These problems are due on Monday, March 1. Late papers will not be accepted.

1. Find the first order partial derivatives of the function $g(u,v,w) = w^2 e^{u}$.

2. Find all second order partial derivatives of $f(x,y) = x^3 \ln(x+y)$.

3. Find the equation of the tangent plane to the surface $z = x^3 + 5xy$ at the point $(1,2,5)$.

4. Find $dz$ if $z = x^2 \tan^{-1}y$.

5. The volume $V$ of a right-circular cone with base radius $r$ and height $h$ is given by the formula $V = \frac{1}{3}\pi r^2 h$. Suppose that the height is decreased from 20 in. to 19.94 in., while the base radius is increased from 4 in. to 4.07 in. Use a differential to approximate the change in the volume.

6. Use the Chain Rule to find $\frac{\partial z}{\partial s}$ and $\frac{\partial z}{\partial t}$ where $z = \sin(x) \cos(y)$, $x = (s+t)^2$, and $y = s^2 - t^2$.

7. Suppose that the base radius of a right circular cone is 120 in. and increasing at a rate of 1.9 in./s, while the height is 140 in. and decreasing at a rate of 2.4 in/s. Find the rate of change of the volume. Is the volume increasing or decreasing?

8. If $z = f(x,y)$, where $x = s+t$ and $y = s-t$, show that $\left(\frac{\partial z}{\partial x}\right)^2 - \left(\frac{\partial z}{\partial y}\right)^2 = \frac{\partial z}{\partial s} \frac{\partial z}{\partial t}$.

9. Find the rate of change (directional derivative) of the function $f(x,y,z) = x^2y + x\sqrt{1+z}$ at the point $(1,2,3)$ in the direction of the vector $v = 2i - j + 2k$.

10. Find the direction in which the function $f(x,y,z) = z e^{xy}$ increases most rapidly at the point $(0,1,2)$. What is the maximum rate of increase?

Note. Exam 2 (Friday, Feb. 26) will be on Chapter 12, Sections 12.1–12.7. This set of problems covers a good bit (although not all) of this material and thus can be regarded as a sort of Review Sheet in preparing for the exam.