

**10% Limits**

- Statement of properties, e.g., limit of a constant, sum, product, or quotient
- Limit calculations, including limits involving infinity, e.g.,  $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$ ,  $\lim_{x \rightarrow 0} \frac{1}{x}$  is nonexistent, and  $\lim_{x \rightarrow \infty} \frac{\sin x}{x} = 0$
- Continuity

**50% Differential Calculus**

The Derivative

- Definitions of the derivative  
e.g.,  $f'(a) = \lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$   
and  $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$
- Derivatives of elementary functions
- Derivatives of sums, products, and quotients (including  $\tan x$  and  $\cot x$ )
- Derivative of a composite function (chain rule), e.g.,  $\sin(ax + b)$ ,  $ae^{kx}$ ,  $\ln(kx)$
- Implicit differentiation
- Derivative of the inverse of a function (including  $\arcsin x$  and  $\arctan x$ )
- Higher order derivatives
- Corresponding characteristics of graphs of  $f$ ,  $f'$ , and  $f''$
- Statement of the Mean Value Theorem; applications and graphical illustrations
- Relation between differentiability and continuity
- Use of L'Hospital's Rule (quotient and indeterminate forms)

Applications of the Derivative

- Slope of a curve at a point
- Tangent lines and linear approximation
- Curve sketching: increasing and decreasing functions; relative and absolute maximum and minimum points; concavity; points of inflection
- Extreme value problems
- Velocity and acceleration of a particle moving along a line
- Average and instantaneous rates of change
- Related rates of change

**40% Integral Calculus**

Antiderivatives and Techniques of Integration

- Concept of antiderivatives
- Basic integration formulas
- Integration by substitution (use of identities, change of variable)

Applications of Antiderivatives

- Distance and velocity from acceleration with initial conditions
- Solutions of  $y' = ky$  and applications to growth and decay

The Definite Integral

- Definition of the definite integral as the limit of a sequence of Riemann sums and approximations of the definite integral using areas of rectangles
- Properties of the definite integral
- The Fundamental Theorem:

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

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

Applications of the Definite Integral

- Average value of a function on an interval
- Area, including area between curves
- Other (e.g., accumulated change from a rate of change)