Math 212 Spring 2006

BONUS Quiz **6** **Multivariable Calculus**

Name: _____

Date: _____ **Friday March 10**
Time Begun: _____ Ron Buckmire
Time Ended: _____

Topic : Gradients and Gradient Fields

The idea behind this quiz is to provide you with an opportunity to illustrate your understanding of the Gradient Operator and Gradient Fields.

Reality Check:

EXPECTED SCORE : _____**/10** ACTUAL SCORE : _____**/10**

Instructions:

0. Please look for a hint on this quiz posted to `faculty.oxy.edu/ron/math/212/06/`.
1. Once you open the quiz, you have as much time as you like to complete it, please record your start time and end time at the top of this sheet.
2. You may use the book or any of your class notes. You must work alone.
3. If you use your own paper, please staple it to the quiz before coming to class. If you don't have a stapler, buy one. **Quizzes with loose sheets will not be graded.**
4. After completing the quiz, sign the pledge below stating on your honor that you have adhered to these rules.
5. Your solutions must have enough details such that an impartial observer can read your work and determine HOW you came up with your solution.
6. Relax and enjoy...
7. **This quiz is due on Monday March 20**, in class. NO LATE QUIZZES WILL BE ACCEPTED.

Pledge: I, _____, pledge my honor as a human being and Occidental student, that I have followed all the rules above to the letter and in spirit.

Math 212 Spring 2006 **SHOW ALL YOUR WORK** **BONUS** Quiz Six

1. (*6 points.*) Consider the following vector fields, i.e. vector functions of a vector variable, $\vec{F}(\vec{x})$ and $\vec{G}(\vec{x})$ where

$$\vec{F}(\vec{x}) = e^{xy}\hat{i} + e^{x+y}\hat{j} \qquad \text{and} \qquad \vec{G}(\vec{x}) = (x^2+y^2)\hat{i} + 2xy\hat{j}.$$

Determine whether $\vec{F}$ or $\vec{G}$ are **gradient fields**. If so, obtain appropriate scalar functions of a vector variable $\phi(x,y)$ that when differentiated produces $\vec{F}$ or $\vec{G}$.

2. (*4 points.*) Given $\phi(x,y,z) = \dfrac{GMm}{||\vec{r}||}$ where $\vec{r} = x\hat{i}+y\hat{j}+z\hat{k}$, G is Newton's Universal Gravitation constant, M is the mass of the earth and m is the mass of the moon. According to Newton's Law of Gravitation, the gravitational force exerted on the moon located at (x,y,z) is given by $\vec{F} = \vec{\nabla}\phi(x,y,z)$. Show that this force $\vec{F} = \dfrac{-GMm}{||\vec{r}||^3}\vec{r}$, where $||\vec{r}||$ is the magnitude of the position vector $\vec{r}$.