**6.1 – Rational Expressions**

Definition :
A **Rational Expression** is an algebraic expression than can be written as a fraction of polynomials.

Ex : $\frac{3}{x+1}; \frac{x^{2}-1}{3x-2}; 4x^{2}+2x+1; 3-\frac{2}{x} $; …

When dealing with rational expressions, we need to determine its **domain**, i.e. determining the values of *x* where the expression exists. The expression won’t exist for values of *x* where leading to a denominator that equals 0.

Examples : a) $\frac{5x+1}{3x-4}$ This expression doesn’t exist if $3x-4=0$

 Restrictions: $3x-4 \ne 0$

 $3x \ne 4$

 $x\ne \frac{4}{3}$

 Domain : $\left\{x\in R, x\ne \frac{4}{3}\right\}$ or $R \\left\{\frac{4}{3}\right\}$

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

 Restrictions: $(x-1)(x-2)\ne 0$

 $x-1\ne 0$ and $x-2\ne 0$

 $x\ne 1$ and $x\ne 2$

 Domain : $\left\{x\in R, x\ne 1;x\ne 2\right\}$ or $R \\left\{1;2\right\}$

 c) $\frac{2x-1}{x^{2}-x-12}$

 Restrictions : $x^{2}-x-12\ne 0$

 By factoring or using the quadratic formula, we get :

 $x\ne -3$ and $x\ne 4$

 Domain: $\left\{x\in R, x\ne -3;x\ne 4\right\}$ ou $R \\left\{-3;4\right\}$

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If there is a common factor on the numerator and the denominator of a rational expression, you can **simplify** it. You’ll get an **equivalent** expression, but it won’t necessarily have the same domain. We often say they are equal, but technically they aren’t for all values of *x*…

Examples : $\frac{3(x+1)}{(x-5)(x+1)}$ and $\frac{3}{x-5}$ are equivalent. with $D\_{1}=$ $R \\left\{-1;5\right\}$ and $D\_{2}=$ $R \\left\{5\right\}$

 i.e. $\frac{3x+3}{x^{2}-4x+5}$ and $\frac{3}{x-5}$ are equivalent.

Remember that a Rational Expression can only be **simplified** if it is **FACTORED**.

And you need to determine the **restrictions** on the variable **before simplifying** it.

Example 1 : $\frac{x^{2}-2x-3}{x^{2}-6x+9}$

 Restrictions :

 Simplification :

Example 2 : $\frac{2x^{2}-x-1}{x^{2}-1}$

 Restrictions :

 Simplification :

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