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| **Subject**: Mathematics | **Course**: Honors Pre-Calculus | **Grade Level**: 11-12 |

**Course Description**: This course is designed to develop in its participants the skills necessary for success in higher mathematics. These skills include mathematical reasoning, development of analytical thinking, elementary functional understanding and analysis, proof techniques, analysis of results, geometric abstraction, and use of a graphing calculator.

This course is a preparation for college bound students for a first course in calculus. Students are introduced to the standard concepts, techniques and languages needed for beginning college mathematics course.

Intermediate algebra, analytic geometry, and transcendental functions are integrated with other important topics in mathematics in preparation for work dealing with concepts concerning and leading up to topics in calculus.

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| **Objectives**  **Topic:** The Real Number Line(review)  Students must be able to …   * Define absolute value algebraically * Understand the concepts and algebraic properties used in solving equations and inequalities containing absolute value by the algebraic definition, including double absolute value. * Read and write simple and compound inequalities in interval notation.   **Topic**: The Cartesian plane   * Understand the construction of the Cartesian Plane * Understand the definition, need, purpose and construction of the Cartesian Product * Understand vertical and horizontal   distance on the Cartesian Pane as  related to the number line.   * Derive and apply the formula for distance between any two points/ordered pairs. * Determine the coordinates of a point located between two given points (relative distance). * Derive and apply the midpoint formula based on above concept. * Understand the algebraic and geometric interpretation of the solution to a linear equation. * Graph a linear equation using slope intercept, point slope and other abstracted forms. * Understand the meaning of the parts in the standard form and general forms of a linear equation and the difference between the two. * Understand and apply the relationship between slope and the tangent of the angle of inclination. * Apply all forms of a linear equation to finding the equation of the line. * Understand and apply the concepts of parallelism and perpendicularity to slope. * Understand the derivation of and meaning of distance between two lines. * Apply the distance formulas for distance between a line and a point or a parallel line.   **Topic**: Functions   * Define, understand and interpret a locus of points to find an equation. * Understand, interpret, and apply functional notation. * Determine the correct technique, based on the problem operations, and apply it to find the domain and range of a relation. * Analyze the domain and range to determine regions where graph will or will not be located. * Recognize and explain the difference between a relation and a function. * Find the domain of a piece wise function, and the range by interpreting the graph. * Recognize the most common functions, understand and analyze their properties in order to sketch their graphs using transformations ( translations). * Understand and use the Greatest Integer Function f(x)=**[**x**]**. * Perform basic operations on functions. * Prove f(x)+g(x)=(f+g)(x), etc. and relate this concept as a technique to graphing (addition of ordinates, i.e. graphical addition). * Define and find the intercepts of a graph. * Find the composite function. * Understand the concept of an inverse function algebraically and graphically as an opposite. * Find the inverse of a function and prove they are inverses of each other by composition. * Classify and prove a function is increasing, decreasing, etc. algebraically and geometrically as a tool for graphing. * Determine symmetry to the x axis, y axis, origin, line x=y as a tool for graphing. * Understand the composition of two or more functions. * Understand and apply the process of determining the domain of a composite function. * Understand the definition of vertical, horizontal and oblique asymptotes. * Recognize the existence of a vertical asymptote, find the vertical asymptote and apply the definition to determine the direction the graph approaches the asymptote. * Know and apply various techniques to find horizontal asymptotes. * Know and apply various techniques to find horizontal asymptotes. * Determine if sample points are necessary and graph the rational function.   **Topic**: Polynomial Functions   * Define a polynomial function and understand the nature of its graph. * Understand the definitions and use the terms dealing with polynomials. * Analyze the nature of a polynomial as applied to graphing. * Understand the uses of the properties of polynomials and the techniques in order to determine the x-intercepts and relative maximum and minimum points.   **Topic**: Transcendental functions   * Understand the definition and recognize a transcendental function vs. an algebraic function. * Define an exponential function * Understand and apply the relationship between exponents and bases. * Understand the correlation between exponential graphs of various bases (a>1, 0<a<1). * Derive the number e…   Limit(1+n)^(1/n) as n->0   * Define and interpret a logarithmic function. * Prove a logarithm and exponential are inverses of each other. * Simplify logarithmic expressions and solve equations using properties. * Define and understand the need and uses of natural and common logs. * Change bases on logarithmic expressions as an exponential function. * Convert an exponential function to a logarithmic function and vice a versa. * Convert where necessary and solve exponential and logarithmic equations.   **Topic**: Conic Sections   * Recognize the general form of a conic section to determine which conic section and put into standard form for graphing. * Derive the general and standard form of any circle from its definition. * Graph a circle based on the standard dorm * Analyze information about the graph of a circle in order to determine its equation in standard and general form. * Derive the equation of a general parabola with vertical or horizontal concavity based on the definition. * Determine the vertex, focus, and directrix and sketch the graph of a parabola. * Determine the equation of a transformed parabola by analyzing information about the graph. * Derive the equation of a general ellipse. * Understand the relationship between ‘a’ and the major axis of a transformed ellipse and determine the center, vertices, foci of an ellipse from standard form. * Determine the equation of a transformed ellipse into standard and general form based on information about the graph. * Understand and apply the concept and definition of eccentricity. * Understand the non-continuous nature of a hyperbola based the derivation of the standard form and domain/range. * Understand the relationship between ’a’ and the transverse axis of a transformed hyperbola and the slope of the asymptotes. * Determine the center, vertices, foci, slopes of the asymptotes, and eccentricity of a hyperbola in standard form. * Understand the major axis as the transverse axis, the minor axis as the conjugate axis and the relationship between a hyperbola and its conjugate. * Determine the standard and general form of a transformed hyperbolic equation by analyzing the information about the graph   **Topic:** Sequences, Series, Probability   * Use PASCAL’s triangle and the Binomial Theorem to expand a binomial and use to determine individual terms of an expansion. * Use sequence notation to write the terms of a sequence * Use factorial and sigma notation * Find sums of infinite series   **Topic:** Partial Fraction Decomposition   * Use systems of linear equations to write partial fraction decompositions of rational expressions   **Topic:** Parametric and Polar Equations   * Evaluate sets of parametric equations for given values of the parameter. * Plot points and find multiple representations of points in the polar coordinate system. * Convert points and equations from rectangular to polar and vice versa.   **Topic**: Limits and Continuity   * Understand the fact that a limit is “approaching” a value. * Intuitive evaluation. * Read functions ordered pairs and graph to evaluate the limit. * Use the algebraic properties of limits to evaluate a limit with an undetermined form. * Evaluate the limit of a piece wise function (including absolute value)algebraically and graphically. * Use the limit definition of slope to find exact slopes of graphs. * Examine the definition of a continuous function using limits. * Determine the location of discontinuities of specific functions. | **Content and Resources**  **Pre-Calculus with Limits, a Graphing Approach**, Ron Larson, 2016.  Ti-84 graphing calculator and emulator.  [**https://kahoot.com**](https://kahoot.com) **online assessment**  **very engaging for students of all ages.**  [All](https://www.bing.com/search?q=khan+academy&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past 24 hours](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez1%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past week](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez2%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)[Past month](https://www.bing.com/search?q=khan+academy&filters=ex1%3a%22ez3%22&pc=cosp&ptag=C36A1C40FF8AFF&conlogo=CT3210127&qpvt=khan+academy)   1. [Khan Academy **-**](https://www.khanacademy.org/)   https://**www.khanacademy.org**  You can learn anything. Expert-created content and resources for every subject and level. Always free.  IXL Software  TI-84 graphing calculator and emulator.  E-texts and worksheets from Cengage publishing.  Khan Academy  TI-84 graphing calculator and emulator.  Polar coordinate system and graphs.  TI-84 graphing calculator and calculator emulator | **Assessments**  Homework assignments, teacher and text generated.  Teacher generated quiz on algebraic solutions to simple absolute value inequalities.  Teacher generated test on algebraic solutions of simple, and compound and double absolute value inequalities in interval notation.  Teacher generated quiz on distance between points on the Cartesian Plane and location of points in relation to each other (relative distance).  Teacher generated test on linear and relative distance, applying linear equations to figures, and finding the equation of a line in a figure.  Teacher generated test on all of the above.  Teacher generated quiz on Locus of Points.  Teacher generated quiz on functional notation and finding the domain of a relation.  Teacher generated test on locus of points, functional notation, and finding the domain and range of a function and /or relation and determine the difference.  Teacher generated quiz on piece wise functions, and graphing absolute value and greatest integer functions using transformations (translations).  Teacher generated test on finding domain and range of a relation and is it a function, piece wise functions, graphing linear, absolute value, and greatest integer functions and compound functions contain same using transformations.  Teacher generated test on domain, range, intercepts, increasing, decreasing, etc. functions, symmetry of functions  Teacher generated test on composition, and composite functions, inverse functions, graphing rational functions.  **MID TERM EXAM**  Graphing project on graphs of polynomial, rational and piece-wise functions.  Teacher generated test on graphing exponential functions, and solving exponential and logarithmic equations  Teacher generated quiz on graphing exponential functions in relation to each other.  Teacher generated quiz on finding critical values and graphing ellipses and hyperbolas, and finding the equation in standard and general form, including eccentricity  Teacher generated mini exam on all Conic Sections.  Teacher generated quiz on graphing factorable (or completing the square) polynomials and synthetic division  Teacher generated test on graphing any degree polynomial using factoring, completing the square, synthetic division, Rational Root theorem, Descartes rule of signs, etc.  Teacher generated test on finding critical values and graphing circles and parabolas and find the equation of each in standard and general form  Tests 0n using PASCAL’s triangle and the Binomial Theorem to expand a binomial and determine individual terms of an expansion.  Test on real world examples using sequences and series.  Test on parametric and polar equations.  Graphing project on graphs of polar equations.  Teacher generated quiz on evaluating elementary limits algebraically and graphically, and determining discontinuities of functions.  **FINAL EXAM** |