

Section 17.1 Double Integrals

- Understand the definition of a double integral over a region in the plane. You should also understand how this definition arises from looking at the limit over all Riemann sums based on refinements of inner rectangular partitions of a region in the plane.
- Understand how to use partitions and a sum of rectangular solids arising from a given partition in order to approximate the value of a double integral.
- Memorize Fubini's Theorem, and be able to apply it to evaluate a double integral by rewriting it as an iterated integral.
- Know and be able to apply the basic properties of double integrals.
- Given a description of a region in the plane R , be able to express R using the limits of integration of an iterated integral. Also, given a iterated double integral, be able to graph the region of integration.

Section 17.2 Area and Volume (Using Double Integrals)

- Be able to express the area of a region in the plane as an iterated integral. These regions could be rectangular, or could be bounded by a pair of functions in one of the two variables.
- Be able to express the volume under a given function and over a region in the plane as an iterated integral.
- Be able to find the area of a region in the plane or the volume under a given function and over a region in the plane by evaluating iterated integrals.

Section 17.3 Double Integrals in Polar Coordinates

- Understand how to translate a double integral over a region in the plane into an iterated polar integral. In particular remember the differential involved: $dA = r dr d\theta$.
- Given a description of a region R in the plane, be able to set up an iterated polar integral representing the area of the region.
- Given a description of a function over a region R in the plane, be able to set up an iterated polar integral representing the volume of the solid under the function and over the region R .
- Be able to translate a rectangular iterated integral into a polar iterated integral.
- Be able to determine, based on the form of the region and/or the integrand, whether a double integral would best be evaluated using rectangular coordinates, or whether polar coordinates would be a better choice of coordinate systems.

Section 17.4 Surface Area

- Understand how to represent the surface area of a surface over a region in the plane using a double integral.
- Be able to set up and evaluate iterated double integrals representing the surface area of a surface over the plane when given a description of the surface.

Section 17.5 Triple Integrals

- Understand the definition of a triple integral over a solid in space. You should also understand how this definition arises from looking at the limit over all Riemann sums based on refinements of inner rectangular partitions of a given solid.
- Memorize Fubini's Theorem for triple integrals, and be able to apply it to evaluate a triple integral by rewriting it as an iterated integral both over a rectangular solid and over more complicated solids.
- Given a description of a solid Q , be able to express Q using the limits of integration of an iterated integral. Also, given a iterated triple integral, be able to graph the solid of integration Q .

Section 17.6 Mass, Moments, and Center of Mass

- Be able to use a double integral to find the mass of a Lamina bounded by a region R in the plane and having density function $\delta(x, y)$ in R .
- Be able to use a triple integral to find the mass of a solid Q given a density function $\delta(x, y, z)$ for points in Q .
- Be able to use double integrals to compute the moments and to find the center of mass of a Lamina bounded by a region R in the plane.
- Be able to use triple integrals to find the moments and center of mass of a solid Q .

Section 17.7 Cylindrical Coordinates

- Understand the definition of cylindrical coordinates and memorize the formulas used to convert from rectangular coordinates to cylindrical coordinates and vice versa.
- Memorize the evaluation theorem for iterated integrals in cylindrical coordinates, especially the differential $dV = r dr d\theta dz$.
- Given an iterated integral in cylindrical coordinates, be able to graph the solid Q determined by the limits of integration.
- Given a description of a solid Q , be able to determine the limits of integration for an iterated integral in cylindrical coordinates that could be used to find the volume of Q .
- Be able to determine, based on the form of the solid Q and/or the integrand, whether a triple integral would best be evaluated using rectangular coordinates, or whether cylindrical coordinates would be a better choice of coordinate systems.
- Be able to set up and evaluate an iterated integral in cylindrical coordinates.

Section 17.8 Spherical Coordinates

- Understand the definition of spherical coordinates and memorize the formulas used to convert from rectangular coordinates to spherical coordinates and vice versa.
- Memorize the evaluation theorem for iterated integrals in cylindrical coordinates, especially the differential $dV = \rho^2 \sin \phi d\rho d\phi d\theta$.
- Given an iterated integral in spherical coordinates, be able to graph the solid Q determined by the limits of integration.
- Given a description of a solid Q , be able to determine the limits of integration for an iterated integral in spherical coordinates that could be used to find the volume of Q .
- Be able to determine, based on the form of the solid Q and/or the integrand, whether a triple integral would best be evaluated using rectangular coordinates, cylindrical coordinates, or spherical coordinates.
- Be able to set up and evaluate an iterated integral in spherical coordinates.