

# M<sup>2</sup> = Math Mediator Lesson 42: Reducing Rational Expressions

<p>Total Recall (Warm-up) (5 minutes approx.)</p>	<p>Total Recall: Exercises based on yesterday's lesson on polynomial factoring: Factor the following polynomials:</p> <ol style="list-style-type: none"> <li>1. <math>6x^3 - 12x^2</math> Answer: <math>6x^2(x - 2)</math></li> <li>2. <math>x^2 - 25</math> Answer: <math>(x + 5)(x - 5)</math></li> <li>3. <math>4x^2 + 12x + 9</math> Answer: <math>(2x + 3)(2x + 3)</math></li> </ol>
<p>Direct Instruction: (5 minutes approx.)</p> <p><b>CA Std 7.0</b></p>	<p>Rational numbers can be expressed as a ratio, or division, of two integers. Examples are <math>5/1</math> is 5, <math>4/5</math> is 0.8, any integers of a, b where <math>a/b</math> is the ratio and <math>b \neq 0</math>.</p> <p>Rational expressions are the division of two polynomials. That is two polynomial expressions A, B where <math>A/B</math> and <math>B \neq 0</math>. Some examples are <math>-x/8</math>; <math>2/x</math>; <math>6/(x - 7)</math>; <math>(3x - 6)/(x^2 - 2x - 8)</math>.</p> <p>Just as some fractions can be simplified or reduced (<math>4/8 = 1/2</math>); so can some rational expressions. Examples are <math>3/6 = (1 \cdot 3)/(1 \cdot 2 \cdot 3) = 1/2</math>; (In this example, emphasize the 1 stays, because many students think that it goes to zero if the top number is factored out); <math>(4x)/(x^2 + 3x) = (4x)/(x(x + 3)) = 4/(x + 3)</math> (where <math>x \neq -3</math>).</p>
<p>Practice: (10 minutes approx.)</p>	<p>U-DO: Simplify or Reduce the following rational expressions:</p> <ol style="list-style-type: none"> <li>1. <math>(5y^2 - 5y)/(5y^2 - 15y + 10)</math>; Answer: <math>5y(y - 1)/(5(y - 2)(y - 1))</math>; which is reduced to <math>y/(y - 2)</math>. Explain that the y cannot be reduced because the y in the binomial cannot be factored out and still be simplifying the expression.</li> <li>2. <math>(3 - b)/(b - 3)</math> Answer: <math>-1(-3 + b)/(b - 3) = -1(b - 3)/(b - 3) = -1</math>; except for the value of <math>b = 3</math>, which makes the original equation undefined (divide by 0).</li> <li>3. <math>(12 - 6k)/(k^2 - 4)</math> Answer: <math>-6(k - 2)/((k + 2)(k - 2)) = -6/(k + 2)</math> without values of <math>k = \pm 2</math>, which make the original equation undefined.</li> </ol>
<p>Direct Instruction and Practice: (10 minutes approx.)</p>	<p>What values for the variables in these expressions make the expression undefined?</p> <ol style="list-style-type: none"> <li>1. <math>7/x</math> Answer: <math>x = 0</math></li> <li>2. <math>3/x^3</math> Answer: <math>x = 0</math></li> <li>3. <math>(y + 2)/(y^2 - 9)</math> Answer: <math>y = \pm 3</math></li> </ol> <p>Reduce the following (Simplify to lowest terms):</p> <ol style="list-style-type: none"> <li>4. <math>(8a^2b^2)/(4ab^{-6})</math> Answer: <math>2ab^8</math></li> <li>5. <math>(x - 9)^{-2}/(x^2 - 81)^{-1}</math> Answer: equals <math>(x^2 - 81)/(x - 9)^2 = ((x + 9)(x - 9))/((x - 9)(x - 9)) = (x + 9)/(x - 9)</math></li> <li>6. <math>(k^2 - 2k)/(k^2 - k - 2)</math> Answer: <math>(k(k - 2))/((k + 1)(k - 2)) =</math></li> </ol>

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	$k/(k + 1)$
Direct Instruction and Motivation (5 minutes approx.)	<p>Rational expressions such as the ones we have been simplifying are used in several careers. Here are three examples:</p> <p><b><u>Agriculture:</u></b> Farmers have soil samples done on their farm land so that they can predict moisture using an expression such as this:</p> <p><u>Polynomial describing how soil retains water</u> Polynomial predicting rainfall cycles</p> <p><b><u>Economics:</u></b> Breaking down the cost of a new television into yearly and then monthly costs:</p> <p><u>Initial cost + yearly electrical costs</u> Number of years (months)</p> <p><b><u>Medical:</u></b> Doctors and nurses use rational expressions for the concentration of drug in the bloodstream, to determine the dosage:</p> $C(t) = \frac{5t}{0.01t^2 + 3.3}$ <p>where C is micrograms of drug, t is minutes.</p>
Practice (10 minutes approx.)	<p>U-DO:</p> <p>1. The expression <math>x/(x - 5)</math> is equal to which of the following? a) <math>x/(5 - x)</math>    b) <math>-x/(x - 5)</math>    c) <math>-x/(5 - x)</math>    d) <math>x/(x + 5)</math>    Answer: c</p> <p>2. Which expression is defined for all rational numbers? a) <math>(x^2 + 5)/(x^2 + 4)</math>    b) <math>(x^2 + 3x)/(x^2 + 5x)</math>    c) <math>(x^2 - 5)/(x^2 - 4)</math> d) <math>(4x^2 - 1)/(4x - 1)</math>    Answer: a (no rational value of <math>x^2</math> can equal -4)</p> <p>3. The expression <math>(x - 3)/(x^2 - 9) = 1/(x + 3)</math> is true for which of the following domains?    a) all rational numbers;    b) all rational numbers except <math>x = 9</math>;    c) all rational numbers except for <math>x = 3</math>;    or d) all rational numbers except for <math>x = \pm 3</math>    Answer: d</p>
Calculator Exercise: (8 minutes approx.)	<p>Compare the graphs of the two following equivalent rational expressions on your calculator.</p> <p>a) <math>(x - 3)/(x^2 - 9)</math>    and    b) <math>1/(x + 3)</math></p> <p>Notice where the graph is undefined (the y values go off the screen). For the a) expression, the undefined values were supposed to be <math>\pm 3</math>, but the graph only shows the -3. Look at the TABLE and see the difference. For a) both +/- 3 shows ERROR.</p>
Wrap-up (2 minutes approx.)	Wrap up closing comments and housekeeping.