Math 10C.
Midterm Exam 2
May 18, 2005

Turn off and put away your cell phone.
You may use a calculator, but no other electronic devices are allowed on this exam.
You may use one page of notes, but no books or other assistance on this exam.
Read each question carefully, answer each question completely, and show all of your work.
Write your solutions clearly and legibly; no credit will be given for illegible solutions.
If any question is not clear, ask for clarification.

1. (4 points) For which value(s) of $t$ are the vectors $3\mathbf{i} + 2\mathbf{j} + t\mathbf{k}$ and $2t\mathbf{i} + 4\mathbf{j} + t\mathbf{k}$ perpendicular?
2. (4 points) Suppose that for some differentiable function $g(x, y)$,

$$g(1, 2) = 4, \quad g_x(1, 2) = -3, \quad g_y(1, 2) = 5.$$ 

(a) Find the local linearization of $g$ near $x = 1$ and $y = 2$.

(b) Approximate the value of $g(1.02, 2.03)$. 
3. (4 points) Find a vector that is perpendicular to the vectors \(4 \mathbf{i} + 3 \mathbf{j} + \mathbf{k}\) and \(4 \mathbf{i} + 6 \mathbf{j} + \mathbf{k}\).
4. (6 points) Let \( f(x, y) = x^2y^5 \). At the point \((-1, 2)\):

(a) Find a vector in the direction of maximum rate of change.

(b) Find a vector in the direction of minimum rate of change.

(c) Find a vector in a direction in which the rate of change is zero.