

Autograph

version 3

and COLLEGE MATH

Autograph is spectacular dynamic software from the UK that allows teachers to visualise many of the MATHEMATICAL topics that occur in the various college level MATH courses.

1st and 2nd DERIVATIVE

Equation 1: $y = x^3 - 3x - 1$
 Gradient 1: 1st Gradient of $y = x^3 - 3x - 1$
 Gradient 2: 2nd Gradient of $y = x^3 - 3x - 1$

MAX and MIN

Tin Can, Volume = 35.1
 Minimum $S = 277.5 \text{ cm}^2$ at $r = 3.837 \text{ cm}$

Equation 1: $s = 2\pi r^2 + 710/r$
 Equation 2: $s = 2\pi r^2$
 Equation 3: $s = 710/r$

EXPONENTIAL FUNCTION

$(0, 1)$
 1st Gradient of $y = a^x$
 Integral Function of $y = a^x$

Constant Controller - [Page - 1]
 Options: $a = 2$ Step: 0.1

$y = a^x$
 Integral Function of $y = a^x$
 1st Gradient of $y = a^x$

PLANES & Cross Product

Plane 1: $3x - y + z = a$
 Plane 2: $x + y = b$

VOLUME of REVOLUTION

Volume: $33.96\pi \text{ cm}^3$
 Area: 10.90 cm^2

Harry's Goblet: $y = 0.00943x^4 - 0.223x^3 + 1.63x^2 - 3.68x + 2.60$

DIFFERENTIAL EQUATIONS

Equation 1: $y' + ky = x$
 Equation 2: $y = x - 1$



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USA 2-YEAR COLLEGE MATH COURSES

with references to AUTOGRAPH



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INTERMEDIATE ALGEBRA

I. Quadratic Functions

- A. Quadratic equations
- B. Graphs of quadratic functions
- C. Equations quadratic in form
- D. Applications



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II. Rational Functions

- A. Operations on rational expressions
- B. Rational equations
- C. Applications

III. Radical Functions

- A. Operations on radical expressions
- B. Operations on complex numbers
- C. Rational exponents
- D. Radical equations
- E. Applications



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IV. Exponential and Logarithmic Functions

- A. Evaluation of expressions
- B. Graphs of exponential and logarithmic functions
- C. Applications



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COLLEGE MATHEMATICS

I. Set Theory

- A. Venn diagrams
- B. Set operations

II. Probability A Experimental vs. theoretical probability

- B. Conditional
- C. Odds
- D. Permutations and combinations

III. Statistics

- A. Descriptive
- B. Normal distribution
- C. Percentiles and quartiles



STATISTICS

2-YEAR COLLEGE MATHEMATICS

IV. Finance

- A. Annuities
- B. Simple vs. compound interest
- C. Exponential growth
- D. Loans
- E. Rates vs. Yield

V. Geometry

- A. Perimeter/area/volume
- B. Unit conversions

VI. Additional Topics

- A. Logic
 - B. Numeration systems
 - C. **Inferential statistics**
 - D. Voting theory
 - E. **Math of music**
 - F. Index numbers
 - G. Graph theory
 - H. Geometry topics
 - 1. **Symmetry**
 - 2. Tessellations
 - 3. Fractals
-

COLLEGE ALGEBRA / FUNCTIONS

I. Behavior and Nature of Functions

- A. **Graphic, numeric, and algebraic representations**
- B. **Characteristics of basic functions**
- C. **Properties, operations, transformations, and inverses of functions**

II. Polynomial and Rational Functions

- A. **Polynomial and rational equations**
- B. **Graphs of polynomial and rational functions**
- C. **Applications**

III. Exponential and Logarithmic Functions

- A. **Exponential and logarithmic equations**
- B. **Graphs of exponential and logarithmic equations**
- C. **Applications**

IV. Systems of Equations and Inequalities

- A. **Linear systems**
- B. **Applications**

V. Optional topics

- A. **Matrices**
- B. Combinatorics
- C. Sequences and series
- D. **Conics**

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 STATISTICS

 2D

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 2D,  3D

2-YEAR COLLEGE MATHEMATICS

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PLANE TRIGONOMETRY

I. Definition and properties of trigonometric functions

- A. **Trigonometric functions of acute angles**
- B. Solving right triangles



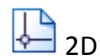
II. Circular functions

- A. **Radian measure**
- B. Length of an arc
- C. Area of a sector
- D. **Linear and angular velocity**



III. Graphs of trigonometric functions

- A. **Phase shift**
- B. **Addition of ordinates**



IV. Inverse trigonometric functions

V. Trigonometric identities

- A. **Fundamental identities**
- B. **Verifying trigonometric identities**
- C. **Sum and difference identities for cosine**
- D. **Double-angle identities**
- E. **Half-angle identities**



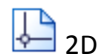
VI. Conditional equations

VII. Trigonometric formulas

- A. Law of sines
- B. Law of cosines

VIII. Complex numbers

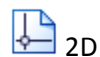
- A. **Trigonometric form of complex numbers**
- B. **De Moivre's theorem**
- C. **Roots of complex numbers**



PRECALCULUS

I. Solving and graphing inequalities

- A. **Linear**
- B. **Absolute value**
- C. **Quadratic**
- D. **Inequalities involving rational expressions**



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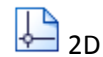
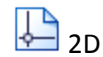
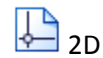
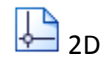
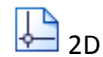
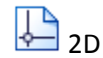
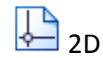
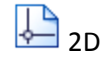
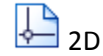
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II. Functions

- A. **Concept of function**
- B. **Graphs of functions**
- C. **Special functions and properties**
 - 1. **One-to-one**
 - 2. **Composite functions**
 - 3. **Inverse**
- D. **Linear functions**
 - 1. **Distance between points**
 - 2. **Midpoint of a line segment**
 - 3. **Parallel and perpendicular lines**
 - 4. **Equation of a line**
 - 5. **Graphs**
- E. **Quadratic functions and graphs**
- F. **Polynomials functions**
 - 1. **Remainder and factor theorems**
 - 2. **Synthetic division**
 - 3. **Fundamental theorem of algebra**
 - 4. **Rational and irrational roots**
 - 5. **Graphs of polynomial functions**
- G. **Rational functions and graphs**
- H. **Exponential and logarithmic functions**
 - 1. **Common logarithms**
 - 2. **Natural logarithms**
 - 3. **Properties of logarithms**
 - 4. **Solving exponential equations**
- I. **Trigonometric functions**
 - 1. **Right-triangle trigonometry**
 - 2. **Trigonometric functions of general angles**
 - 3. **Law of sines**
 - 4. **Law of cosines**
 - 5. **Graphs**
 - 6. **Inverses of trigonometric functions and graphs**

III. Analytical trigonometry

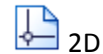
- A. **Trigonometric functions of real numbers**
- B. **Identities and proofs**
- C. **Addition formulas for sine and cosine**
- D. **Double-angle, half-angle, and reduction formulas**
- E. **Trigonometric equations**
- F. **Trigonometric form of complex numbers**
- G. **Polar coordinates**



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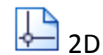
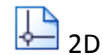
IV. Systems of equations and inequalities

- A. **Linear systems**
- B. **Matrices**
 - 1. Determinants
 - 2. Cramer's rule
 - 3. Algebra of matrices
 - 4. Inverses of matrices
- C. Nonlinear systems
- D. **Systems of inequalities**



V. Graphing aids

- A. **Intercepts and symmetry**
- B. **Asymptotes**
- C. **Excluded regions**
- D. **Curve sketching**



VI. Conic sections and graphs

- A. **Parabola**
- B. **Ellipse and circle**
- C. **Hyperbola**



VII. Sequences and series

- A. Arithmetic and geometric sequences
 - B. Series
 - C. Infinite geometric series
 - D. Mathematical induction
 - E. Binomial theorem
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BRIEF CALCULUS

I. Derivatives

- A. **Limits**
- B. **Slope and rate of change**
- C. **Definition of the derivative**
- D. **Rules of differentiation**
 - 1. **Product**
 - 2. **Quotient**
 - 3. **Chain rules**
 - 4. **Implicit**
 - 5. **Related rates**
 - 6. **Higher order**



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2-YEAR COLLEGE MATHEMATICS

II. Applications of the Derivative

- A. Increasing and decreasing functions
- B. Extrema and first-derivative test
- C. Concavity and second-derivative test
- D. Optimization problems
- E. Applications to business, life, and social sciences



2D

III. Integration

- A. Antiderivatives and indefinite integrals, including integration by parts
- B. Definite integrals and the fundamental theorem of calculus
- C. Improper integrals



2D

IV. Applications of Integration

- A. Area under a curve
- B. Area between two curves
- C. Applications related to business, life, and the social sciences



2D

CALCULUS WITH ANALYTIC GEOMETRY I

I. Limits and Continuity

- A. Definitions
- B. Computations with limits
 - 1. Algebraic
 - 2. Numerical
 - 3. Graphical
- C. Infinite limits
- D. Limits at infinity



2D

II. The Derivative

- A. Definition
- B. Techniques of differentiation
- C. Extrema of a function
- D. First and second derivative test
- E. Applications of the derivative



2D

III. The Integral

- A. Anti-derivatives and the indefinite integral
- B. Evaluate the definite integral
- C. Properties of the definite integral
- D. Fundamental theorem of calculus
- E. Elementary applications of the integral



2D

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CALCULUS WITH ANALYTIC GEOMETRY II

I. Techniques of Integration

- A. **Integration by parts**
- B. **Trigonometric integrals**
- C. **Trigonometric substitution**
- D. Integration of rational functions by partial fractions
- E. Integration tables
- F. **Improper Integrals**



II. Applications of Integral Calculus

- A. **Determination of volumes**
- B. **Physical and other sciences**



III. Elements of Analytic Geometry

- A. **Parametric equations**
- B. **Polar equations**
- C. **Conic sections**



IV. Sequences and Series

- A. Basic Definitions
 - 1. Geometric sequences and series
 - 2. Telescoping series
 - 3. P-series
 - 4. Alternating series
- B. Various tests for Conditional or Absolute Convergence
 - 1. Divergence test
 - 2. Integral test
 - 3. Direct and limit comparison tests
 - 4. Alternating series test
 - 5. Ratio test

V. Power Series

- A. Interval of convergence
- B. Polynomial approximations
- C. Power series representations of functions
- D. Differentiation and integration of power series

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CALCULUS WITH ANALYTIC GEOMETRY III

I. Vectors

- A. **Definitions**
- B. **Operations and their properties**
- C. **Representations of lines and planes**
- D. **Applications**



II. Vector-Valued Functions

- A. Definitions and representations
- B. Limits
- C. Derivatives
- D. Integrals
- E. Applications

III. Functions of Several Variables

- A. **Representation of surfaces by**
 - 1. Contour diagrams (family of level curves)
 - 2. **Graphs in three dimensions**
 - 3. Appropriate technology
- B. **Limits and continuity**
- C. Partial derivatives and their applications
- D. **Optimization problems**



IV. Multiple Integrals

- A. **Visualizing the domain of integration**
- B. Order of integration
- C. **Change of variables**
 - 1. **Cartesian coordinates**
 - 2. **Polar coordinates**
 - 3. **Cylindrical coordinates**
 - 4. **Spherical coordinates**
- D. Applications



V. Vector Fields and Line Integrals

- A. Definitions
- B. Properties
- C. Applications
- D. Surface integrals (Green's Theorem and Stokes' Theorem)
- E. Volume integrals (Gauss' Theorem)

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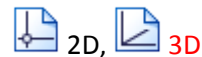
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ELEMENTARY LINEAR ALGEBRA

I. Linear Equations and Matrices

- A. **Linear Systems** : Methods of elimination; Dependent and inconsistent systems
- B. **Matrices**: Operations on matrices; Properties of matrix operations
Inverse of a matrix; **Solutions of equations using matrices**



II. Determinants

- A. Definitions and properties
- B. Cofactor expansion

III. Vectors and Vector Spaces

- A. **Vectors in R^2 and R^3**
Vector operations; Orthogonal and unit vectors
- B. Vectors in R^n
Inner product; Triangle inequality
- C. Vector spaces and subspaces
Properties of vector spaces; Definition of a subspace
Span of a set of vectors
- D. Linear independence
- E. Basis and dimension
Definition of a basis; Finite and infinite - dimensional vector spaces
- F. Rank of a matrix
Row rank and column rank;
Consistency of non homogeneous linear systems
- G. Orthonormal basis in R^n (Gram-Schmidt process)



IV. Eigenvalues and Eigenvectors

- A. Characteristic polynomials and equations for square matrices
- B. **Determining eigenvalues and eigenvectors for a square matrix**
- C. Diagonalization of a matrix



V. Linear Transformations and Matrices

- A. Properties and examples of linear transformations
- B. Kernel and range of a linear transformation
- C. **Matrix of a linear transformation**



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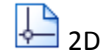
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DIFFERENTIAL EQUATIONS

I. Exact methods of solution

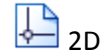
A. First order equations

1. Separable; Non-separable exact
2. Homogeneous
4. Integrating factor techniques
5. Linear coefficient functions



B. Second order equations

1. Homogeneous; Non-homogeneous; Cauchy-Euler



II. Power series methods

A. Homogeneous

1. Ordinary point solutions
2. Regular singular point solutions (optional)

B. Nonhomogeneous-Taylor series solutions (optional)

C. Successive approximations (optional)

III. Discrete approximations (optional)

A. Euler and improved Euler; Runge-Kutta

B. Adams-Bashforth/Adams-Moulton



IV. Systems of differential equations

A. Laplace transform; Differential operator method

B. Matrix method (optional)

V. Applications

A. First order; Second order; Systems



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