University of Delaware
Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
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Fall 2012

Homework 10

Due date: November 13, 2012

Problems

Based on Sections 14.7 – 14.8, and 15.1–15.3 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. Find and classify all the critical points of the function $x^4 + y^4 - 4xy + 2$. Plot the function from a perspective that allows one to see all the relevant aspects of the function. In particular, mark the function's local maxima (or minima) and saddle points. (Include the printout with the critical points visibly marked).
2. Repeat the previous exercise with function $(1 + xy)(x + y)$.
3. Repeat the previous exercise with function $y^2 - 2y \cos x$, $1 \leq x \leq 7$.
4. Following Example 7 in Section 14.7, find the absolute and minimum values of $f(x, y) = 3 + xy - x - 2y$ on the domain D, which is the closed triangular region with vertices $(1, 0)$, $(5, 0)$, and $(1, 4)$.
5. Find the shortest distance from the point $(2, 1, -1)$ to the plane $x + y - z = 1$ using calculus. Verify your result using vector projections.
6. Find the point on the line of intersection of the planes $3x + y - z = 2$ and $x - y + z = 2$ that is closest to the point $(1, 1, 1)$.
7. Find the maximum and minimum values of the function $f(x, y) = 4x + 6y$ subject to the constraint $xy = 1$.
8. Find the maximum and minimum values of the function $f(x, y, z) = xyz$ subject to the constraint $x^2+2y^2+3z^2 = 6$.
9. Evaluate the double integral by first identifying it as the volume of a solid.

   $$\iint_R 3\, dA,$$

   where $R = \{(x, y) \mid -2 \leq x \leq 2, 1 \leq y \leq 6\}$.

10. Evaluate the double integral by first identifying it as the volume of a solid.

$$\iint_R (5 - x)\, dA,$$

where $R = \{(x, y) \mid 0 \le x \le 5, 0 \le y \le 3\}$.

11. Calculate the double integral above as an interated integral.

12. Calculate the iterated integral $\displaystyle\int_0^1 \int_1^2 (4x^3 - 9x^2y^2)\, dy\, dx$.

13. Calculate the iterated integral $\displaystyle\int_0^1 \int_1^2 \frac{xe^x}{y}\, dy\, dx$.

14. Calculate the double integral $\displaystyle\iint_R \cos(x + 2y)\, dA$, where $R = \{(x, y) \mid 0 \le x \le \pi, 0 \le y \le \pi/2\}$.

15. Sketch the solid whose volume is given by the interated integral $\displaystyle\int_0^1 \int_0^1 (4 - x - 2y)\, dxdy$.

16. Find the volume of the solid that lies under the hyperbolic paraboloid $z = 4 + x^2 - y^2$ and above the square $R = [-1, 1] \times [0, 2]$.

17. Find the volume of the solid in the first octant bounded by $z = 14 - x^2$ and the plane $y = 5$.

18. Evaluate the iterated integral $\displaystyle\int_0^2 \int_y^{2y} xy\, dxdy$.

19. Evaluate the double integral $\displaystyle\iint_D x^3\, dA$, where $D = \{(x, y) \mid 1 \le x \le e, 0 \le y \le \ln x\}$.

20. Evaluate the double integral $\displaystyle\iint_D (x + y)\, dA$, where D is bounded by $y = \sqrt{x}$ and $y = x^2$.