PROBLEM SET

Extra Credit for Exam 1

Math 332350, Spring 2008

Feb. 22, 2008

• Write all of your answers on separate sheets of paper. You can keep the question sheet.
• You must show enough work to justify your answers. Unless otherwise instructed, give exact answers, not approximations (e.g., $\sqrt{2}$, not 1.414).
• This problem set has 1 problems. There are 40 points total.
• This problem set is due at Noon on Tuesday, February 26.
• I’ll replace your score on problem 6 of the exam by the max of your score on problem 6 and your score on this problem set.

Good luck!
Problem 1.
Suppose that the temperature at a point \((x, y)\) in the plane is given by
\[ f(x, y) = x^2 + y^3 - 3xy^2. \]
Suppose that a bug is walking through the plane at a constant speed of 13.

A. Suppose that at time \(t_0\) the bug is at the point \(P(3, 1)\) and his velocity vector is \(v_0 = 12\mathbf{i} - 5\mathbf{j}\). How fast is the temperature experienced by the bug changing at time \(t_0\)?

B. What is the directional derivative of \(f\) at \(P\) in the direction of the vector \(v_0\)? How, and why, does this differ from the answer to the previous part?

C. In what direction is the directional derivative of \(f\) at \(P\) the largest? What is the value of this largest directional derivative?

D. If the bug wants to get warm as fast as possible, what should he make his velocity vector at time \(t_0\) (his speed is still 13)?
If he uses this velocity vector, what rate of change of temperature will he experience? How does this relate to the previous part?