Course: **Advanced Placement Calculus AB**

A. Functions

1. Properties of functions

a. Definition, domain, and range
b. Sum, product, quotient, and composition
c. Absolute value (See Figure # 1)
d. Inverse
e. Odd and even
f. Periodicy
g. Graphs; symmetry and asymptotes
h. Zeros of a function

$|f(x)|$ and $f(|x|)$

Figure # 1

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

Figure # 2

2. Limits

a. Statement and applications of properties
b. The number e (See Figure # 2)
c. The limit of the ratio of sin x to x as x gets small. (See figure # 3)
d. Nonexistent limits; including reasoning
e. Continuity
f. Statements and applications involving continuity

$$\lim_{x\to 0}\frac{\sin x}{x} = 1$$

Figure # 3

B. Differential Calculus

1. The derivative

a. Both definitions (See Figure # 4)
b. Derivatives of elementary functions
c. Derivatives of sum, product, and quotient
d. Derivatives of a composite functions (Chain Rule)
e. Derivatives of an implicitly defined function
f. Derivative of the invers of a function
g. Logarithmic Differentiation
h. Derivatives of higher order
i. Application and graphical illustraitons of Mean Value Thm
j. Relation between differentiability and continuity
k. Use of l'Hopital's rule (quoteint indeterminate forms)

$$\lim_{x\to a}\frac{f(x)-f(a)}{x-a} = f'(a)$$

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h} = f'(x)$$

Figure # 4

(continued below)

2. Applicatons of the derivative

   a. Slope of a curve; tangent and normal lines to a curve (including linear approx)
   b. Curve sketching

      1. Increasing and decreasing functions
      2. Critical points, rel and abs max and min points
      3. Concavity
      4. Points of inflection

   c. Extreme value problems
   d. Velocity and acceleration of a particle moving along a line
   e. Average and instantaneous rates of change
   f. Related rates of change
   g. Newton's Method of solving for roots of equations

C. Integral Calculus

1. Antiderivatives
2. Appications of antiderivatives
   a. Distance and velocity from acceleration with initial conditions
   b. Solutions of $y' = ky$ and applications to growth and decay
   c. Solutions of $f(y)dy = g(x)\,dx$ (variables separable)
3. Techniques of integration
   a. Basic integration formulas
   b. Integration by substitution
   c. Simple integration by parts
4. The definite integral
   a. Concept of the definite integral as an area
   b. Approximations to the definite integral by using rectangles or trapezoids
   c. Definition of the definite integral as alimit of a sum
   d. Properties of the definite integral
   e. Fundamental theorems (See Figure # 5)
5. Applications of the integral
   a. Average value of a function on an interval
   b. Area between curves
   c. Volume of a solid of revolution (disc, washer, and shell methods about either axis.

$$\frac{d}{dx}\int_a^x f(t) = f(x) \quad \textit{and}$$

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

where $F'(x) = f(x)$

Figure # 5