KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
MATHEMATICAL SCIENCES DEPARTMENT
MATH 201
EXAM # 3
Tuesday November 27, 2001

NAME:	Sec#:	ID#:

SHOW ALL YOUR WORK

1. **a.** **(3pts)** Show that $\lim_{(x,y)\to(0,0)} \dfrac{x^3y}{2x^6+y^2}$ does not exist.

b. **(3pts each)** Compute the following limits. Show all details

(i) $\lim_{(x,y,z)\to(0,0,0)} \dfrac{\sin^2\sqrt{x^2+y^2+z^2}}{x^2+y^2+z^2}$

(ii) $\lim_{(x,y)\to(0,0)} xy\ln(x^2+y^2)$

(iii) $\lim_{(x,y)\to(0,0)} \dfrac{x^2-xy+x-y}{y^2-xy-2x+2y}$

2. **a.** **(3pts)** Suppose $z = f(u),\ u = g(x,y)$. Draw a tree diagram and use it to find $\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}$ in terms of $\frac{dz}{du}, \frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}$.

b. **(3pts)** Apply your results in part (a) to the case $z = f(x^2 - y^2)$.

3. **(4pts)** Let $f(x,y) = \ln\sqrt{1+xy}$, $P = (0,2),\ Q = (-.09, 1.98)$. Use differentials to approximate f at Q.

4. Let $f(x,y) = \frac{xy}{x+y}, P = (1,0),\ Q = (-.1,-1)$.

- **a.** **(3pts)** Find the directional derivative of f at P in the direction of Q.
- **b.** **(3pts)** Find the maximum ascent of f at P and the direction in which it occurs.
- **c.** **(2pts)** Find the maximum descent of f at P and the direction in which it occurs.

5. **(5pts)** Show that the surfaces $z = \sqrt{x^2+y^2}$ and $z = \frac{1}{10}(x^2+y^2) + \frac{5}{2}$ intersect at $(3,4,5)$ and have a common tangent plane at that point.

6. **(5pts)** Discuss the relative maxima, relative minima and saddle points of the function $f(x,y) = xy + \frac{a^3}{x} + \frac{b^3}{y}$ in the cases $a = b = 0$ and $a > 0,\ b < 0$.