

M² = Math Mediator Lesson 45: Add & Subtract Rational Expressions

<p>Total Recall (Warm-up) (5 minutes approx.)</p>	<p>Total Recall: Exercises based on yesterday's lesson on Multiplying and Dividing Rational Expressions: Perform the following operations and simplify.</p> <p>1. $\frac{x^2 + 1}{x^2 - 1} \div \frac{1}{x - 1}$ Answer: $\frac{x^2 + 1}{x^2 - 1} \cdot \frac{x - 1}{1} = \frac{(x^2 + 1) \cdot (x - 1)}{(x + 1)(x - 1)} = \frac{(x^2 + 1)}{x + 1}$</p> <p>2. $\frac{y - b}{b^{-3}y} \div \frac{y - b}{by^3}$ Answer: $\frac{y - b}{b^{-3}y} \cdot \frac{by^3}{y - b} = b^4y^2$</p> <p>3. $\frac{4ax^2}{(3y)^3} \cdot \frac{3y^3}{(2ax)^2}$ Answer: $\frac{4ax^2}{27y^3} \cdot \frac{3y^3}{4a^2x^2} = \frac{1}{9a}$</p>
<p>Direct Instruction: (7 minutes approx.)</p> <p>CA Std 7.0</p>	<p>Adding Rational Expressions involves obtaining the lowest common denominator in some cases:</p> <p>Example: $\frac{1}{4} + \frac{1}{8} = \frac{1 \cdot 2}{4 \cdot 2} + \frac{1}{8} = \frac{3}{8}$ Example: $\frac{2}{xy^3} + \frac{3}{xy^3} = \frac{5}{xy^3}$</p> <p>Example: $\frac{x^2}{x + 2} + \frac{3x}{2(x + 2)} = \frac{x^2 \cdot 2}{(x + 2) \cdot 2} + \frac{3x}{2(x + 2)} = \frac{2x^2 + 3x}{2(x + 2)}$</p> <p>Example: Subtracting Rational Expressions is very similar to adding</p> <p>$\frac{1}{4} - \frac{1}{8} = \frac{1 \cdot 2}{4 \cdot 2} - \frac{1}{8} = \frac{2}{8} - \frac{1}{8} = \frac{1}{8}$</p> <p>Example: $\frac{2}{xy^3} - \frac{3}{xy^3} = \frac{-1}{xy^3}$</p> <p>Example: $\frac{x^2}{x + 2} - \frac{3x}{2(x + 2)} = \frac{x^2 \cdot 2}{(x + 2) \cdot 2} - \frac{3x}{2(x + 2)} = \frac{2x^2 - 3x}{2(x + 2)}$</p>
<p>Practice: (8 minutes approx.)</p>	<p>U-DO: Perform the following addition and subtraction:</p> <p>1. $\frac{2x}{4} + \frac{3x}{4} + \frac{2x}{4}$ Answer: $\frac{7x}{4}$</p> <p>2. $\frac{9a}{7b} - \frac{a}{7b} + \frac{3a}{7b}$ Answer: $\frac{11a}{7b}$</p> <p>3. $\frac{2k^2}{k^2 + 3k} - \frac{k^2 - 9}{k^2 + 3k}$ Answer: $\frac{k^2 + 9}{k^2 + 3k}$</p> <p>4. $\frac{x^2 + 16}{4 - x} + \frac{8x}{x - 4}$ Answer:</p>

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	$\frac{x^2 + 16}{4 - x} - \frac{8x}{4 - x} = \frac{x^2 - 8x + 16}{4 - x} = \frac{(x - 4)(x - 4)}{(4 - x)} = \frac{-(x - 4)(x - 4)}{(x - 4)} = 4 - x$
<p>Direct Instruction: (5 minutes approx.)</p>	<p>Tips for finding the Lowest Common Multiple (LCM) or the Lowest Common Denominator (LCD):</p> <p>Example: $\frac{x + 2}{x^2 - x} - \frac{6}{x^2 - 1}$ First Factor all terms and look for common factors:</p> $\frac{x + 2}{x(x - 1)} - \frac{6}{(x - 1)(x + 1)}$ <p>Next, multiply each expression by 1, in the form of the factor that completes the LCD over itself. In this case the lowest common denominator is $x(x + 1)(x - 1)$: Remember to put parenthesis around the expression in the numerator, otherwise it may be tempting to just multiply by one term.</p> $\frac{(x + 2) \cdot (x + 1)}{x(x - 1) \cdot (x + 1)} - \frac{6 \cdot x}{(x - 1)(x + 1) \cdot x} = \frac{\{(x + 2)(x + 1)\} - 6x}{x(x + 1)(x - 1)}$ <p>Finally, multiply the binomials together, because there will be an 'x' term that can be combined with the -6x.</p> $\frac{x^2 + 3x + 2 - 6x}{x(x + 1)(x - 1)} = \frac{x^2 - 3x + 2}{x(x + 1)(x - 1)}$ <p>Then factor the quadratic in the numerator to see if there is any common term with one in the denominator.</p> $\frac{(x - 2)(x - 1)}{x(x + 1)(x - 1)} = \frac{x - 2}{x(x + 1)}$ <p>Which is the answer!</p>
<p>Practice (10 minutes approx.)</p>	<p>U-DO:</p> <p>1. $\frac{3y}{2y - 6} + \frac{9}{6 - 2y}$ Answer: $\frac{3y - 9}{2y - 6} = \frac{3(y - 3)}{2(y - 3)} = \frac{3}{2}$</p> <p>2. $\frac{3a - 2}{5a} + \frac{2a - 3}{4a}$ Answer: $\frac{4(3a - 2) + 5(2a - 3)}{20a} = \frac{22a - 23}{20a}$</p> <p>3. $\frac{1}{x^2 + 4x + 3} + \frac{1}{x^2 - 1}$ Answer:</p> $\frac{1}{(x + 3)(x + 1)} + \frac{1}{(x - 1)(x + 1)} = \frac{(x - 1)1 + (x + 3)1}{(x + 3)(x + 1)(x - 1)} = \frac{2x + 2}{(x + 3)(x + 1)(x - 1)}$ $= \frac{2(x + 1)}{(x + 3)(x + 1)(x - 1)} = \frac{2}{(x + 3)(x - 1)}$

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Direct Instruction (3 minutes approx.)	<p>Other tips when adding and multiplying rational expressions:</p> <p>Tip #1: 4 quarters = 1 dollar or $\frac{25}{100} + \frac{25}{100} + \frac{25}{100} + \frac{25}{100} = \frac{100}{100}$</p> <p>Fractions with 100 in denominator appear frequently in handling money and other common problems.</p> <p>Tip #2: When adding and subtracting, you need a Lowest common Denominator. When multiplying, you don't need a LCD. You just multiply the numerators and the denominators.</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; padding: 5px;">Addition</td> <td style="text-align: center; padding: 5px;">Multiplication</td> </tr> <tr> <td style="text-align: center; padding: 5px;">$\frac{25}{100} + \frac{4}{1} = \frac{25}{100} + \frac{400}{100} = \frac{425}{100}$</td> <td style="text-align: center; padding: 5px;">$\frac{25}{100} \cdot \frac{4}{1} = \frac{25 \cdot 4}{100 \cdot 1} = \frac{100}{100} = 1$</td> </tr> </table>	Addition	Multiplication	$\frac{25}{100} + \frac{4}{1} = \frac{25}{100} + \frac{400}{100} = \frac{425}{100}$	$\frac{25}{100} \cdot \frac{4}{1} = \frac{25 \cdot 4}{100 \cdot 1} = \frac{100}{100} = 1$
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Practice (5 minutes approx.)	<p>U-DO: Pick one from 1 & 2 and one from 3 & 4 to practice:</p> <p>1. $\frac{1}{4x^2} + \frac{x}{8x^2 - 16x}$ Answer:</p> $\frac{1}{4x^2} + \frac{x}{4x(2x-4)} = \frac{1(2x-4)}{4x^2(2x-4)} + \frac{x \cdot x}{4x \cdot x(2x-4)} = \frac{x^2 + 2x - 4}{4x^2(2x-4)}$ <p>2. $\frac{3}{5x} - \frac{1}{6}$ Answer: $\frac{3 \cdot 6}{5x \cdot 6} - \frac{1 \cdot 5x}{6 \cdot 5x} = \frac{18 - 5x}{30x}$</p> <p>3. $\frac{3x-12}{x-4} \cdot \frac{x+6}{2x-8}$ Answer: $\frac{3(x-4)}{x-4} \cdot \frac{x+6}{2x-8} = \frac{3x+18}{2x-8}$</p> <p>4. $\frac{2x^2}{x-4} \div \frac{x}{2(x-4)}$ Answer: $\frac{2x^2}{x-4} \cdot \frac{2(x-4)}{x} = 4x$</p>				
Direct Instruction (5 minutes approx.)	<p>Complex Fraction: When simplifying a complex fraction, which is a fraction with a fraction in the denominator, combine the denominator fraction(s) first and then treat it as a divide exercise.</p> <p>Example: $\frac{\frac{3}{x-4}}{\frac{1}{x-4} + \frac{4}{x}}$ is a complex fraction. First, combine the denominator fractions using a LCD. $\frac{\frac{3}{x-4}}{\frac{1x}{x(x-4)} + \frac{4(x-4)}{x(x-4)}}$ Then treat as a divide exercise, like we've already done. Maybe you can also do the quick invert and multiply in your head and proceed:</p> $\frac{3}{x-4} \cdot \frac{x(x-4)}{x+4x-16} = \frac{3x}{5x-16} \quad \text{Which is the answer!}$				

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Practice (5 minutes approx.)	<p>U-DO: Simply the following Complex Fractions:</p> <p>1. $\frac{\frac{3}{ax}}{\frac{6}{bx}}$ Answer: $\frac{3}{ax} \cdot \frac{bx}{6} = \frac{b}{2a}$</p> <p>2. $\frac{\frac{1}{d}}{\frac{1}{d}-1}$ Answer: $\frac{\frac{1}{d}}{\frac{1}{d}-\frac{d}{d}} = \frac{1}{d} \cdot \frac{d}{1-d} = \frac{1}{1-d}$</p>
Wrap-up (2 minutes approx.)	Wrap up closing comments and housekeeping.