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Algebra Lecture 18

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Last Time

- Adding and Subtracting Rational Expressions
- Solving Rational Equations

Topics

Topics for Today

- Complex Fractions

Simplifying Complex Fractions

What is a Complex Fraction?

Complex Fraction

A **complex fraction** is a fraction of the form

$$\frac{\frac{p}{q}}{\frac{y}{z}},$$

where either the numerator or denominator is itself a fraction.

Simplify the following Complex Fraction

$$\frac{1 + \frac{4}{49}}{1 - \frac{2}{7}}$$

Simplify the following Complex Fraction

$$\frac{1 + \frac{4}{49}}{1 - \frac{2}{7}}$$
$$= \frac{\frac{49}{49} + \frac{4}{49}}{1 - \frac{2}{7}}$$

$$= \frac{\frac{49 + 4}{49}}{1 - \frac{2}{7}}$$

$$= \frac{49 + 4}{49} \\ 1 - \frac{2}{7}$$

$$= \frac{49 + 4}{49} \\ 1 - \frac{2}{7}$$

$$= \frac{53}{49} \frac{2}{1 - \frac{2}{7}}$$

$$= \frac{53}{49} \cdot \frac{2}{1 - \frac{2}{7}}$$

$$= \frac{53}{49} \cdot \frac{2}{\frac{7}{7} - \frac{2}{7}}$$

$$= \frac{\frac{53}{49}}{\frac{7}{7} - \frac{2}{7}}$$

$$= \frac{\frac{53}{49}}{\frac{7}{7} - \frac{2}{7}}$$

$$= \frac{\frac{53}{49}}{\frac{7-2}{7}}$$

$$= \frac{53}{\frac{49}{57}}$$

$$= \frac{53}{\frac{49}{5 \cdot 7}}$$

$$= \frac{53}{49} \times \frac{7}{5}$$

$$= \frac{53}{\frac{49}{5 \cdot 7}}$$

$$= \frac{53}{49} \times \frac{7}{5}$$

$$= \frac{53 \times 7}{49 \times 5}$$

$$= \frac{53}{\frac{49}{5 \cdot 7}}$$

$$= \frac{53}{49} \times \frac{7}{5}$$

$$= \frac{53 \times 7}{49 \times 5} = \boxed{\frac{53}{35}}$$

Simplify the following Complex Fraction

$$\frac{\frac{\heartsuit}{\diamond^2}}{\frac{\heartsuit^2}{\diamond}}$$

Simplify the following Complex Fraction

$$\frac{\frac{\heartsuit}{\diamond^2}}{\frac{\heartsuit^2}{\diamond}} = \frac{\heartsuit}{\diamond^2} \times \frac{\diamond}{\heartsuit^2}$$

Simplify the following Complex Fraction

$$\frac{\frac{\heartsuit}{\diamond^2}}{\heartsuit^2 \diamond}$$

$$= \frac{\heartsuit}{\diamond^2} \times \frac{\diamond}{\heartsuit^2}$$

$$= \frac{\heartsuit \diamond}{\diamond^2 \heartsuit^2}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit^2 \heartsuit^2}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit^2 \heartsuit^2}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit \spadesuit \heartsuit \heartsuit}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit^2 \heartsuit^2}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit \spadesuit \heartsuit \heartsuit}$$

$$= \frac{\cancel{\heartsuit} \cancel{\spadesuit}}{\cancel{\spadesuit} \spadesuit \cancel{\heartsuit} \heartsuit}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit^2 \heartsuit^2}$$

$$= \frac{\heartsuit \spadesuit}{\spadesuit \spadesuit \heartsuit \heartsuit}$$

$$= \frac{\cancel{\heartsuit} \cancel{\spadesuit}}{\cancel{\spadesuit} \spadesuit \heartsuit \heartsuit}$$

$$= \boxed{\frac{1}{\spadesuit \heartsuit}}$$

Simplify the following Complex Fraction

$$\frac{\frac{\clubsuit + 2}{5}}{\frac{\clubsuit - 9}{\clubsuit}}$$

Simplify the following Complex Fraction

$$\frac{\frac{\clubsuit + 2}{5}}{\frac{\clubsuit - 9}{\clubsuit}}$$

$$= \frac{\clubsuit + 2}{5} \times \frac{\clubsuit}{\clubsuit - 9}$$

Simplify the following Complex Fraction

$$\frac{\frac{\clubsuit + 2}{5}}{\frac{\clubsuit - 9}{\clubsuit}}$$

$$= \frac{\clubsuit + 2}{5} \times \frac{\spadesuit}{\spadesuit - 9}$$

$$= \frac{(\spadesuit + 2)\spadesuit}{5(\spadesuit - 9)}$$

Simplify the following Complex Fraction

$$\frac{\frac{1}{\spadesuit - 6}}{\frac{6}{\spadesuit^2 - 36}}$$

Simplify the following Complex Fraction

$$\frac{\frac{\frac{1}{\spadesuit - 6}}{6}}{\spadesuit^2 - 36}$$
$$= \frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 36}{6}$$

Simplify the following Complex Fraction

$$\frac{\frac{1}{\spadesuit - 6}}{6}$$
$$\frac{\spadesuit^2 - 36}{\spadesuit^2 - 36}$$

$$= \frac{1}{\spadesuit - 6} \times \frac{\heartsuit^2 - 36}{6}$$

$$= \frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 6^2}{6}$$

$$\frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 6^2}{6}$$

$$\frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 6^2}{6}$$
$$= \frac{1}{\spadesuit - 6} \times \frac{(\spadesuit - 6)(\spadesuit + 6)}{6}$$

$$\begin{aligned} & \frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 6^2}{6} \\ = & \frac{1}{\spadesuit - 6} \times \frac{(\spadesuit - 6)(\spadesuit + 6)}{6} \\ = & \frac{(\spadesuit - 6)(\spadesuit + 6)}{(\spadesuit - 6)6} \end{aligned}$$

$$\begin{aligned} & \frac{1}{\spadesuit - 6} \times \frac{\spadesuit^2 - 6^2}{6} \\ = & \frac{1}{\spadesuit - 6} \times \frac{(\heartsuit - 6)(\heartsuit + 6)}{6} \\ = & \frac{(\spadesuit - 6)(\spadesuit + 6)}{(\spadesuit - 6)6} \\ = & \frac{\cancel{(\heartsuit - 6)}(\spadesuit + 6)}{\cancel{(\heartsuit - 6)}6} = \boxed{\frac{(\heartsuit + 6)}{6}} \end{aligned}$$

Simplify the following Complex Fraction

$$\frac{\frac{1}{x} + \frac{8}{x^2}}{\frac{3}{x} - \frac{4}{x^2}}$$

Simplify the following Complex Fraction

$$\frac{\frac{1}{\heartsuit} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit}{\heartsuit} \times \frac{1}{\heartsuit} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit}{\heartsuit} \frac{1}{\heartsuit} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit 1}{\heartsuit \heartsuit} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit}{\heartsuit^2} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit}{\heartsuit} \frac{1}{\heartsuit} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit}{\heartsuit^2} + \frac{8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}} = \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$\frac{\text{♥} + 8}{\text{♥}^2} = \frac{3}{\text{♥}} - \frac{4}{\text{♥}^2}$$

$$\frac{\heartsuit + 8}{\heartsuit^2} = \frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}$$

$$= \frac{\heartsuit + 8}{\heartsuit^2} = \frac{\heartsuit}{\heartsuit} \times \frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}$$

$$= \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{\heartsuit}{\heartsuit} \times \frac{3}{\heartsuit} - \frac{4}{\heartsuit^2}} = \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{3\heartsuit}{\heartsuit^2} - \frac{4}{\heartsuit^2}}$$

$$\frac{\heartsuit + 8}{\heartsuit^2}$$
$$= \frac{3\heartsuit}{\heartsuit^2} - \frac{4}{\heartsuit^2}$$

$$= \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{3\heartsuit}{\heartsuit^2} - \frac{4}{\heartsuit^2}}$$

$$= \frac{\frac{\heartsuit + 8}{\heartsuit^2}}{\frac{3\heartsuit - 4}{\heartsuit^2}}$$

$$\begin{aligned} & \frac{\heartsuit + 8}{\heartsuit^2} \\ = & \frac{3\heartsuit}{\heartsuit^2} - \frac{4}{\heartsuit^2} \end{aligned}$$

$$\begin{aligned} = & \frac{\heartsuit + 8}{\heartsuit^2} = \frac{\heartsuit + 8}{\heartsuit^2} \times \frac{\heartsuit^2}{3\heartsuit - 4} \\ = & \frac{3\heartsuit - 4}{\heartsuit^2} \end{aligned}$$

$$= \frac{\heartsuit + 8}{\heartsuit^2} \times \frac{\heartsuit^2}{3\heartsuit - 4}$$

$$= \frac{\heartsuit + 8}{\heartsuit^2} \times \frac{\heartsuit^2}{3\heartsuit - 4}$$

$$= \frac{(\heartsuit + 8)\heartsuit^2}{\heartsuit^2(3\heartsuit - 4)}$$

$$= \frac{\heartsuit + 8}{\heartsuit^2} \times \frac{\heartsuit^2}{3\heartsuit - 4}$$

$$= \frac{(\heartsuit + 8)\heartsuit^2}{\heartsuit^2(3\heartsuit - 4)}$$

$$= \frac{(\heartsuit + 8)\cancel{\heartsuit^2}}{\cancel{\heartsuit^2}(3\heartsuit - 4)}$$

$$= \frac{\heartsuit + 8}{\heartsuit^2} \times \frac{\heartsuit^2}{3\heartsuit - 4}$$

$$= \frac{(\heartsuit + 8)\heartsuit^2}{\heartsuit^2(3\heartsuit - 4)}$$

$$= \frac{(\heartsuit + 8)\cancel{\heartsuit^2}}{\cancel{\heartsuit^2}(3\heartsuit - 4)} = \boxed{\frac{(\heartsuit + 8)}{(3\heartsuit - 4)}}$$

Topics Discussed Thus Far

- Polynomials
- Factoring Polynomials & Trinomials
- Special Cases of Factoring
- Polynomial Equations
- Rational Functions & Domains of Rational Functions
- Multiplying, Dividing, Adding, & Subtracting Rational Expressions
- Rational Equations
- Complex Fractions

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