Mathematics 251
Exam 3

October 30, 2012 Name: ____________________

Instructions: This exam is closed book. You may refer to one double-sided page of handwritten notes, but no electronic aids or other printed references are permitted. Justification of all answers is required for partial credit; please $\boxed{\textbf{box}}$ your final answers. Unless specifically directed, leave all answers in **exact form**, e.g. $\sqrt{3}$ instead of 1.732 and $\pi/2$ instead of 1.57.

Show all pertinent work. *Correct answers without accompanying work will receive little or no credit.* Results from class or from homework or from class can be cited freely. It is in your interest to display your solution in a clear, readable fashion.

You need to make sure your work is organized. I suggest you start each problem on a separate page. Problems that stop and start with other problems in between are not acceptable.

Be sure to read all questions carefully and completely.

Question:	1	2	Total
Points:	0	0	0
Bonus Points:	0	0	0
Score:			

Good luck!

1. In this problem, let $f(x, y) = x^3 - 3xy^2 + y^3$ and let $c(t) = \langle 2 + t, -3 + t/3 \rangle$.
   (a) Find the gradient of f at the point $c(0)$.
   (b) A bug is sitting on the graph of $f(x, y)$, directly over the point $c(0)$. In which direction should the bug face if it wants to climb up the surface most quickly? Give your answer as a 2-dimensional vector that points in the appropriate direction (it doesn't have to be a unit vector).
   (c) Find the (instantaneous) rate of change of $f(x, y)$ at $c(0)$ in the y-direction.
   (d) Find the directional derivative of $f(x, y)$ at $c(0)$ in the direction given by the vector $\langle 1, 1 \rangle$.
   (e) Find the (instantaneous) rate of change of $f(c(t))$ at $t = 0$. It is possible to do this using the earlier parts of this problem.

2. In this problem, consider the function $g(x, y) = 7 - 2xy^2$ and the point $P = (1, -1)$.
   (a) Give a formula for the linearization $L(x, y)$ of g at P. Describe the graph of L geometrically (in a complete sentence).
   (b) Use the linearization to estimate $g(0.9, -1.1)$.