MATH 126 B & C
Exam II
Autumn 2013

Name _____

Student ID #_____ Section _____

HONOR STATEMENT

"I affirm that my work upholds the highest standards of honesty and academic integrity at the University of Washington, and that I have neither given nor received any unauthorized assistance on this exam."

SIGNATURE:_____

| | | |
|---|---|---|
| 1 | 10 | |
| 2 | 10 | |
| 3 | 10 | |
| 4 | 10 | |
| 5 | 10 | |
| Total | 50 | |

- Your exam should consist of this cover sheet, followed by 5 problems. Check that you have a complete exam.
- Pace yourself. You have 50 minutes to complete the exam and there are 5 pages. Try not to spend more than 10 minutes on each page.
- Unless otherwise indicated, show all your work and justify your answers.
- Unless otherwise indicated, your answers should be exact values rather than decimal approximations. (For example, $\frac{\pi}{4}$ is an exact answer and is preferable to its decimal approximation 0.7854.)
- You may use a scientific calculator and one 8.5×11-inch sheet of handwritten notes. All other electronic devices (including graphing and programmable calculators and calculators with calculus functions) are forbidden.
- You are not allowed to use scratch paper. If you need more room, use the back of the page and indicate to the reader that you have done so.
- The use of headphones or earbuds during the exam is not permitted.
- There are multiple versions of the exam, you have signed an honor statement, and cheating is a hassle for everyone involved. DO NOT CHEAT.
- Turn your cell phone OFF and put it AWAY for the duration of the exam.

GOOD LUCK!

1. (10 points)

   (a) Find the equation of the plane tangent to $f(x, y) = \dfrac{3x}{x + y^4}$ at $(2, 1)$.

   (b) Use your answer to (a) to approximate $\dfrac{3(2.03)}{2.03 + (0.97)^4}$. (As always, you must show some work to justify your answer.)

2. (10 points) The position of a moving object at time $t$ is given by

$$\mathbf{r}(t) = \langle 2t - 1, t^2, 2\sqrt{t} \rangle.$$

(a) Find the velocity and acceleration at time $t$.

(b) Find all points $(x, y, z)$ at which the acceleration vector is parallel to the unit normal vector.

(HINT: What must be true about the tangential component of acceleration if the acceleration and unit normal vectors are parallel?)

3. (10 points) Let $c$ be a non-zero constant and let

$$f(x, y) = xe^{cy^2} + x^2.$$

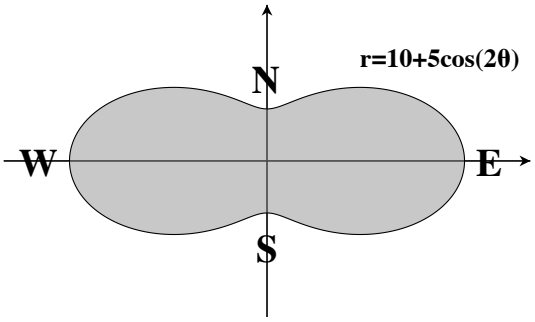
(a) Find the critical point of $f(x, y)$. (There should be exactly one.)

(b) If $f(x, y)$ has a saddle point at its critical point, what can you conclude about the value of the constant $c$?

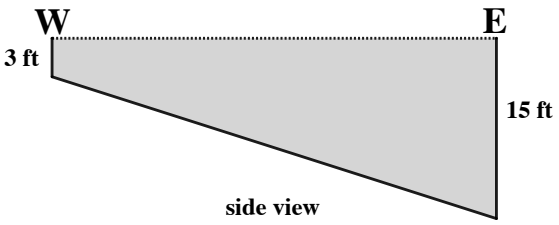
4. (10 points) Reverse the order of integration to evaluate:

$$\int_0^1 \int_0^{\cos^{-1}(y)} e^{\sin x}\, dx\, dy + \int_{-1}^0 \int_0^{\cos^{-1}(-y)} e^{\sin(x)}\, dx\, dy.$$

5. (10 points) A swimming pool is built in the shape of a peanut given by the polar curve $r = 10 + 5\cos(2\theta)$, where $r$ is measured in feet. The depth of the pool is constant along north-south lines and increases linearly from 3 feet on the west end of the pool to 15 feet on the east end. Shown below are views of the pool from overhead and the side. Set up an iterated integral in polar coordinates that gives the volume of the pool in cubic feet. (DO NOT EVALUATE THE INTEGRAL.)



overhead view



side view