

MCR3U: Functions

Adding and Subtracting Rational Expressions (Monomial Denominators)

J. Garvin



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Adding and Subtracting Rational Numbers

Recap

Evaluate $\frac{3}{8} + \frac{7}{12}$.

$$\begin{aligned}\frac{3}{8} + \frac{7}{12} &= \frac{3 \times 3}{8 \times 3} + \frac{7 \times 2}{12 \times 2} \\ &= \frac{9}{24} + \frac{14}{24} \\ &= \frac{23}{24}\end{aligned}$$

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Adding and Subtracting Rational Expressions

Like rational numbers, rational expressions can be added or subtracted using the same rules.

It is necessary to find a common denominator before adding or subtracting.

By finding the *lowest common denominator* (LCM), the expressions may be easier to work with.

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Adding Rational Expressions

Example

Simplify $\frac{3}{4x} + \frac{7}{6x}$.

$$\begin{aligned}\frac{3}{4x} + \frac{7}{6x} &= \frac{3 \times 3}{(4 \times 3)x} + \frac{7 \times 2}{(6 \times 2)x} \\ &= \frac{9}{12x} + \frac{14}{12x} \\ &= \frac{23}{12x}, x \neq 0\end{aligned}$$

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Adding Rational Expressions

Your Turn

Simplify $\frac{5}{14m} + \frac{4}{21n}$.

$$\begin{aligned}\frac{5}{14m} + \frac{4}{21n} &= \frac{(5 \times 3)n}{(14 \times 3)mn} + \frac{(4 \times 2)m}{(21 \times 2)mn} \\ &= \frac{15n}{42mn} + \frac{8m}{42mn} \\ &= \frac{15n + 8m}{42mn}, m \neq 0, n \neq 0\end{aligned}$$

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Adding Rational Expressions

Example

Simplify $\frac{5}{2x} + \frac{4}{y} + \frac{2}{3xy}$.

$$\begin{aligned}\frac{5}{2x} + \frac{4}{y} + \frac{2}{3xy} &= \frac{(3 \times 5)y}{(3 \times 2)xy} + \frac{(6 \times 4)x}{6xy} + \frac{2 \times 2}{(2 \times 3)xy} \\ &= \frac{15y}{6xy} + \frac{24x}{6xy} + \frac{4}{6xy} \\ &= \frac{15y + 24x + 4}{6xy}, x \neq 0, y \neq 0\end{aligned}$$

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Subtracting Rational Expressions

Example

Simplify $\frac{3a+1}{4b} - \frac{2b-3}{2a}$.

$$\begin{aligned}\frac{3a+1}{4b} - \frac{2b-3}{2a} &= \frac{a(3a+1)}{4ab} - \frac{2b(2b-3)}{2b(2a)} \\ &= \frac{3a^2+a}{4ab} - \frac{4b^2-6b}{4ab} \\ &= \frac{3a^2+a-4b^2+6b}{4ab}, a \neq 0, b \neq 0\end{aligned}$$

Watch out for sign changes!

Subtracting Rational Expressions

Example

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

$$\begin{aligned}4 - \frac{3}{2x} &= \frac{4}{1} - \frac{3}{2x} \\ &= \frac{(4 \times 2)x}{2x} - \frac{3}{2x} \\ &= \frac{8x}{2x} - \frac{3}{2x} \\ &= \frac{8x-3}{2x}, x \neq 0\end{aligned}$$

Subtracting Rational Expressions

Example

Simplify $\frac{3p-1}{6q} - \frac{2p+4}{9q}$.

$$\begin{aligned}\frac{3p-1}{6q} - \frac{2p+4}{9q} &= \frac{3(3p-1)}{3(6q)} - \frac{2(2p+4)}{2(9q)} \\ &= \frac{9p-3}{18q} - \frac{4p+8}{18q} \\ &= \frac{9p-3-4p-8}{18q} \\ &= \frac{5p-11}{18q}, q \neq 0\end{aligned}$$

Always try to simplify!

Subtracting Rational Expressions

Your Turn

Simplify $\frac{3n+m}{10m} - \frac{2n-7m}{15n} + 5$.

$$\begin{aligned}\frac{3n+m}{10m} - \frac{2n-7m}{15n} + 5 &= \frac{3n+m}{10m} - \frac{2n-7m}{15n} + \frac{5}{1} \\ &= \frac{3n(3n+m)}{30mn} - \frac{2m(2n-7m)}{30mn} + \frac{30mn(5)}{30mn} \\ &= \frac{9n^2+3mn}{30mn} - \frac{4mn-14m^2}{30mn} + \frac{150mn}{30mn} \\ &= \frac{9n^2+3mn-4mn+14m^2+150mn}{30mn} \\ &= \frac{9n^2+14m^2+149mn}{30mn}, m \neq 0, n \neq 0\end{aligned}$$

Questions?

