Multiple Integrals

Technology Exercise 4
20 points

Use DPGraph and Derive to find the following. Note, you can copy to the clipboard in DPGraph and paste directly into Derive.

1. Use a double integral in polar coordinates to find the volume of the solid inside the sphere $x^2 + y^2 + z^2 = 9$ and outside the cylinder $x^2 + y^2 = 1$.

   a. Use DPGraph to graph the solid.

   b. Use Derive to find the volume of the solid described.

2. Consider the torus
   $x = (5 + 2\cos v)\cos u,\ y = (5 + 2\cos v)\sin u,\ z = 2\sin v$

   a. Use DPGraph to graph it.

   b. Use Derive to find the equation of the tangent plane at the point when $u = \frac{\pi}{3}, v = \frac{\pi}{6}$.

   c. Graph both the original surface and the tangent plane on the same graph.

3. Use Derive to find $\iiint_G e^{-x^2-y^2-z^2}\,dV$, where G is the spherical region $x^2 + y^2 + z^2 \le 1$.

4. Approximate the location of the centroid of the solid that is bounded above by the surface $z = \left(x^2 + y^2 + 1\right)^{-1}$, below by the xy-plane, and laterally by the plane $y = 0$ and the surface $y = \sin x$ for $0 \le x \le \pi$. (see 15.6.31)

   a. Use DPGraph to sketch the graph of the solid.

   b. Use Derive to find the centroid.

5. Consider $\iint_R xy\,dA$ where R is the region in the first quadrant enclosed by the hyperbolas $x^2 - y^2 = 1$ and $x^2 - y^2 = 4$ and the circles $x^2 + y^2 = 9$ and $x^2 + y^2 = 16$.

   a. Use Derive to sketch the region in the xy-plane.

   b. Use appropriate transformations to convert the region into the uv-plane and sketch the region in the uv-plane.

   c. Find the iterated integral using the uv coordinate system.