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## PROBLEM SET

Extra Credit for Exam 1

Math 332350, Spring 2008

Feb. 22, 2008

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- 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!

40 pts.

**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  $\mathbf{v}_0 = 12\mathbf{i} - 5\mathbf{j}$ . 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  $\mathbf{v}_0$ ? 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?
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