Mathematics 2110 Print Name: ______________________
Problem Set
Due Due Wednesday, October 15, 2008 Signature: ______________________

Your signature is your pledge that you have adhered to the guidelines for problem sets and take-home examinations.

This problem set will be graded on the basis of 100 points but will be worth 50 points. Make sure that you check the course website for instructions, available from the ***General Policies*** portion of the web site. Remember that your paper may be handed in before the deadline but that no late papers will be accepted regardless of the reason. The course website also includes an explanation of how your average will be calculated if you fail to complete this assignment.

Note that, since most of the calculations involved can be done routinely using either a calculator or a symbolic manipulation program such as Maple or Mathematica, it will obviously be necessary to show, through your work, exactly how you came up with your solutions.

Each question will be given the same weight. Please don't omit the extra credit question.

1. Let $f(x, y, z) = x^2y + y^3 \sin(z^2)$. Find all three first partial derivatives of f.
2. Consider the function $z = g(x, y)$ defined implicitly by the equation $x^2y + y^3 \sin(z^2) = 1$ in the neighborhood of some point. Find $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$. ***Extra Credit: Why did I add the description about a neighborhood of a point?***
3. Let $f(x, y, z) = x^2y + y^3 \sin(z^2)$. Find ∇f in general and also calculate $\nabla f\big|_{(-1,1,\sqrt{\pi})}$.
4. Find an equation for the plane tangent to $x^2y + y^3 \sin(z^2) = 1$ at $(-1, 1, \sqrt{\pi})$.
5. Use the Chain Rule to evaluate $\dfrac{dw}{dt}$, where $w = x^2y + y^3 \sin(z^2)$ with $x = 5t$, $y = t^2$ and $z = 4t + 9$. ***Please do not try to simplify this.***
6. Use the Chain Rule to evaluate $\dfrac{\partial w}{\partial s}$ and $\dfrac{\partial w}{\partial t}$, where $w = x^2y+y^3 \sin(z^2)$ with $x = s^2+5t$, $y = s^3t^2$ and $z = e^{st}$. ***Please do not try to simplify this.***
7. Let $f(x, y, z) = x^2y+y^3 \sin(z^2)$ and let $\mathbf{u}$ be the unit vector in the direction of $\langle 5, -2, 9\rangle$. Find the directional derivative $D_{\mathbf{u}}f$.
8. Find all critical points of the function $f(x, y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$. Examine each critical point and determine what you can about it in terms of whether it's a local minimum, local maximum or saddle point.
9. Find all critical points of the function $f(x, y) = (x - 1)(y - 1)(x + y - 1)$. Examine each critical point and determine what you can about it in terms of whether it's a local minimum, local maximum or saddle point.

10. Find the point of the plane $2x - 3y - 4z = 25$ which is nearest to the point $(3, 2, 1)$. *Extra Credit: Do this two completely di erent ways. Even More Extra Credit: Do this three completely di erent ways.*

11. Find the minimum value for $x^3 + y^3 + z^3$ among points on the plane $x + 4y + 9z = 28$ for which all the coordinates are positive.

12. Use a double integral to find the area of a unit circle. *You will need to represent the area as a double integral of some function over some plane region and then use an iterated integral to evaluate the double integral. It is likely that you'll need some of the integration techniques from Calculus II in order to evaluate the iterated integral.*

Extra Credit

Extra credit will be awarded for the best joke. All jokes must observe standards of good taste. The determination of the best joke will be made by popular vote in class when the papers are returned.