Math 212 Fall 2005

BONUS Quiz 8

Multivariable Calculus

Name: ________________________________

Date: ________________________________

BONUS Quiz 8

Time Begun: ________________________________

Time Ended: ________________________________

Wednesday November 30

Ron Buckmire

Topic: Div, Grad and Curl

The idea behind this quiz is to provide you with another opportunity to illustrate your facility with the
differential operators of vector fields.

Reality Check:

EXPECTED SCORE : __________/10

ACTUAL SCORE : __________/10

Instructions:

0. Please look for a hint on this quiz posted to http://faculty.oxy.edu/ron/math/212/05/

1. Once you open the quiz, you have 30 minutes to complete, 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.

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 December 5, 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.
Consider the **Maxwell Field Equations** for a region in $\mathbb{R}^3$ containing no charge or current:

\[
\begin{align*}
\nabla \cdot \vec{E} &= 0 & \nabla \cdot \vec{B} &= 0 \\
\nabla \times \vec{E} &= -\frac{1}{c} \frac{\partial \vec{B}}{\partial t} & \nabla \times \vec{B} &= \frac{1}{c} \frac{\partial \vec{E}}{\partial t}
\end{align*}
\]

where $\vec{B}(\vec{x}, t)$ is the magnetic field and $\vec{E}(\vec{x}, t)$ is the electric field and $c$ is the speed of light. Given the vector identity $\nabla \times (\nabla \times \vec{F}) = \nabla (\nabla \cdot \vec{F}) - \nabla^2 \vec{F}$ manipulate the Maxwell Field Equations to obtain the following results:

**a.** (5 points.) Show that $\nabla \times (\nabla \times \vec{B}) = -\frac{1}{c^2} \frac{\partial^2 \vec{B}}{\partial t^2}$.

**b.** (5 points.) Show that $\nabla^2 \vec{B} = \frac{1}{c^2} \frac{\partial^2 \vec{B}}{\partial t^2}$ (This is a very famous equation known as **The Wave Equation**.)