Pre Calculus Art Project

Objective: The student will reinforce the understanding of functions discussed in this and previous mathematical courses. This would include linear, absolute value, ceiling & floor, parabolic (quadratic), cubic, quartic (fourth degree), trigonometric, elliptical, hyperbolic, circular, rational, and piecewise functions.

Method: Using **graph paper**, sketch out an emblem, picture, face, or some other item that tickles your fancy. The project should have an element of fun associated with it so be creative when brainstorming. For those needing a little inspiration think of a cobra displaying its hood, a landscape, a hot air balloon, superhero symbol, or your own personal emblem. This point value associated with this assignment will reflect the amount of work needed to complete it. By that judgment, this will be worth about a test grade **(125 pts)**

Requirement: The design must include an **element of symmetry (about a point, an axis, or a line)** and contain a **variety** of functions outlined in the objective portion of this document.

Each function must be well defined and graphed appropriately on the graph paper.

Each student will turn in

1) A **rough draft** of the idea **sketched** out on **graph paper** followed by
2) A **refined picture** that has **well defined lines, curves, and functions.** This will be a clean depiction of the sketched image that has every mark accounted for by use of **algebraic equations.** (Final Pencil Paper Version)
3) The **final draft** of the picture must include a **refined version with color**. (Shared Computer Generated Image and Artistic Rendition)

The image must contain a **minimum** of **fifteen different functions** that span each of the groups of functions. Obviously there is an opportunity to go above and beyond the requirements of the assignment. Meeting the minimum does not translate into earning the highest marks for the assignment. In other words, doing the minimum does not guarantee an "A" on the project. Other criteria will be considered.

Please look at the included rubric for grading criteria and **ask questions** if anything is unclear.

Rubric for Pencil Paper Version of Project

Use of Linear Equations: This includes lines, linear absolute value, and traditional floor & ceiling functions.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Points are accurately plotted and easily recognizable. **Clever** use of function. Used more than minimum requirement.	Points are accurately plotted and most easily depicted. **Solid** use of function in design. Used more than minimum requirement.	Points are accurately plotted and recognizable. **Used the minimum requirement of two linear equations.**	Lines are recognizable but the graph appears basic. Question the appropriateness of using the function in the image.	Appears messy, thrown together and lacks effort. Lines visibly crooked. Plotted points in question.
Use of Polynomial Equations: This includes quadratic or (parabolic), cubic, and quartic functions.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Points are accurately plotted and easily recognizable. **Clever** use of function. Used more than minimum requirement.	Points are accurately plotted and most easily depicted. **Solid** use of function in design. Used more than minimum requirement.	Points are accurately plotted and recognizable. **Used the minimum requirement of two polynomial equations.**	Curves are recognizable but the graph appears basic. Question the appropriateness of using the function in the image.	Appears messy, thrown together and lacks effort. Curves visibly crooked, shaky, or lumpy. Plotted points in question.
Use of Other Conic Equations: This includes circles, ellipses, and hyperbolic functions.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Points are accurately plotted and easily recognizable. **Clever** use of function. Used more than minimum requirement.	Points are accurately plotted and most easily depicted. **Solid** use of function in design. Used more than minimum requirement.	Points are accurately plotted and recognizable. **Used the minimum requirement of three conic equations.**	Curves are recognizable but the graph appears basic. Question the appropriateness of using the function in the image.	Appears messy, thrown together and lacks effort. Curves visibly crooked, shaky, or lumpy. Plotted points in question.

Use of Trigonometric Equations: This includes sine, cosine, tangent, cosecant, secant, and cotangent functions.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Points are accurately plotted and easily recognizable. **Clever** use of function. Used more than minimum requirement.	Points are accurately plotted and most easily depicted. **Solid** use of function in design. Used more than minimum requirement.	Points are accurately plotted and recognizable. **Used the minimum requirement of two trigonometric equations.**	Curves are recognizable but the graph appears basic. Question the appropriateness of using the function in the image.	Appears messy, thrown together and lacks effort. Curves visibly crooked, shaky, or lumpy
Use of Rational Equations: This should be self-explanatory.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Points are accurately plotted and easily recognizable. **Clever** use of function. Used more than minimum requirement. All asymptotes depicted.	Points are accurately plotted and most easily depicted. **Solid** use of function in design. Used more than minimum requirement. All asymptotes depicted.	Points are accurately plotted and recognizable. **Used the minimum requirement of two rational equations.** All asymptotes depicted.	Curves are recognizable but the graph appears basic. Question the appropriateness of using the function in the image. Missing depicted asymptotes.	Appears messy, thrown together and lacks effort. Curves visibly crooked, shaky, or lumpy. Plotted points in question.
Axes Labeled: Use of axes to organize and clearly graph equations but not detract from image.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Axes are present. Easily distinguishable but not so dark that they detract from image.	Axes are present. Easily distinguishable.	Axes are present. Easily distinguishable but perhaps a little dark and they detract from image.	Axes present but clearly too dark. Actually split image because the axes are drawn excessively thick.	Cannot distinguish where the axes, and by extension, the origin are located.

Legend: Organize the equations in an appropriate display that works well with the image.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
All equations are represented in exceptional form and provide a clear link to the image through organized coding (labels to each part of image and indication of each type of equation used)	All equations are represented in a well-organized form and can easily be traced back to image. Some basic type of coding was used such as color coding, alphabetic, or numerical.	All equations are represented in **written** form and can easily be traced back to image.	Equations written and for the most part appear to match the image but lack some of the necessary notation.	Equations not clearly written and lack most of the necessary notation.
Appropriate Dimensions: Does the image fill at least on 8" x 12" piece of Quad Paper (Graph Paper)				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
The image fills at least ¾ of the page and has elements of intricate detail. Clearly recognizable as having invested serious time and effort.	The image fills at least ¾ of the page but also includes enough detail that it portrays depth of thought.	The image fills **at least ¾ of the page**.	The image did not fit the requirement of at least ¾ of a page.	Image is too small and has poor workmanship.

Rubric for Final Version of Project

Creative Use of Algebraic Equations: This would include the use of restricted domains, piecewise functions, more advanced ceiling & floor function, as well as more advanced absolute value functions.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
The image clearly takes advantage of advanced planning, considerable thought and exceptional use of equations. Demonstrates a powerful understanding of said equations by use of phase shifts and restricted domains.	The image clearly has some well thought out planning, and demonstrates the use of some advanced equations. Strong evidence for understanding different types of equations.	The image is recognizable. The requirement met, and demonstrates a solid understanding of basic graphing principles. Overall a plain presentation of equations.	Image lacks any sense of direction. Mediocre understanding of functions. No use of items mentioned above beyond basic equations.	Image poorly done, unrecognizable. Poor use of equations. Questionable choices of equations and lacks any understanding of limiting domains.
Overall Use of Equations: Were there enough equations, and how appropriate were the equations.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Graphs are accurately plotted with a solid resemblance to original concept. Impressive use of equations with regard to quantity and quality. Clear demonstration of an exhaustive effort with time management.	Graphs are accurately plotted with a solid resemblance to original concept. Significantly went over the minimum number of equations and the use of equations fit the scheme of the image. Domains were restricted with inequality notation.	Graphs are accurately plotted with a solid resemblance to original concept. **Used the minimum requirement of fifteen equations.** There are an appropriate variety of equations. **Domains were restricted with inequality notation.**	Equations plotted drastically change the original concept but still fairly recognizable. Did **NOT** meet the minimum requirement of fifteen equations. Domains were restricted with inequality notation most of the time.	Appears messy, thrown together and lacks effort. Use of equations does not make sense with the image. Poor use or understanding of restricted domains. Obvious gaps that was unintentional to the original concept.

Use of Symmetry: Symmetry used about a point, an axis, or a line.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Unique use of symmetry to the point that the image captures one's eye. In other words the image causes one to linger with the depth of complexity displayed. Clever use reflections or inverses.	Clear use of symmetry that so that it can immediately be identified. Symmetry is traditional with X or Y-axis. Perhaps used through reflections.	Standard use of symmetry but nothing out of the ordinary. Plain image with inherit symmetry of equation. Nothing special done to take symmetry over the top.	Has an element of symmetry but overall the image is asymmetric with little balance.	No symmetry found in the image.
Creativeness: How original is the piece, does it speak to the standard of excellence expected of Tuslaw students.				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
Fantastic image that speaks to the time and effort invested. Quality workmanship. Something that represents Tuslaw well. Worthy of posting on Website.	The image is technically sound and has some stand out qualities.	The image is technically sound but ordinary and lacks any standout characteristic.	The image has some minor technical flaws.	Inappropriate image, or major flaws in design and execution.

Presentation / Organization: This criterion covers how the image displays				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
The project was turned in with a sense of accomplishment, meaning there are no smug marks, possibly even presented with sleeves or folder. Clear evidence of the development of project, includes sketch, developing equations, Computer image both with and without color. Also an electronic copy was shared with teacher.	The project was turned in with a high degree of quality. The paper is not crinkled and has few if any smug marks. A very clean appearance. Computer image both with and without color. Also an electronic copy was shared with teacher.	The project is turned in with the standard stable in the left hand corner. The organization aspect made grading easy. Limited smug marks. **Also an electronic copy was shared with teacher.**	Missing portions of project such as the original sketch concept. Electronic copy MUST be shared with teacher.	No electronic version Shared. THIS WOULD BE A CONSIDERABLE DEDUCTION, AS IT WILL NEEDLESSLY COST ADDITIONAL TIME TO GRADE.
Title Page: Should include an interesting title, by [student name] and for [teacher name]				
Excellent (10 pts)	Good (8-9 pts)	Average (5-7 pts)	Below Average (2-4 pts)	Poorly Done (0-1 pt)
The project is turned in with a title that is appropriate to the image created. Student and teacher name is also included on title page. Additionally it would be appropriate to have the date and class period.	The project is turned in with a title that is appropriate to the image created. Student name is also included on title page.	The project is turned in with a title that is appropriate to the image created.	Title is rather plain, or any misspellings.	No title page.

Special Merit or Award (12 Bonus pts): Special Recognition Categories for Work Above and Beyond the Call of Duty				
Best Presentation	Best Design	Best Use of Functions	Over the Top	Voted Favorite
*Clean *Excellent choice in color scheme. *Hits the majority of the criteria. *Everything about project well done.	*Most thought out. *Embodies artistic vision. *Incredible Image	*Most creative use of functions. *Advanced thought used when generating functions. *Represent	*Demonstrates an exhaustive effort that far exceeds all others. *An obvious amount of additional work went into making an exceptionally complex image.	*This may be done through online voting if possible. *Otherwise this will be done by a group of faculty.

Once a working model has been created using **PENCIL and PAPER,** the next step will be to generate the image using computer software. This will ensure that the images, if done correctly, will have that professional quality. Students will need to create an account at https://www.desmos.com/calculator using their gmail username and a **DIFFERENT** password.

Equations can be entered in any form (solved for x, solved for y, or as an unsolved equation with a mix of x and y values) followed with braces to restrict the domain of the equations. Example: $(x+3)^2+(y-2)^2=16 \quad \{-4 < x \le 0\}$. In order to call up the less than or equal to symbol "≤" press alt and < at the same time. For the most part you will have to play around with the program. You **must** create an account or you will not be able to **save your work**. Consequently you will not be able to share your work with the teacher and that would be a huge deduction.

Play around with the software as it has plenty of bells and whistles. I would appreciate if the equations are grouped together based of the rubric. Color can be used at the student's discretion. Once an equation is graphed you can slide it up or down the list. Additionally, comments can be used to denote the various types of equations. In other words, it would take a student about five minutes group and label each of the types of equations without affecting the actual graphs.