Knewton Alta

Calculus Early Transcendentals | Table of Contents

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  - Solve a first order differential equation using a power series
  - Solve Airy's equation using a power series (5)

10.3 Taylor and Maclaurin Series
- Taylor and Maclaurin Polynomials
  - Recognize a Taylor series (5)
  - Find the Taylor polynomials for a function at a value (40)
- Estimating Function Values with Taylor and Maclaurin Series
  - Find the Maclaurin polynomials for a function (40)

        - Determine the error of a estimated function value using Taylor's theorem (5)
        - Estimate a function value using Taylor polynomials (40)
        - Estimate a trigonometric function value using Maclaurin polynomials (5)
    - Representing Functions with Taylor and Maclaurin Series
        - Represent a function at a value with a Taylor series and determine the interval of convergence
        - Find the Maclaurin series for a function and show that the series converges

10.4 Working with Taylor Series

- Binomial Series
    - Find the binomial series for function (5)
    - Estimate a function value using a binomial series (5)
- Finding the Maclaurin Series that Represents a Function
    - Find the Maclaurin series for a trigonometric function (5)
    - Find the Maclaurin series for a logarithmic or exponential function (5)
    - Find a Maclaurin series by differentiating another series (5)
- Applications of the Taylor and Maclaurin Series
    - Evaluate a nonelementary definite integral using a Taylor series (5)
    - Approximate a probability using a Maclaurin series (5)
    - Approximate the period of a pendulum using a binomial series

Chapter 11: Parametric Equations and Polar Coordinates

11.1 Parametric Equations

- Write Parametric Equations
    - Parameterize a curve (5)
    - Find the parametric equations for a line segment given an orientation (5)
- Eliminate the Parameter
    - Eliminate the parameter in linear equations (5)
    - Eliminate the parameter in polynomial and radical equations (8)
    - Eliminate the parameter in exponential and logarithmic equations (8)
    - Eliminate the parameter in trigonometric parametric equations (5)
- Graph Parametric Equations
    - Graph parametric equations by plotting points (5)
    - Graph trigonometric parametric equations by plotting points (5)
    - Use parametric equations in applications
- Cycloids
    - Graph a cycloid defined by parametric equations (5)
    - Determine the number of cusps on a hypocycloid (5)

11.2 Calculus of Parametric Curves

- Derivatives of Parametric Equations
    - Find the derivative of a curve defined by polynomial parametric equations
    - Find the derivative of a curve defined by trigonometric parametric equations
    - Find the equation of a line tangent to a parametrically defined curve
    - Find the second derivative of curve defined by parametric equations (5)
- Integrating Parametric Curves

        - Find the area under a curve defined by parametric equations (5)
        - Find the arc length of a curve defined by trigonometric parametric equations (5)
        - Find the surface area of a volume of revolution generated by revolving a parametrically defined curve

11.3 Polar Coordinates

- Defining Polar Coordinates
    - Locate points in a plane by using polar coordinates
    - Convert coordinates from polar form to rectangular form
    - Convert coordinates from rectangular form to polar form
- Converting Equations Between Rectangular and Polar Forms
    - Convert a cartesian equation to polar form
    - Convert a polar equation to cartesian form
- Graphs Using Polar Coordinates
    - Identify symmetry in polar equations and curves
    - Graph polar equations by plotting points and find zeros and maximum values for a polar equation

11.4 Calculus in Polar Coordinates

- Area and Arc Length in Polar Coordinates
    - Find the area of a region between two polar curves
    - Find the arc length of a polar curve
    - Find the area of a region bounded by a polar curve

Chapter 12: Vectors in Space

12.1 Vectors in the Plane

- Introduction to Plane Vectors
    - Describe a plane vector using correct notation (5)
    - Perform the basic vector operations of scalar multiplication and vector addition and subtraction
    - Determine if vectors are equivalent
- Vectors in Component Form
    - Express a vector in component form
    - Find the magnitude of a vector and perform vector operations in component form
    - Find the component form of a vector using trigonometry
- Unit Vectors
    - Find a unit vector
    - Express a vector in terms of standard unit vectors (5)
- Application of Vectors
    - Find a resultant force or velocity using vectors

12.2 Vectors in Three Dimensions

- Introduction to Three-Dimensional Coordinate Systems
    - Sketch a point in three-dimensional space
    - Find the distance between two points in space
- Graph Equations in Three Dimensions
    - Write the equation of a plane parallel to a coordinate plane

        - Find the equation of a sphere
        - Graph other equations in three dimensions
    - Application of Vectors in Three Dimensions
        - Graph and find component forms for vectors in three dimensions
        - Perform vector operations in three dimensions
        - Applications of vectors in three dimensions

12.3 The Dot Product

- Properties of the Dot Product
    - Calculate a dot product
    - Use properties of the dot product
- Angles Between Vectors and Directional Angles
    - Find the angle between two vectors using dot products and magnitudes
    - Determine if vectors are orthogonal (5)
    - Determine directional angles and directional cosines (5)
- Projections of Vectors
    - Determine a vector projection
    - Resolve a vector into components
- Applications of Dot Products
    - Use a scalar projection to determine a velocity
    - Use a dot product to determine amount of work (5)

12.4 The Cross Product

- Properties of the Cross Product
    - Find the cross product of two vectors (5)
    - Find the cross product of standard unit vectors and use properties of the cross product
    - Find the magnitude of a cross product (5)
    - Use a determinant to find a cross product (5)
- Find Orthogonal Vectors and Areas with Cross Products
    - Find a unit vector orthogonal to two given vectors
    - Find the area of a parallelogram or triangle using a cross product
- Triple Scalar Products and Volumes of Parallelepipeds
    - Calculate a triple scalar product (5)
    - Find the volume of a parallelepiped (5)
- Applications of Cross Products
    - Determine if vectors are coplanar and find a vector orthogonal to a plane
    - Calculate torque

12.5 Equations of Lines and Planes in Space

- Vector and Parametric Equations of a Line
    - Find parametric and symmetric equations of a line passing through two points
    - Find parametric equations of a line segment (5)
    - Calculate the distance from a point to a line (5)
    - Determine if two lines are parallel, intersecting, or skew (5)
- Equations for a Plane
    - Write the equation of a plane given points or lines (5)
    - Find the distance between a plane and a point (5)

- Parallel and Intersecting Planes
    - Find the line of intersection for two planes
    - Find the angle between two planes (5)
    - Find the distance between two parallel planes (5)

12.6 Quadric Surfaces

- Identifying Cylinders
    - Identify the graph of a cylindrical surface given an equation
- Identifying Quadric Surfaces
    - Recognize a quadric surface and sketch an ellipsoid
    - Identify the equation or traces of a hyperboloid of one or two sheets or an elliptic cone
    - Identify the equation or traces of an elliptic paraboloid or hyperbolic paraboloid

12.7 Cylindrical and Spherical Coordinates

- Cylindrical Coordinates
    - Convert between cylindrical and rectangular coordinates
    - Identify a surface in the cylindrical coordinate system
- Spherical Coordinates
    - Convert between spherical and rectangular coordinates
    - Identify a surface in the spherical coordinate system

Chapter 13: Vector-Valued Functions

13.1 Vector-Valued Functions and Space Curves

- Definition and Graphs of Vector-Valued Functions
    - Evaluate and determine the domain of a vector-valued function
    - Graph a vector-valued function (5)
- Limits and Continuity of Vector-Valued Functions
    - Evaluate the limit of a vector-valued function (5)
    - Determine if a vector-valued function is continuous at a point (5)

13.2 Calculus of Vector-Valued Functions

- Derivatives of Vector-Valued Functions
    - Find the derivative of a vector-valued function (5)
    - Use linear properties of derivatives of vector-valued functions
    - Use dot product, cross product, and chain rule properties of derivatives of vector-valued functions (5)
- Tangent Vectors and Unit Tangent Vectors
    - Find the unit tangent vector to a vector-valued function
- Integrals of Vector-Valued Functions
    - Find the antiderivative of a vector-valued function
    - Find the definite integral of a vector-valued function

13.3 Arc Length and Curvature

- Arc Length and Arc-Length Parameterization
    - Find the arc length for a vector-valued function
    - Find an arc-length parameterization for a vector-valued function
- Curvature

        - Find the curvature of a curve
    - Normal and Binormal Vectors
        - Find the principal unit normal vector and binormal vector of a curve
        - Find the equation of an osculating circle

13.4 Motion in Space

- Motion Vectors in the Plane and in Space and Components of the Acceleration Vector
    - Find the velocity, acceleration, and speed of a particle moving along a curve (5)
    - Find the tangential and normal components of acceleration
- Projectile Motion
    - Solve problems involving projectile motion

Chapter 14: Differentiation of Functions of Several Variables

14.1 Functions of Several Variables

- Graphs of Functions of Two Variables
    - Find the domain and range of a function of two variables (5)
    - Identify the graph of a two variable function
- Level Curves and Vertical Traces of Functions of Two Variables
    - Find the level curves of a function of two variables (5)
    - Find the vertical traces of a function of two variables (5)
- Graphs and Level Curves of Functions of Three Variables
    - Find the domain of a function of three variables
    - Find the level surfaces of a function of three variables

14.2 Limits and Continuity for Functions of Several Variables

- Limit of a Function of Two Variables
    - Find the limit of a function of two variables using direct substitution (5)
    - Use paths to determine if the limit of a function of two variables exists
- Continuity of a Function of Two Variables
    - Understand the conditions for continuity of a function of two variables at a point
    - Determine the region of the coordinate plane where a function of two variables is continuous
- Limit of a Function of Three or More Variables
    - Find the limit of a function of three variables (5)

14.3 Partial Derivatives

- Partial Derivatives of a Function of Two Variables
    - Find the partial derivative of a function of two variables (40)
    - Estimate the partial derivative of a function at a point from a graph or contour map
- Partial Derivatives of a Function of Three or More Variables
    - Find the partial derivative of a function of three variables
- Higher Order Partial Derivatives
    - Find the higher order partial derivatives of a function of two variables (40)
- Partial Differential Equations
    - Verify a solution to a partial differential equation

14.4 Tangent Planes and Linear Approximations

- Tangent Planes

        - Find the equation of the tangent plane to a surface at a point (5)
    - Linear Approximations of Functions of Several Variables
        - Approximate the value of a function of several variables using a linear approximation
    - Differentiability of Functions of Several Variables
        - Understand differentiability for a function of several variables and the relationship between continuity of first partials and differentiability
    - Differentials and Maximum Error
        - Use the differential to approximate the change in a function given the change in the inputs or to calculate maximum error (40)

14.5 The Chain Rule

- The Chain Rule for Functions of Several Variables
    - Use the chain rule for one independent variable (40)
    - Use the chain rule for two independent variables
    - Use the generalized chain rule (40)
- Implicit Differentiation by Partial Derivatives
    - Use implicit differentiation to find partial derivatives

14.6 Directional Derivatives and the Gradient Vector

- Directional Derivatives and Gradients for Functions in Two Variables
    - Find the directional derivative of a function of two variables (5)
    - Find the gradient of a function of two variables (5)
- Applications of Directional Derivatives and Gradients
    - Find the maximum and minimum directional derivative of a function of two variables
    - Understand the relationship between the gradient and level curves of a two variable function (5)
- Directional Derivatives and Gradients for Functions in Three Variables
    - Find the gradient of a function of three variables (5)
    - Find the directional derivative of a function of three variables

14.7 Maximum and Minimum Values for Functions of Two Variables

- Critical Points and the Second Derivative Test for Functions of Two Variables
    - Find critical points of a function of two variables (40)
    - Use the second derivative test to classify critical points of a function of two variables (40)
- Absolute Extrema and Applications for Functions of Two Variables
    - Find the absolute extrema of a function of two variables on a closed region (40)
    - Solve maximization and minimization word problems with multiple variables (6)

14.8 Lagrange Multipliers

- Lagrange Multipliers with One Constraint
    - Use Lagrange multipliers to find maximum and minimum values of a function of two variables with a single constraint (40)
    - Use Lagrange multipliers to find maximum and minimum values of a function of three variables with a single constraint (40)
- Lagrange Multipliers with Two Constraints
    - Use Lagrange multipliers to find maximum and minimum values of a function with two constraints (40)

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Chapter 15: Multiple Integration

15.1 Double Integrals over Rectangular Regions

- Volume and Double Riemann Sums
  - Set up and approximate a double integral over a rectangular region (5)
- Iterated Integrals and Properties of Double Integrals
  - Recognize and use some of the properties of double integrals (40)
  - Evaluate a double integral over a rectangular region by writing it as an iterated integral (40)
  - Evaluate a double integral over a rectangular region by reversing the order of integration (40)
- Applications of Double Integrals Over Rectangular Regions
  - Find the volume under a surface (5)
  - Find the average value of a function over a rectangular region (40)

15.2 Double Integrals over General Regions

- Double Integrals Over Nonrectangular Regions
  - Recognize when a function of two variables is integrable over a general region (5)
  - Evaluate a double integral by computing an iterated integral over a region bounded by two lines and two functions (40)
- Double Integrals by Decomposing Regions or Changing the Order of Integration
  - Evaluate a double integral over a more complex region by decomposing the region (40)
  - Simplify the calculation of an iterated integral by changing the order of integration
- Applications of Double Integrals Over General Regions
  - Use double integrals to calculate the area of a general plane region (5)
  - Use double integrals to calculate the volume of a region between two surfaces over a general plane region (40)
  - Find the average value of a function over a general region
- Improper Double Integrals
  - Evaluate a double improper integral (5)
- The Joint Density Function with Double Integrals
  - Find the probability given a joint density function
  - Find the expected value given a joint density function (5)

15.3 Double Integrals in Polar Coordinates

- Double Integrals Over a Polar Rectangular Region
  - Express a region of the plane in terms of polar coordinates (5)
  - Evaluate a double integral in polar coordinates by using an iterated integral (5)
  - Convert an integral from rectangular to polar coordinates and evaluate (5)
- Double Integrals Over a General Polar Region
  - Evaluate a double integral over a general polar region
- Polar Areas and Volumes
  - Use double integrals in polar coordinates to compute areas (5)
  - Use double integrals in polar coordinates to compute the area between polar curves (5)
  - Use double integrals in polar coordinates to compute volume
- Improper Double Integrals in Polar Coordinates

- Evaluate a double improper integral in polar coordinates (5)

15.4 Triple Integrals

- Triple Integrals Over a Rectangular Box
  - Evaluate a triple integral over a box
- Triple Integrals Over a General Bounded Region
  - Evaluate a triple integral over a general bounded region (5)
  - Simplify a calculation by changing the order of integration of a triple integral (5)
- Volume and Average Value of a Function of Three Variables
  - Find the volume of a general bounded region using a triple integral
  - Calculate the average value of a function of three variables

15.5 Triple Integrals in Cylindrical and Spherical Coordinates

- Integration in Cylindrical Coordinates
  - Evaluate a triple integral over a cylindrical box (5)
  - Convert a triple integral from rectangular to cylindrical coordinates and evaluate
- Integration in Spherical Coordinates
  - Evaluate a triple integral in spherical coordinates (5)
  - Convert a triple integral from rectangular to spherical coordinates and evaluate
  - Change the order of integration in a spherical triple integral (5)
- Volume in Spherical Coordinates
  - Compute the volume of a portion of a sphere using spherical coordinates (5)
  - Compute the volume between two surfaces in spherical coordinates (5)

15.6 Calculating Centers of Mass and Moments of Inertia

- Center of Mass in Two Dimensions
  - Use double integrals to find the total mass of a lamina given its density function
  - Use double integrals to find the moments and center of mass of a lamina
  - Use double integrals to locate the centroid of a two-dimensional region
- Moments of Inertia in Two Dimensions
  - Use double integrals to find the moments of inertia of a two-dimensional object (5)
  - Use double integrals to find the radius of gyration of a two-dimensional object (5)
- Center of Mass in Three Dimensions
  - Use triple integrals to find the mass of a three-dimensional object (5)
  - Use triple integrals to locate the center of mass of a three-dimensional object
- Moments of Inertia in Three Dimensions
  - Use triple integrals to find the moments of inertia of a solid (5)

15.7 Change of Variables in Multiple Integrals

- Planar Transformations and Jacobians
  - Determine the image of a region under a given transformation of variables
  - Compute the Jacobian of a given transformation
- Change of Variables for Double Integrals
  - Evaluate a double integral using a change of variables (5)
- Change of Variables for Triple Integrals
  - Evaluate a triple integral using a change of variables (5)

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Chapter 16: Vector Calculus

16.1 Vector Fields

- Drawing a Vector Field
  - Find the vector associated with a given point in a vector field (5)
  - Identify the plot of a two-dimensional vector field
  - Identify the plot of a three-dimensional vector field
- Gradient Fields
  - Plot the gradient vector field of a scalar function (5)
  - Verify a potential function for a vector field
  - Use the cross-partial property to determine if a vector field is not conservative

16.2 Line Integrals

- Scalar Line Integrals
  - Calculate a scalar line integral along a general curve
  - Find the arc length of a curve using a line integral
- Vector Line Integrals
  - Calculate a vector line integral along an oriented curve in space
  - Calculate a vector line integral written in expanded notation (5)
  - Use properties to compute a vector line integral
- Applications of Line Integrals
  - Calculate the mass of a wire (5)
  - Use a line integral to compute the work done in moving an object along a curve in a vector field
- Flux and Circulation
  - Compute the flux of a vector field across a curve
  - Calculate the circulation of a vector field

16.3 Conservative Vector Fields

- Curves and Regions
  - Identify simple and closed curves
  - Identify connected and simply connected regions (5)
- Fundamental Theorem for Line Integrals
  - Use the Fundamental Theorem for Line Integrals to compute line integrals
  - Understand the definition of path independence (5)
  - Find the potential function for a vector field in two dimensions (5)
  - Find the potential function for a vector field in three dimensions
- Potential Functions for Line Integrals
  - Use the cross-partial property to show that a vector field is conservative
  - Find the potential function and use it to compute a line integral

16.4 Green’s Theorem

- Circulation Form of Green's Theorem
  - Apply the circulation form of Green's theorem (5)
  - Use Green's theorem to calculate work
  - Use Green's theorem to find the area of a region enclosed by a curve

- Flux Form of Green's Theorem
    - Apply the flux form of Green's theorem
    - Find the flux in a word problem context
- Source Free and Harmonic Functions
    - Determine if a vector field F is source free and find a stream function for F (5)
    - Determine if a vector field satisfies Laplace's equation
- Green's Theorem on General Regions
    - Use Green's theorem on a region with holes

16.5 Divergence and Curl

- Divergence
    - Find the divergence of a vector field (5)
    - Determine if a vector field is magnetic (5)
- Divergence and Flow
    - Determine if a vector field is source free using the divergence test (5)
    - Use divergence to determine flow of a fluid
- Curl
    - Compute the curl of a vector field
    - Show that a vector field is not the curl of another vector field (5)
- Applications of Curl
    - Use curl to determine if a vector field is conservative
    - Use Laplace's equation to determine if a function can represent an electrostatic potential

16.6 Surface Integrals

- Parametric Surfaces
    - Identify the surface described by a parametrization
    - Find a parametrization for a surface
    - Identify a smooth, regular parametrization of a surface (5)
- Scalar Surface Integrals
    - Find the surface area of a parametrized surface
    - Calculate the surface integral of a scalar valued function
    - Calculate the mass of a sheet described by a parametrized surface
- Surface Integrals of a Vector Field
    - Find an orientation for a surface
    - Calculate a surface integral of a vector field
- Applications of Surface Integrals
    - Calculate mass flow rate using a surface integral
    - Calculate heat flow using a surface integral

16.7 Stokes’ Theorem

- Understand and Apply Stokes' Theorem
    - Understand Stokes' theorem
    - Use Stokes' theorem to compute a surface integral
    - Use Stokes' theorem to compute a line integral
    - Use Faraday's law to compute the curl of an electric field (5)

16.8 The Divergence Theorem

- Understand and Apply the Divergence Theorem
    - Understand the divergence theorem
    - Use the divergence theorem to compute the flux across a closed surface
- Divergence Theorem for Electrostatic Fields
    - Apply the divergence theorem to electrostatic fields

Chapter 17: Second-Order Differential Equations

17.1 Homogeneous Second-Order Linear Differential Equations

- Understanding and Classifying Linear Differential Equations
    - Identify linear and homogeneous differential equations (5)
    - Verify a solution to a differential equation
- The Superposition Principle
    - Understand the superposition principle
    - Identify linearly dependent functions
    - Find the general solution to a differential equation
- Solving Homogeneous Second-Order Linear Differential Equations
    - Solve a second-order differential equation with constant coefficients, characteristic equation has distinct roots (5)
    - Solve a second-order differential equation with constant coefficients, characteristic equation has a repeated root (5)
    - Solve a second-order differential equation with constant coefficients, characteristic equation has complex roots (5)
- Initial Value Problems for Second-Order Linear Differential Equations
    - Solve an initial value problem for a second-order differential equation (5)
    - Solve a second-order differential equation representing a spring problem (5)
    - Solve a boundary value problem for a second-order differential equation

17.2 Nonhomogeneous Linear Equations

- Finding Particular Solutions Using Undetermined Coefficients
    - Given a particular solution, find the general solution to a nonhomogeneous differential equation
    - Use the method of undetermined coefficients when r(x) is a polynomial or exponential
    - Use the method of undetermined coefficients when r(x) is a more complicated function
    - Use the method of undetermined coefficients when r(x) is a solution of the complementary equation
- Finding Particular Solutions Using Variation of Parameters
    - Use Cramer's rule to solve a system of equations with variable coefficients (5)
    - Use the method of variation of parameters to find a particular solution to a differential equation

17.3 Applications of Second-Order Differential Equations

- Simple Harmonic Motion
    - Solve problems involving simple harmonic motion
    - Express a sum of trigonometric functions as a single trigonometric function (5)
- Damped Spring-Mass Systems
    - Solve an overdamped spring-mass system (5)

        - Solve a critically damped spring-mass system
        - Solve an underdamped spring-mass system
        - Find the transient and steady-state solution in an application problem
    - RLC Series Circuits
        - Solve problems involving an RLC series circuit

17.4 Power Series Solutions

- Solve Differential Equations with Power Series
    - Find a power series solution to a differential equation