MAT 012 **Lecture Notes: ch 7.5 Rational Equations**

Cross multiplication is used if you have exactly ONE rational expression on the left side and ONE rational expression on the right side. (It can also be used if only one of the expressions is rational.) As soon as you see more than one term on one of the sides, cross multiplication is not appropriate.

Ex: $\dfrac{4}{x+3} \not= \dfrac{2}{x-2}$

a) Give the values of x for which the equation is not defined.

$x \neq -3$ or $x \neq 2$

b) Solve

$4(x-2) = 2(x+3)$

$4x - 8 = 2x + 6$

$-2x \quad -2x$

$2x - 8 = 6$

$+8 \quad +8$

$\dfrac{2x}{2} = \dfrac{14}{2}$

$x = 7$

compare

c) State the answer(s).

$x = 7$

Ex: $\dfrac{x}{x+6} \not= \dfrac{1}{x+2}$

a) Give the values of x for which the equation is not defined.

$x \neq -6$ or $x \neq -2$

b) Solve

$x(x+2) = 1(x+6)$

$x^2 + 2x = x + 6$

$-x - 6 \quad -x - 6$

$x^2 + x - 6 = 0$

$(x+3)(x-2) = 0$

$x + 3 = 0$ or $x - 2 = 0$

$-3 \quad -3$ $\qquad$ $+2 \quad +2$

$x = -3$ $\qquad$ $x = 2$

compare

c) State the answer(s).

$x = -3$ or $x = 2$

When solving rational equations, analyze the two sides as well as the denominators. If one of the given sides in the equation has more than one term (usually an addition or subtraction of several mostly rational terms) and the denominators are not alike, then we have to use an LCD (Least Common Denominator) to solve.

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Ex: $\frac{2}{x+3} - \frac{1}{x-3} = \frac{1}{x^2-9}$

a) Rewrite the entire equation, but factor the denominator, which needs to be factored.

$$\frac{2}{x+3} - \frac{1}{x-3} = \frac{1}{(x+3)(x-3)}$$

b) Give the values of x for which the equation is not defined.

$x \neq 3$ or $x \neq -3$

c) Give the LCD

$(x+3)(x-3)$

d) Solve the equation. [**Don't forget to check** if your solutions "candidates" are actual solutions]

$$\frac{2(x-3)}{(x+3)(x-3)} - \frac{1\cdot(x+3)}{(x-3)(x+3)} = \frac{1}{(x+3)(x-3)}$$

$$2(x-3) - (x+3) = 1$$

$$2x - 6 - x - 3 = 1$$

$$x - 9 = 1$$

$$+9 \quad +9$$

$$x = 10$$

e) State the answer(s).

$x = 10$

Ex: $\frac{x}{x+6} = \frac{72}{x^2-36} + 4$

a) Rewrite the entire equation, but factor the denominator, which needs to be factored.

$$\frac{x}{x+6} = \frac{72}{(x+6)(x-6)} + \frac{4}{1}$$

b) Give the values of x for which the equation is not defined.

$x \neq 6$ or $x \neq -6$

c) Give the LCD

$(x+6)(x-6)$

d) Solve the equation. [**Don't forget to check** if your solutions "candidates" are actual solutions]

$$\frac{x(x-6)}{(x+6)(x-6)} = \frac{72}{(x+6)(x-6)} + \frac{4(x+6)(x-6)}{1(x+6)(x-6)}$$

$$x^2 - 6x = 72 + 4[(x+6)(x-6)]$$

$$x^2 - 6x = 72 + 4(x^2 - 36)$$

$$x^2 - 6x = 72 + 4x^2 - 144$$

$$-x^2 + 6x \qquad\qquad -x^2 + 6x$$

$$0 = 72 + 3x^2 - 144 + 6x$$

$$0 = 3x^2 + 6x - 72$$

$$0 = 3(x^2 + 2x - 24)$$

$$0 = 3(x+6)(x-4)$$

$x+6=0$ or $x-4=0$

$-6\ -6 \qquad +4\ +4$

$x = -6$ disregard $\qquad \boxed{x = 4}$

e) State the answer(s).

$x = 4$

Ex: $\dfrac{2x-3}{x+1} - \dfrac{2x}{4x+4} = \dfrac{x}{2x+2}$

a) Rewrite the entire equation, but factor the denominators, which need to be factored.

$$\frac{2x-3}{x+1} - \frac{2x}{4(x+1)} = \frac{x}{2(x+1)}$$

b) Give the values of x for which the equation is not defined.

$x \neq -1$

c) Give the LCD

$4(x+1)$

d) Solve the equation. [**Don't forget to check** if your solutions "candidates" are actual solutions]

$$\frac{4(2x-3)}{4(x+1)} - \frac{2x}{4(x+1)} = \frac{2x}{2\cdot 2(x+1)}$$

Compare

$$4(2x-3) - 2x = 2x$$

$$8x - 12 - 2x = 2x$$

$$6x - 12 = 2x$$

$$-2x \qquad -2x$$

$$4x - 12 = 0$$

$$+12 \qquad +12$$

$$\frac{4x}{4} = \frac{12}{4}$$

$x = 3$

e) State the answer(s).

$x = 3$