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Instructions

1. Write your *Name*, *PID*, *Section*, and *Exam Version* on the front of your Blue Book.
  2. No calculators or other electronic devices are allowed during this exam.
  3. You may use one page of notes, but no books or other assistance during this exam.
  4. Read each question carefully, and answer each question completely.
  5. Write your solutions clearly in your Blue Book.
    - (a) Carefully indicate the number and letter of each question and question part.
    - (b) Present your answers in the same order as they appear in the exam.
    - (c) Start each numbered problem on a new side of a page.
  6. Show all of your work. No credit will be given for unsupported answers, even if correct.
  7. Write Name & PID on this exam sheet and return inside front cover of your Blue Book.
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0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. (6 points) The function  $f$  and its partial derivatives have the following values at  $(3, 4)$ :

$$f(3, 4) = 7, \quad \frac{\partial f}{\partial x}(3, 4) = -3, \quad \frac{\partial f}{\partial y}(3, 4) = 2.$$

- (a) Give the equation of the tangent plane to the surface  $z = f(x, y)$  at the point  $(3, 4)$ .
  - (b) Use the linear approximation of  $f(x, y)$  to estimate the value of  $f(3.1, 3.8)$ .
2. (6 points) Let  $g$  be a function given by the formula  $g(x, y) = e^{-2x} \cos(Ay)$ .
- (a) Compute all second order partial derivatives of  $g$ .
  - (b) Find all values of  $A$  (if any) for which  $g$  is a solution to Laplace's Equation:  $\frac{\partial^2 g}{\partial x^2} + \frac{\partial^2 g}{\partial y^2} = 0$ .
3. (6 points) Assume the temperature at a point  $(x, y)$  is  $T(x, y)$  degrees Celsius and assume that

$$\frac{\partial T}{\partial x}(3, 6) = 12 \quad \text{and} \quad \frac{\partial T}{\partial y}(3, 6) = 10.$$

A small Egyptian scarab beetle crawls so that its position after  $t$  seconds is given by

$$x = \sqrt{3 + t} \quad \text{and} \quad y = 3 + \frac{1}{2}t.$$

How fast is the temperature rising on the Egyptian scarab beetle's path after 6 seconds?

4. (6 points) Find the global maximum and global minimum values of  $h(x, y) = 2x^2 + 2y^2 + 8x + 16$  on the closed set  $D = \{(x, y) \mid x^2 + y^2 \leq 25\}$ .

(This exam is worth 25 points.)