## Rational Functions Project

The following is required to earn a test grade of an 85 on this project. You must go above and beyond these minimum requirements to earn more points. To receive full credit, you must support your answers with work shown. You may only use a Tl-84 or equivalent graphing calculator. You may not use a Tl-89.

Find the rational function below that corresponds to the first letter of your last name. This is the rational function that you will be researching.

| A: $\frac{x^{3}+x^{2}+9 x+9}{3 x^{3}-4 x^{2}-5 x+2}$ | B: $\frac{3 x^{3}+4 x^{2}-x-2}{4 x^{3}+20 x^{2}+8 x-32}$ | C: $\frac{3 x^{3}-8 x^{2}+12 x-32}{x^{4}-2 x^{3}-3 x^{2}+4 x+4}$ |
| :--- | :--- | :--- |
| D: $\frac{12 x^{3}-19 x^{2}-3 x+10}{12 x^{3}-11 x^{2}-13 x+10}$ | E-G: $\frac{x^{3}+6 x^{2}+16 x+96}{3 x^{2}+16 x-12}$ | H-I: $\frac{x^{3}-3 x^{2}+4}{x+1}$ |
| J-L: $\frac{18 x^{3}-15 x^{2}-4 x+4}{2 x^{3}+7 x^{2}-5 x-4}$ | Ma-Me: $\frac{4 x^{3}-4 x^{2}+x-1}{x^{2}-x-6}$ | Mf-Mz: $\frac{3 x^{2}-10 x+7}{4 x^{3}-5 x^{2}-17 x+18}$ |
| N-P: $\frac{9 x^{3}+48 x^{2}-35 x+6}{2 x^{2}+10 x-28}$ | Q-R: $\frac{-36 x^{2}+12 x+35}{2 x^{2}+14 x-16}$ | S: $\frac{-x^{4}+40 x^{2}-144}{3 x^{3}+15 x^{2}-24 x-36}$ |
| T-W: $\frac{}{4 x^{2}-13 x-5}$ |  |  |

## Part 1:

Take the numerator portion of your rational function (a polynomial) and discuss at least the following characteristics:

- Domain and Range (interval notation)
- Increasing and Decreasing (interval notation)
- Even and Odd symmetry
- Relative Maximums and Relative Minimums
- Lead Coefficient Test
- Rational Root Theorem
- Zeros, Roots, X-intercepts (real and imaginary)
- End Behavior
- Multiplicity

On all parts: Show your work by hand wherever possible! Use technology to assist with extrema.

- Extrema
- Graph it!

Part 2:
Take the denominator portion of your rational function (a polynomial) and discuss at least the following characteristics:

- Domain and Range (interval notation)
- Increasing and Decreasing (interval notation)
- Even and Odd symmetry
- Relative Maximums and Relative Minimums
- Lead Coefficient Test
- Rational Root Theorem
- Zeros, Roots, X-intercepts (real and imaginary)
- End Behavior
- Multiplicity
- Extrema
- Graph it!

Part 3: Look at the whole rational equation and discuss at least the following characteristics:

- Intercepts
- Asymptotes (vertical, horizontal, and slant)
- Discontinuity
- Even and Odd Symmetry
- End Behavior
- Graph it!

Part 4: Investigate inequalities of rational functions by discussing:

- Where the numerator is positive and negative
- Where the denominator is positive and negative
- Where the rational function is positive and negative
- Express using proper notation
$\bullet$
Part 5: Discuss other function characteristics such as:
- Is the numerator, denominator, and entire rational expression one-to-one?
- Is there anything interesting about the inverses of the numerator, denominator, and rational functions?
- If the whole function does not have an inverse, how would you restrict the domain to issue that it would have an inverse?
Part 6: Function operations. Let the numerator be the function $N(x)$ and the denominator be the function $\mathrm{D}(\mathrm{x})$. Investigate some of the following function operations algebraically and graphically.
- $N+D$
- $D-N$
- ND
- N/D

Finally, create a unique way of displaying all the information you have as well as any additional information that you found along the way about your polynomial and your rational equation. You can use PowerPoint, 3-D model, scrapbook, formal report, Excel, etc but I do not want a poster board. The use of a graphing calculator is expected, but you should be able to insert your graphs into a digital file. (Desmos is preferred.) I will need a digital copy of your work before you put it into your presentation format. This digital copy may be sent to me via email prior to the duedate.

Turn in by Monday $\mathbf{3 / 2 5}$ for up to 105, or by Friday for up to a 95 . This project may not be turned in after Spring Break.

You may contact me via email at rebecca.gammill@cobbk12.org anytime for questions or concerns regarding this project.

