AP Calculus (AB)

Course Syllabus

2003-2004

CONTACT INFORMATION:

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TEXT:

Tinnin, John (2002). JT's CALCULUS (AB) WORKBOOK

INSTRUCTOR REFERENCE TEXTS:

- Forester, Paul (2002). CALCULUS: CONCEPTS AND APPLICATIONS. San Francisco: Key Curriculum Press.
- Varberg, Purcell (1992). CALCULUS WITH ANALYTIC GEOMETRY. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. (any edition)
- Thomas, Finney (1989): ELEMENTS OF CALCULUS AND ANALYTIC GEOMETRY. Addison-Wesley (any edition)

DESCRIPTION:

Calculus is a very interesting area of mathematics that comes a great number of people. Traditionally it is the first math course one takes in college for studies in mathematics, engineering, science and other fields To quote Richard Courant, "[Calculus is] the outcome of a dramatic intellectual struggle which has lasted for twenty-five hundred years. Its early roots lie in published writings of Newton, Leibniz, L'Hopital and others but Newton is generally recognized as the father of "The Calculus".

Our study will focus on three areas of calculus noted here:
Infinitesimal Calculus: A branch of mathematics dealing with the way that relations between certain sets (functions) are affected by very small changes in one of their variables (independent variable) as they approach zero.

Differential Calculus: The branch of mathematics dealing with continously varying quantities, with applications in determination of maximum and minimum points, and with rates of change through the use of derivatives and differentials.

Integral Calculus: A branch of mathematics dealing with integrals and differentail equations, used to determine areas, volumes, and lengths, and in many areas of applied mathematics.

PRE-REQUISITES: Proficiency in Pre-Calculus

GOALS:

1. To gain an appreciation for the beauty of calculus found in the world around us.
2. For those who elect to participate, to be proficient (at least a score of 3) on the 2003 AP Calculus AB exam given by the College Board.
3. To provide further understanding with the concepts presented in the Wyoming Math Content Standards.

Content Standards

Communications & Connections
Students apply Pre-Calculus and Calculus concepts in a problem solving situation involving real world problems and communicate their reasoning using mathematical language in clear and efficient ways. They make connections between Pre-Calculus and Calculus topics and other mathematical areas as well as to their own personal lives.

Limits
Students use and apply the concept of a limit to determine the derivative of most fundamental/basic Pre-Calculus functions (linear, quadratic, general polynomial, trigonometric, nth root, exponential, and logarithmic), to determine function continuity, to find asymptotes in rational and exponential functions, and to analyze the end behavior of functions. They understand and apply L'Hopital's Rule in determining the limit of Indefinite Forms.

Derivatives
Students determine the derivative of polynomial, trigonometric, nth root, exponential, and logarithmic functions by using various definitions and properties. They use and apply the derivative(s) of a function in determining the equation of a line tangent to a curve, the velocity or acceleration of a moving particle, characteristics of functions including roots (Newton's Method), critical values, increasing/decreasing characteristics, and concavity in problem solving situations. In addition, they understand the basic concepts of differentials and can apply them to numeric approximations.

Integrals
Students determine the indefinite integral for polynomial, trigonometric, nth root, exponential, and logarithmic functions by using various definitions and properties. They use and apply the definite integral of a function in determining the area under the curve, the area between curves, the surface area and volume of a Surface of Revolution, the length of a curve, and mean value of a function in problem solving situations. In addition, they can applied the basic understanding of the Riemann Sum as well as other numerical methods to do numeric integration.

Performance Standards

Advanced
In a problem solving situation, using appropriate tools and technology, Calculus students performing at an advanced level independently use and apply limits, derivatives and integrals to a variety of functions typically studied in Pre-Calculus to reach solutions and to make extended connections. Their mathematical models of real world problems are correct and all computations are accurate. They communicate their reasoning and solutions using appropriate and sometimes unique mathematical language using coherent, concise and precise sentence structure.

Proficient
In a problem solving situation, using appropriate tools and technology, Calculus students performing a proficient level use and apply limits, derivatives and integrals to a variety of functions typically studied in Pre-Calculus to reach solutions and to make connections. Their mathematical models of real world problems are mostly correct and most computations are accurate. They use appropriate mathematical language to communicate their reasoning in clear and logical ways.

Basic
In a problem solving situation, using appropriate tools and technology, Calculus students performing a basic level sometimes use and apply limits, derivatives and integrals to a variety of functions typically studied in Pre-Calculus to reach solutions and to make connections. Their mathematical models of real world problems, as well as computations are inaccurate and in-complete. They use minimal or incorrect mathematical language to communicate their thought processes.

Below Basic
Calculus students performing a novice level rarely use or apply limits, derivatives and integrals to a variety of functions typically studied in Pre-Calculus to reach solutions and to make connections. They fail to use appropriate mathematical language to communicate their reasoning in clear, concise and logical ways.

REQUIREMENTS:
At the beginning of each unit, students will be given an assignment guide that details what their assignments, quizzes and tests will be for the unit. Homework assignments (those items that are not quizzes or tests) are to be turned in as requested. Those assignments will be graded and recorded as a homework score.

Approximately every week, students will be required to take a test, either a short quiz that is directly taken from the weekly homework assignments, or a major chapter test, during the normal class period, in which they are to demonstrate proficiency with the topics at hand. These tests are traditional in nature and students will not be allowed to consult other reference material, other than those allowed by the instructor at that specific time.

At least once during the nine weeks, students may be required to take a "take home" exam that covers a significant portion of the course to that point. These tests are difficult and are intended to be intellicually stimulating. Students typically are given a week to complete the exam and are given apecific instructions about the exam as well as reminders regarding honor and what it means to be an honorable person.

Students are required to keep a notebook in which they document class notes, course definitions, their own conjectures, daily assignments, past exams and other material handed out in class. They are free to organize it in any way they choose however material must be organized, bounded, and easily accessible. A three ring binder is recommended with dividers. This notebook will be scored quarterly.

TOOLS:
Students will work frequently with a ruler, protractor, compass and a graphing calculator and it is helpful that they have their own. Those calculators can be ones that belong to the student or borrowed from the school. While the instructor does not wish to restrict free choice of tools, he uses a Texas Instrument TI-83 and a TI-89 and can answer support question involving them. Students that use other calculators are responsible for their own support issues.

The instructor will work frequently with Mathematica and Geometer's Sketchpad. While it is not required, it is recommended that each school install Geometer's Sketchpad and Mathematica on at least one computer, preferrably the one in theWEN Video Room.

GRADING:
All homework assignment and tests/quizzes will be graded according to your learning contract. As stated there, each assignment will be given four scores (one each for Problem Solving, Representation, Calculations, & Communication) using a four point scale, Those scores will be averaged to derive a score for the paper. The notebook, as mentioned above, will count as a single test score. As time progresses, all assignments, as well as tests, will be averaged separately to determine a homework and test average. Those averages will then be used, applying the 40% (Homework) /60% (Tests) weighting to compute a final grade for the quarter. Since a percentage is reported back to the schools that quarter grade, which will be on a four point scale, will be converted to a percent by applying the following:

3.3 +	95%
2.1 – 3.2	85%
1.0 – 2.0	75%

All students will be advised of their grade weekly and that grade will be given as a percent. The assignment of a letter grade to that percent will be done by the schools involved, according to the policies of those schools.

Unless reguired by a school, there will not be a semester exam.

RULES:
1. Please treat everyone with dignity, courtesy, and respect.
2. Please keep yourself and others safe from harm.
3. Please respect the physical and intellicual property of others.
4. Please encourage learning and mental exercise within yourself and others and come to class intellicually and physically prepared.

COURSE OBJECTIVES:

The student will be able to:

1. Describe the domain and range, specify basic characteristics, find the inverse (if it exists) and sketch the graph of a function and/or its inverse over a specified interval, that is either polynomial (with n <= 10), rational, radical, trigonometric, exponential, logarithmic, absolute value, step, or piece-wise defined.
2. Determine the limit of a function, specified in #1, as the independent variable approaches a constant or Infinity. Included herein, are Indeterminate Forms and the use of L'Hopital's Rule.
3. Establish theorems for finding the derivative of a function by using the definition of a derivative.
4. Determine the first, second and continued derivatives for polynomial, rational, radical, trigometric, exponential, logarithmic, absolute value, step, or piece-wise defined.
5. Sketch the graphs of functions by using properties of the first and second derivative to determine where a function increases or decreases, to find relative maximum or minimum points, to describe a functions concavity, and to determine what a function does as the independent variable approaches infinity.
6. Demonstrate full understanding of the Fundamental Theorem of Calculus and establish theorems for finding the integral of a function. With those theorem establish, integrate polynomial (with n <= 10), rational, radical, trigonometric, exponential, logarithmic, absolute value, step, or piece-wise defined functions.
7. Fully communciate the principles that develop the concepts of differentiation and integration as well as describe the differences between the indenfinte and definite integral.
8. Use the Reimann Sum and other numerical methods to compute the definite integral of a function defined on an interval.
9. Use the definite integral to compute the area, volume and arc length of functions under specific conditions.
10. Use derivatives or integrals to solve practical application problems.
11. Students use appropriate tools and technologies to model, measure, and apply the results in a problem-solving situation.

Table of Contents

5. General Integration (24 days)

Lesson 49 – The Indefinite Integral and the Antiderivative
Lesson 50 – Antidifferentiation Rules and Techniques
Lesson 51 – Series & Finite Differences
Lesson 52 – Estimating Area of a Region (Left & Right)
Lesson 53 - The Area of a Region (Reimann Sum)
Lesson 54 – The Fundamental Theorem of Calculus
Lesson 55 - The Definite Integral
Lesson 56 – Properties of the Definite Integral
Lesson 57 – Substitution & the Definite Integral
Lesson 58 – Integration of the Inverse Trig Functions
Lesson 59 - Integration of Exponential & Logarithmic Functions

6. Differential Equations (8 days)

Lesson 60 – Definition of a Differential Equation
Lesson 61 – Slope Fields including Solutions of Intial Value Problems
Lesson 62 – Solving Separable Differential Equations

7. Applications of the Definite Integral (22 days)

Lesson 63 – Displacement, Velocity, Acceleration Revisited
Lesson 64– Areas of Plane Regions (Part 1)
"Integrate with respect to the x axis"
Lesson 65 – Areas of Plane Regions (Part 2)
"Integrate with respect to the y axis"
Lesson 66 – Volume: Solids of Revolution (Disks)
Lesson 67 – Volume: Solids of Revolutions (Washers)
Lesson 68 – Volume: Solids of Revolutions (Shells)
Lesson 69 – Volume of Solids with Known Cross Sections
Lesson 70 – Numerical Integration
Lesson 71 – Arc Length: Explicit & Parametric
Lesson 72 – Area of a Surface of Revolution
Lesson 73 – Average Value & Work
Lesson 74 – Moments & Center of Mass (Optional)

8. AP Calculus (AB) Exam Review (8 days)

Lesson 75 – Free Response Questions: Various Years
Lesson 76 – Released Exams: AP Calculus AB & BC
Lesson 77– 2004 AP Calculus (AB) Exam - May 5th

9. More Integration Techniques (Optional)(12 days)

Lesson 78 – Techniques of Integration: Powers of Sine & Cosine
Lesson 79 – Techniques of Integration: Rationalizing Substitutions
Lesson 80 – Techniques of Integration: Integration by Parts
Lesson 81 – Techniques of Integration: Integration of Rational Functions
Lesson 82 – Integration of Powers of Tangent, Cotangent, Secant, Cosecant
Lesson 83 – Using the Standard Mathematical Tables Book

Total Instruction Days (177 Days)

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We, the undersigned, have read this document and accept its contents, with the following exceptions or questions.

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Student: _____ Date: _____

Parent / Guardian: _____ Date: _____

Instructor Name: _____ Date: _____