Math 2374	**Name (Print):** _____
Spring 2009	**Student ID:** _____
Midterm 1	**Section Number:** _____
February 25, 2009	**Teaching Assistant:** _____
Time Limit: 1 hour	**Signature:** _____

This exam contains 7 pages (including this cover page) and 6 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated. You are allowed to take one-half of one (doubled-sided) 8.5 inch $\times$ 11 inch sheet of notes into the exam.

Do not give numerical approximations to quantities such as $\sin 5$, π, or $\sqrt{2}$. However, you should simplify $\cos \frac{\pi}{4} = \sqrt{2}/2$, $e^0 = 1$, and so on.

The following rules apply:

- **Show your work**, in a reasonably neat and coherent way, in the space provided. **All answers must be justified by valid mathematical reasoning, including the evaluation of definite and indefinite integrals**. To receive full credit on a problem, you must show enough work so that your solution can be followed by someone without a calculator.
- **Mysterious or unsupported answers will not receive full credit**. Your work should be mathematically correct and carefully and legibly written.
- **A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit**; an incorrect answer supported by substantially correct calculations and explanations will receive partial credit.
- Full credit will be given only for work that is presented neatly and logically; work scattered all over the page without a clear ordering will receive from little to no credit.

1	25 pts	
2	25 pts	
3	20 pts	
4	25 pts	
5	25 pts	
6	20 pts	
TOTAL	140 pts	

1. (25 points) Find the equation of the plane that contains the lines given in parametric form by $\mathbf{c}_1(t) = (0, 5-t, 0)$ and $\mathbf{c}_2(t) = (1, 2+t, 3)$. Give your answer in the form $Ax+By+Cz+D = 0$.

2. (25 points) Consider the surface given by $g(x, y, z) = 7$ where $g(x, y, z) = x^2 - y^2 + \frac{z^2}{4}$.

   (a) (15 points) Show that the point $(2, 1, 4)$ lies on the surface and find the equation of the tangent plane to the surface at this point. (Give your answer in the form $Ax + By + Cz + D = 0$.)

   (b) (10 points) Find the points of the surface where the tangent plane is horizontal.

3. (20 points) The trajectory of a flying mosquito is given by the path $\mathbf{c}(t) = (\cos t, t, \sin t)$. The temperature at each point of the space is measured by a function $T(x, y, z)$ and we know that $\nabla T(x, y, z) = (-z, y^2, x)$. Find the rate of change of temperature that the mosquito is experiencing at any given time t.

4. (25 points) Give a linear approximation of the function

$$f(x,y) = \left(2\,y + \frac{1}{2}\right)e^{2x-4+y^2}$$

near the point $(2,0)$. Use it to approximate the value of $f(1.9,\, 0.01)$.

5. (25 points) The height of land in a certain region is given as a function of the horizontal coordinates $h(x, y) = 3 + x^2y + y^3$.

   (a) (15 points) If we are located in the point with horizontal coordinates $(1, 1)$, what is the direction of steepest descent at that point? (Give it as a unit vector). Compute the slope in that direction.

   (b) (10 points) Compute $\mathbf{D}_{\mathbf{v}}h(1, 1)$ when $\mathbf{v}$ is the unit vector in the direction of $(-1, 2)$.

6. (20 points) Compute the area of the triangle whose vertices are $(1, 1, 1)$, $(2, 1, 0)$ and $(0, 3, 2)$.