Honors Precalculus **Name:**

Precalculus Portfolio

Objective: Honors Precalculus students will construct a portfolio that will assist in their preparation for Calculus.

Procedures: For each topic the following procedures will be followed.

1. Write the portfolio item and number verbatim from the topic list at the top of the page. For example,

   1.1 Explain the meaning of a mathematical sequence.

2. State the definitions and theorems that relate to the topic.
3. In the case of a problem type item, explain in words the procedure for completing the problem related to the topic. Number the steps used. Include examples in your entry. The examples should be worked out completely and should include graphs and diagrams as necessary.
4. There should only be one topic per page.
5. Your entries *must* be *hand-written*.
6. *Each student is responsible for his own work.* If you work with someone, I expect the procedure to be in each individual's own words. You may not split up the topics and do only a few. This defeats the purpose of the portfolio.
7. Your portfolio will be due at the end of each chapter, however, the best way to attack it is to complete the topics as we cover them. Waiting until the last minute will prove to be a disaster.
8. Portfolios should be submitted in a journal or spiral bound notebook. Tabs should be inserted for each chapter.

Chapter 1: Sequences and Bivariate Data

1.1 Explain the meaning of a **mathematical sequence**. Include a discussion of subscript notation. Include examples. (Sec 1.1)

1.2 Explain **sigma notation**. Include examples. (Sec 1.1)

1.3 Explain the meaning of an **arithmetic sequence**. Include examples. (Sec 1.1)

1.4 Explain the meaning of a **geometric sequence**. Include a discussion of the **common ratio**. Include examples. (Sec 1.2)

1.5 Explain the meaning of an **infinite sequence**. Include examples. Include discussions of **convergent** and **divergent** sequences along with examples. (Sec 1.2)

1.6 Explain the meaning of an **infinite series**. Include examples. (Sec 1.2)

1.7 Discuss the relationship between the convergence behavior of an infinite sequence and the convergence behavior of it corresponding infinite series. (Sec 1.2)

1.8 Explain the meaning of a **recursive sequence**. Include a discussion of **explicit form** and examples. (Sec 1.3)

1.9 Using an example of your choice, explain the steps involved in finding a **median-median line** for a data set. Discuss how the median-median line would be used for making predictions in a real-life setting. Give the real-life interpretations of the slope and y-intercept from your example. (Sec 1.4)

1.10 Explain the meanings of **extrapolation** and **interpolation**. (Sec 1.5)

1.11 Explain the meaning of **residual**. Include an example. (Sec 1.5)

1.12 Using an example of your choice, explain the steps involved in finding a **least squares regression line**. Discuss how the line would be used for making predictions in a real-life setting. Give the real-life interpretations of the slope and y-intercept from your example. (Sec 1.5)

1.14 Explain the meaning of **outlier**. (Sec 1.6)

1.15 Discuss what a **residual plot** is and how it is used. Include an example. (Sec 1.6)

1.16 Explain what the **correlation coefficient** is and how it is used. (Sec 1.6)

Chapter 2: Functions and Their Graphs

2.1 Explain the "Rule of Four." Give examples of each. (Sec 2.1)

2.2 Explain the meaning of each of the following:

a. Polynomial function
b. Relative maximum
c. Relative minimum
d. x- and y-intercepts
e. End behavior

Choose an example polynomial and explain how to find characteristics b-e above for your polynomial. (Sec 2.1)

2.3 Explain how to solve a polynomial inequality. Include an example. (Sec 2.3)

2.4 Explain the meaning of each of the following:

a. Rational function
b. Horizontal asymptote
c. Vertical asymptote
d. Domain
e. Range

Choose an example rational function and explain how to find characteristics b-e above for your function. Also explain how to use the characteristics to graph your function without a calculator. (Sec 2.4 and 2.5)

2.5 Give the general form for an exponential function. Explain the difference between growth and decay. Give real life applications of both. (Sec 2.6)

2.6 Explain the meaning of the number e. (Sec 2.6)

2.7 Explain the meaning of logarithm functions and how they are related to exponential functions. (Sec 2.7)

2.8 Explain the meaning of natural logarithm. (Sec 2.7)

2.9 List the properties of logarithms and give examples of each. (Sec 2.7)

2.10 Explain how to solve logarithmic and exponential equations. Include examples. (Sec 2.7)

2.11 For each of the following parent functions, sketch a graph and label key points. (Sec 2.8)

a. Absolute Value
b. Quadratic
c. Cubic
d. Quartic
e. Natural logarithm
f. Linear
g. Exponential
h. Rational
i. Square root

2.12 For the function f(x), explain how to perform the following transformations and the resulting functional effects that they have on f(x). (Sec 2.8):

a. Horizontal translation (shift) right and left
b. Vertical translation up and down
c. Horizontal compression
d. Horizontal stretch
e. Vertical compression
f. Vertical stretch
g. Reflection over the x-axis
h. Reflection over the y-axis

2.13 Explain the definitions of odd and even functions. Give examples of each and explain how to determine if functions are odd or even. (Sec 2.8)

2.14 Explain the meaning of composition of functions. Give examples. (Sec 2.8)

Chapter 3: Trigonometric Functions

3.1 Explain the meaning of an angle in *standard position*. Give examples. (Sec 3.1)

3.2 Explain the meaning of *radian*. (Sec 3.1)

3.3 Explain how to convert (a) degrees to radians; (b) radians to degrees. Include examples. (Sec 3.1)

3.4 Explain the meaning of *reference angle*. Include examples. (Sec 3.1)

3.5 List the trigonometric ratios for sine, cosine, tangent, cotangent, secant and cosecant. (Sec 3.1)

3.6 Explain the meaning of a *periodic function*. Include discussions of *period, amplitude* and *phase shift* in your answer. (Sec 3.2)

3.7 Explain the meaning of *unit circle*. Draw a unit circle. Label the reference angles for 0, $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$ and their multiples up to 2π and label the coordinate pairs for each of these reference angles. (Sec 3.3)

3.8 Build a table that lists the values of *sine, cosine* and *tangent* for 0, $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$ and their multiples up to 2π. (Sec 3.3)

3.9 Draw graphs of the parent functions $f(x) = \sin x$ and $f(x) = \cos x$. Give the *domain, range, amplitude* and *period* of each. (Sec 3.4)

3.10 Give the standard form of the equations for sin x and cos x. Explain the meaning of the parameters A, C, and D. (Sec 3.4)

3.11 Explain how to create a trigonometric function in standard form from its graph. Include examples. (Sec 3.4)

3.12 Explain how to graph a trigonometric function from its equation. Include examples. (Sec 3.4)

3.13 Draw the graphs of the parent functions $y = \tan x$ and $y = \cot x$. Give the *domain* and *range* of each. (Sec 3.5)

3.14 Explain what an inverse trigonometric function does. Give examples. (Sec 3.6)

3.15 Explain how to solve trigonometric equations. Include examples. (Sec 3.7)

3.16 Using the example of your choice, show how a real-life situation involving period behavior can be modeled using a trigonometric function. (Sec 3.7)

Chapter 4: Analytic Trigonometry and Trigonometric Applications

4.1 Explain the meaning of an "*identity*." Give examples. (Sec 4.1)

4.2 List the six *reciprocal* trigonometric identities. (Sec 4.1)

4.3 List the three *Pythagorean* trigonometric identities (Sec 4.1)

4.4 Using three examples of your choice show how trigonometric identities can be used to simplify expressions. (Sec 4.1)

4.5 List the eight identities for sine and cosine involving $(\pi+\theta)$, $(\pi-\theta)$, $(2\pi+\theta)$, and $(2\pi-\theta)$. (Sec 4.2)

4.6 List the eight identities for sine and cosine involving $(180+\theta)$, $(180-\theta)$, $(360+\theta)$ and $(360-\theta)$. (Sec 4.2)

4.7 Using three examples of your choice show how identities in items 4.5 and 4.6 can be used. (Sec 4.2)

4.8 Write the trigonometric formula for finding the area of any triangle if you know the lengths of two sides and the included angle (SAS). Using the example of your choice, show how it is used by computing the area of a triangle (Sec 4.4)

4.9 Write Heron's Formula for finding the area of any triangle if you know the lengths of the sides (SSS). Using the example of your choice, show how it is used by computing the area of a triangle (Sec 4.4)

4.10 Write the Law of Cosines. Show an example of how it is used to solve (1) an SAS triangle and (2) an SSS triangle. (Sec 4.5)

4.11 Write the Law of Sines. Show an example of how it is used to solve (1) an SAA triangle and (2) an ASA triangle. (Sec 4.6)

4.12 Show an example of how the Law of Sines is used to solve (1) an SSA triangle with one solution; (2) an SSA triangle with two solutions; and (3) an SSA triangle with no solutions. (Sec 4.6)

Chapter 5: Polar Coordinates and Graphs

5.1 Give the equations of the standard forms of parabolas with both vertical and horizontal axes of symmetry. (Sec 5.1)

5.2 Using the example of your choice, explain how to find the coordinates of the vertex and focus and the equations of the axis of symmetry and directrix from the equation of a parabola. (Sec 5.1)

5.3 Using the example of your choice, show how to use completing the square to write the equation of a parabola into standard form. (Sec 5.1)

5.4 Give the equations of the standard forms of ellipses with both vertical and horizontal major axes. (Sec 5.2)

5.5 Using the example of your choice, show how to use completing the square to write the equation of an ellipse in standard form and how to find the coordinates of the center, the foci, and the endpoints of the major and minor axes. (Sec 5.2)

5.6 Give the equations of the standard forms of hyperbolas with both horizontal and vertical transverse axes. (Sec 5.2)

5.7 Using the example of your choice, show how to use completing the square to write the equation of a hyperbola in standard form and how to find the coordinates of the center, the foci, the vertices, and equations of the asymptotes. (Sec 5.2)

5.8 Give the equation of the standard form of a circle. (Sec 5.3)

5.9 Using the example of your choice, show how to find the standard form of a circle and how to find the center and radius. (Sec 5.3)

5.10 Given an equation in $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$ form, explain how to determine if the graph is a hyperbola, ellipse or circle, or a parabola. (Sec 5.3)

5.11 Explain the meaning of *polar coordinate*. (Sec 5.4)

5.12 Explain how to plot polar coordinates. Include 3 examples of plotting points. (Sec 5.4)

5.13 Explain how to create equivalent coordinates of the form $(r, \theta+2\pi)$, $(-r, \theta-\pi)$, $(-r, \theta+\pi)$ from (r, θ). Include examples. (Sec 5.4)

5.14 Explain how to convert polar coordinates to rectangular coordinates. Include an example. (Sec 5.4)

5.15 Explain how to convert rectangular coordinates to polar coordinates. Include an example. (Sec 5.4)

5.16 Explain how to sketch a polar graph. Include an example. (Sec 5.4)

5.17 Explain how to transform a polar function into a rectangular function. Include an example. (Sec 5.5)

5.18 Explain how to transform a rectangular function into a polar function. Include an example. (Sec 5.5)

5.19 Build a *table* that displays the characteristics of the *families of polar curves* including *lines, circles, even- and odd-petal roses, lemniscates,* and *all three types of limacons/cardioids.* For each curve give the general form(s) of equations along with example functions and their graphs. Include any other characteristics such as their domains and how sine or cosine might affect the graph's orientation. (Sec 5.5)

Chapter 6: Vectors, Parametric Equations & Motion

6.1 Give the general form of a function in parametric form. (Sec 6.1)

6.2 Explain how to sketch a parametric curve by making a table of values. Include an example (Sec 6.1)

6.3 Explain how to convert a function in parametric form to rectangular form. Include an example. (Sec 6.1)

6.4 Explain how to convert a function in parametric form to rectangular form with domain restrictions. Include an example. (Sec 6.1)

6.5 Explain how to convert a function in rectangular form to parametric form. Include an example. (Sec 6.1)

6.6 Give an example of using a parametric function to model a real-life situation. Include computations (Sec 6.1)

6.7 Explain the difference between *velocity* and *speed*. (Sec 6.2)

6.8 Explain what a *vector* is. (Sec 6.2)

6.9 Discuss "vector basics" including notation, horizontal and vertical components, magnitude and equal vectors. (Sec 6.2)

6.10 Explain how to *add* and *subtract* vectors. Include examples. (Sec 6.2)

6.11 Explain *scalar multiplication*. Include an example. (Sec 6.2)

6.12 Explain how to *resolve a vector into its component parts*. Include an example. (Sec 6.3)

6.13 Explain what a *unit vector* is and how to express a vector as a *linear combination of standard unit vectors*. (Sec 6.3)

Chapter 7: Foundations for Calculus

7.1 Explain what a *limit* is. (Sec 7.2)

7.2 Using the function of your choice, explain how to find a limit *graphically*. (Sec 7.2)

7.3 Using the function of your choice, explain how to find a limit *numerically*. (Sec 7.2)

7.4 Explain the concept of *left-hand* and *right-hand limits*. Give an example. (Sec 7.2)

7.5 Give an example where a limit does not exist and explain why. (Sec 7.2)

7.6 List the *basic limit rules* and the properties of limits for *constant multiples, sums or differences, products, quotients,* and *powers*. Give examples for each (Sec 7.2)

7.7 Give an example of a limit that results in the *indeterminate form* $\frac{0}{0}$ and explain how to find it. (Sec 7.2)

7.8 Explain what the *limit of a sequence* is. Choose an example of a *convergent sequence* and a *divergent sequence* and show how the limit is used to determine convergence or divergence. (Sec 7.3)

7.9 Explain what *limits at infinity* are. Give examples of finding limits at infinity for *polynomial*, *rational,* and *linear functions*. (Sec 7.3)

7.10 Explain what *continuity* means graphically. (Sec 7.4)

7.11 List the *three types of discontinuities* and give examples of each. Include graphs with your examples. (Sec 7.4)

7.12 Give the definitions of *continuity at a point* and *continuity on an interval*. (Sec 7.4)

7.13 Choose an example of a function that is continuous on an interval and use the definition of continuity to *prove* it is continuous. (Sec 7.4)

7.14 Choose an example of a function that is not continuous at a point and use the definition of continuity to prove it is not continuous (Sec 7.4)

7.15 State the *Intermediate Value Theorem (IVT)* and give an example of how it can be used. (Sec 7.4)

7.16 State the *Extreme Value Theorem (EVT)* and give an example of how it can be used. (Sec 7.4)