University of Delaware
Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
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Spring 2013

Homework 10

Due date: April 22, 2013

Problems

Based on Sections 15.8, 15.9, 16.1, 16.2 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. Using either Cartesian, cylindrical, or spherical coordinates (whichever set of coordinates seems more appropriate to you), evaluate $\iiint_E z\,dV$, where E is enclosed by the paraboloid $z = 2x^2 + 2y^2$, and the plane $z = 2$.

2. Change the integral $\int_{-3}^{3}\int_{0}^{\sqrt{9-x^2}}\int_{0}^{9-x^2-y^2} \sqrt{x^2+y^2}\,dz\,dy\,dx$ to either Cylindrical or Spherical coordinates (again, use the transformation that you think is more appropriate) and evaluate it.

3. Use spherical coordinates to show that $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \sqrt{x^2+y^2+z^2}\,e^{-(x^2+y^2+z^2)}\,dx\,dy\,dz = 2\pi$. (Hint: Calculate the triple integral over a solid sphere of radius a and then take the limit as the radius of the sphere increases indefinitely.)

4. Sketch the vector field $\boldsymbol{F} = \langle y, x+y \rangle$.

5. Evaluate the line integral $\int_C xyz\,ds$, where $C:\ x = 2\sin t,\ y = t,\ z = -2\cos t$, where $0 \le t \le \pi$.

6. Evaluate the line integral $\int_C y\,dx + z\,dy + x\,dz$, where $C:\ x = \sqrt{t},\ y = t,\ z = t^2$, where $1 \le t \le 4$.

7. Evaluate $\int_C \boldsymbol{F}\cdot d\boldsymbol{r}$, where $\boldsymbol{F}(x,y) = e^{x-1}\boldsymbol{i} + xy\boldsymbol{j}$ and C is given by $\boldsymbol{r}(t) = t^2\boldsymbol{i} + t^3\boldsymbol{j}$, where $0 \le t \le 1$.

8. Find the work done by the force field $\boldsymbol{F}(x,y) = \langle x^2, ye^x \rangle$ on a particle that moves along the parabola $x = y^2 + 1$ from $(1,0)$ to $(2,1)$.

9. Find the work done by the force field $\boldsymbol{F}(x,y) = \langle x^2, xy \rangle$ on a particle that moves once around the circle $x^2+y^2 = 4$ oriented in the counter-clockwise direction.

10. Show that a constant force field (that is, a field $\boldsymbol{F}(x,y) = \langle a, b \rangle$, with a, b constants) does zero work on a particle that moves once uniformly around the circle $x^2 + y^2 = 1$.