

Mathematics 2401T Test 2 25 September 2008 VERSION Ğ

NAME: \_\_\_\_\_

TA: \_\_\_\_\_

**Instructions:** Work absolutely on your own, without reference to notes or text. Answers should be as specific as possible and it should be evident how they were obtained. Write the answers where indicated. **Your grade will be based on the best 4 of the 6 problems.** You may choose to do only 4, or you may attempt more, and the graders will drop the lowest scores. Each problem is worth 25 points.

This test will end promptly at 5:55. Sign below and await the signal to begin the test.

*I am familiar with the Georgia Tech Honor Code and will abide by it. Any stored information about MATH 2401 has been erased from my calculator (or similar storage device)*

\_\_\_\_\_

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1. Find the rate of change of the function  $f(x, y) = x^2 - 3y^2$  with respect to  $t$  along the curve  $\mathbf{r}(t) = e^{-t} \mathbf{i} - e^t \mathbf{j}$ .

ANSWER \_\_\_\_\_

2. Let  $F(x, y) := y^{-2} \sin(\pi x/2)$ . Find the directional derivative of  $F(x, y)$  at the point  $(1, 2)$  in the direction from that point toward the origin.

ANSWER \_\_\_\_\_

3. Find the curvature of the path  $\mathbf{r}(t) = 3t\mathbf{i} - \cos 2t\mathbf{j} + \sin 2t\mathbf{k}$  at time  $t$ .

ANSWER \_\_\_\_\_

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4. (Dang, if this isn't just like an example done in class on Monday!) Consider the surface given as the graph  $z = f(x, y)$  of the function  $f(x, y) = 2y^2 - x^2$ . The point  $P = (1, 2, 7)$  is on this surface.

a) Find an upward normal vector to the surface at the point  $P$ .

ANSWER \_\_\_\_\_

b) Give a formula for the normal line to the surface passing through  $P$ .

ANSWER \_\_\_\_\_

5. Consider the surface corresponding to  $9x^2 - 12y + 4z^2 = 0$ .

a) Is this surface symmetric about the  $xz$  plane \_\_\_\_\_(Y/N)?  
The  $yz$  plane \_\_\_\_\_(Y/N)?

b) Give a formula for the tangent plane to the surface at the point  $(-2, 6, 3)$ .

ANSWER \_\_\_\_\_

6. On the attached topographic map several points are designated by spots near circled letters.

a) Draw arrows with bases at the spots  $P$  and  $D$ , pointing in the direction of the gradient of the altitude function.

b) Estimate the magnitude of the gradient at the point  $P$ . The contours are at heights differing by 20 feet and a horizontal scale is shown. We expect accuracy of about 10 % or better. ANSWER \_\_\_\_\_

c) If the gradient at any of the points on the graph H,N,Q,R is approximately  $\mathbf{0}$ , list those points here: \_\_\_\_\_

d) Estimate the directional derivative of the height function at the point  $P$  in the somewhat northerly direction along the road through  $P$ .

ANSWER \_\_\_\_\_