Math 2263	**Name (Print):** ____________________
Spring 2009	**Student ID:** ____________________
Midterm 1	**Section Number:** __________
February 19, 2009	**Teaching Assistant:** ____________________
Time Limit: 50 minutes	**Signature:** ____________________

This exam contains 8 pages (including this cover page) and 7 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. Calculators may be used. Please turn off cell phones.
Do not give numerical approximations to quantities such as $\sin 5$, π, or $\sqrt{2}$. However, you should simplify $\cos \frac{\pi}{2} = 0$, $e^0 = 1$, 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.** 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 might still receive partial credit.

1	15 pts	
2	15 pts	
3	15 pts	
4	15 pts	
5	10 pts	
6	15 pts	
7	15 pts	
TOTAL	100 pts	

1. (15 points) Find an equation for the **plane** passing through the two points $\langle x, y, z\rangle = \langle 4, -2, 2\rangle$ and $\langle 1, 0, -2\rangle$ so that the vector $\vec{i} + \vec{j} + \vec{k}$ is tangent to the plane.

2. (15 points) Find an equation for the surface in (x, y, z)-space obtained by **rotating** the ellipse $x^2 + 4y^2 = 1$ of the (x, y)-plane **about the x-axis.**

3. (15 points) The lines given parametrically by

$$(x, y, z) = (7 + 2t, -1 - t, -2t), \quad -\infty < t < \infty$$

and

$$(x, y, z) = (4 - s, -1 + 2s, 2 + 2s), \quad -\infty < s < \infty$$

intersect at the point $\langle x, y, z\rangle = \langle 3, 1, 4\rangle$. Find an equation for the **plane** which contains both lines.

4. (15 points) For the function $f(x, y) = e^{2x+y} \sin y$, find the **second partial derivatives**

$$f_{xx}, \quad f_{xy} \quad \text{and} \quad f_{yy}.$$

5. (10 points) Suppose $z = f(x, y)$ is a function with first partial derivatives $f_x(1, 2) = 3$ and $f_y(1, 2) = 5$. If x and y are both functions of t: $x = g(t) = -1 - 2t$ and $y = h(t) = 6 + 4t$, find the **derivative at** $t = -1$:
$$\frac{dz}{dt} = \frac{d}{dt} f\Big(g(t), h(t)\Big).$$

6. (15 points) The point $\langle x, y, z\rangle = \langle 1, -1, 2\rangle$ lies on the surface S:

$$x^2 + z^2 - 2xy - y^2 = 6.$$

Find the equation of the **tangent plane** to the surface S at $\langle 1, -1, 2\rangle$. Write it in the form $ax + by + cz = d$.

7. **(15 points)** **(a)** Find the **gradient** of the function $f(x, y, z) = e^x \ln(xy + z^2)$ at the point $\langle x, y, z\rangle = \langle -1, 1, 2\rangle$.

(b) Find the **directional derivative** of f at the point $\langle x, y, z\rangle = \langle -1, 1, 2\rangle$ in the direction of the unit vector

$$\vec{u} = \frac{1}{3}\left(2\vec{i} - 2\vec{j} + \vec{k}\right).$$