}$

Mixed Review Exercises

Simplify.

1. $-4^2 \cdot 3$ **2.** $(3 \cdot 5 - 10)^2$ **3.** $(-3x^2)^3$

4. $3y(y-4) + 2y(y+9)$ **5.** $-\frac{1}{5}(-30x + 20y)$ **6.** $(4x^2y)(3x^3y^2)(5y^2)$

7. $\left(\frac{6x^2y^2}{7}\right)\left(\frac{-14xy^2}{3}\right)$ **8.** $n^2(n+6) - (2n^2 - 4)n$ **9.** $(3 - 2 \cdot 10)^2$