Math 10C
Final Examination
June 8, 2011
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Version A

Instructions

1. **No calculators or other electronic devices are allowed during this exam.**
2. **You may use one page of notes, but no books or other assistance during this exam.**
3. **Write your *Name*, *PID*, and *Section* on the front of your Blue Book.**
4. **Write the *Version* of your exam at the top of the page on the front of your Blue Book.**
5. **Write your solutions clearly in your Blue Book**
   (a) **Carefully indicate the number and letter of each question and question part.**
   (b) **Present your answers in the same order they appear in the exam.**
   (c) **Start each question on a new side of a page.**
6. **Read each question carefully, and answer each question completely.**
7. **Show all of your work; no credit will be given for unsupported answers.**

0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. (6 points) The company Colonel Electric has produced a new brand of light bulb. Suppose that x measures the number of hours elapsed before one of these light bulbs fails. The probability density function for x is given by

$$p(x) = 200e^{-cx} \quad \text{for } x \geq 0 \quad \text{(and 0 otherwise)}$$

where c is a constant.

   (a) What is the value of c?
   (b) What is the probability that a light bulb lasts for more than 50 hours?
   (c) What is the median value of the number of hours these light bulbs last?

2. (4 points) If $1 + x + x^2 + x^3 + \cdots = 3$ and $a + ax + ax^2 = -9$, find x and a.

3. (4 points) Find the second order Taylor polynomial for $x\sin(x)$ near $x = 0$. Use this to approximate $0.1\sin(0.1)$.

4. (6 points) Find the maximum and minimum values of the function $f(x, y) = xy$ subject to the constraint $9x^2 + y^2 = 18$.

5. (6 points) Let $f(x, y) = x^3y + 12x^2 - 8y$.
   (a) Find all the critical points of f.
   (b) Classify each of the critical points of f as a local minimum, local maximum, or saddle point.

6. (6 points) Find an equation for the plane through the points $(1, 1, 5)$, $(1, -3, 1)$, and $(6, 1, 1)$.

7. (4 points) Let $\vec{u} = \vec{i} + \vec{j} - \vec{k}$ and $\vec{v} = 2\vec{i} - \vec{j} + \vec{k}$.

   (a) Compute $\vec{u} \cdot \vec{v}$, the dot product of $\vec{u}$ and $\vec{v}$.

   (b) Find the angle between $\vec{u}$ and $\vec{v}$. You may express this angle as the inverse cosine (or arc cosine) of a number.

8. (6 points) A rectangular box without a top has a volume of $32cm^3$. Find the dimensions of the box having minimal surface area.

9. (6 points) Let f be a function whose contour diagram is given below.

   (a) Find the coordinates (to the nearest 0.2) of the local maxima and local minima of the function f.

   (b) The function f also has at least one saddle point. Find the coordinates (to the nearest 0.2) of the saddle point(s).

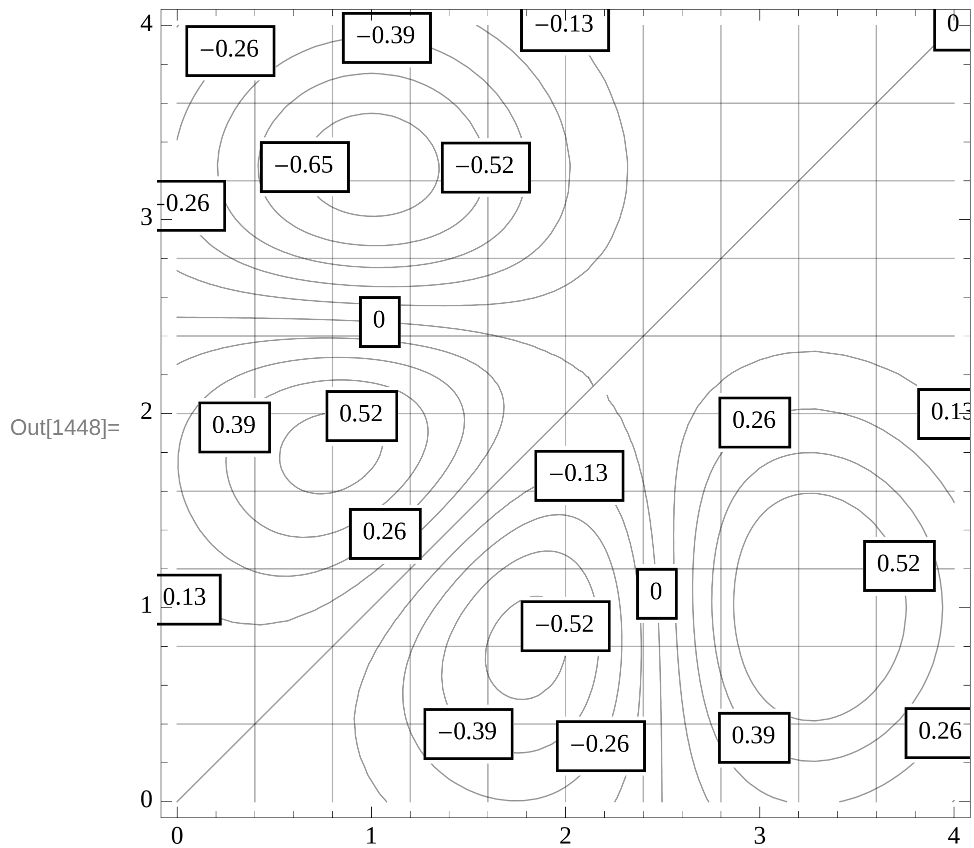

Figure 1: Contour diagram of the function f.