

NAME \_\_\_\_\_

Instructions: Write the answers where indicated and give clear evidence of your reasoning (or points will be taken off). You may attach extra sheets with your work if it is organized enough to be helpful. Graphs should be clearly labeled. **Calculators are not permitted if they can store formulae or do symbolic mathematics (algebra & calculus).** Graphing is OK.

NOTE: All answers should be as specific as possible. A "specific expression" is one you could show to someone who knows calculus, so that person could evaluate it without being shown the original problem or told anything. It should contain no expressions like "f(x)," only specific functions like "sin(x)."

**SCORING - DO NOT WRITE ANSWERS ON THIS PAGE:**

1 | \_\_\_\_\_2 | \_\_\_\_\_3 | \_\_\_\_\_4 | \_\_\_\_\_TOTAL \_\_\_\_\_

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TA \_\_\_\_\_

In Problems 1 and 2, let  $F(x,y) := \ln(x^2 + 4y^2)$  and  $\mathbf{r}(t) := 2t\mathbf{i} + \sin(3t)\mathbf{j}$ . As a notational matter, let  $F(\mathbf{x}) := F(x,y)$  for  $\mathbf{x} = x\mathbf{i} + y\mathbf{j}$ .

**1** (10 points). Calculate the following. Note: You will receive 0 points if your answer is the "wrong kind of animal."

a)  $F(x,y) =$  \_\_\_\_\_

b)  $\frac{\partial^2 F}{\partial y \partial x}(-1,2) =$  \_\_\_\_\_

c)  $\frac{dF(\mathbf{r}(t))}{dt} =$  \_\_\_\_\_

d) What is the directional derivative of  $F(x,y)$  in the first quadrant at angle  $\pi/6$  with the  $x$ -axis, at the position at  $(x,y) = (-1,2)$ ?

ANSWER: \_\_\_\_\_

**2** (10 points).

Consider the surface defined by  $z = F(x,y)$ .

a) A vector perpendicular (=normal) to the surface at  $(x_0,y_0) = (-1,2)$  is:

\_\_\_\_\_

b) A formula for positions  $\mathbf{x}$  on the tangent plane to the surface at  $(x_0,y_0) = (-1,2)$  is:

\_\_\_\_\_

c) A vector parallel to the tangent plane is: \_\_\_\_\_

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3 (10 points) "Find the maximum volume for a rectangular solid in the first octant with one vertex at the origin and the opposite vertex on the plane  $x/2 + y/3 + z/5 = 1$ ."

- a) The specific function you are maximizing is \_\_\_\_\_
- b) Its maximum occurs when the variable(s) = \_\_\_\_\_
- c) The maximum volume is \_\_\_\_\_
- d) Aren't you glad you did assigned problem 38 on p. 925? \_\_\_\_\_

4 (10 points). On the topographic map shown below, of the Shining Rock Wilderness in Western North Carolina, altitude is measured in feet and the contours are 40 feet apart.

- a) Mark with a capital M the local maximum height which is the farthest south.
- b) Mark with a capital S a saddle
- c) Indicate with an arrow the direction of the gradient at the 'n' in "Daniels."
- d) The magnitude of the gradient of part c is \_\_\_\_\_

