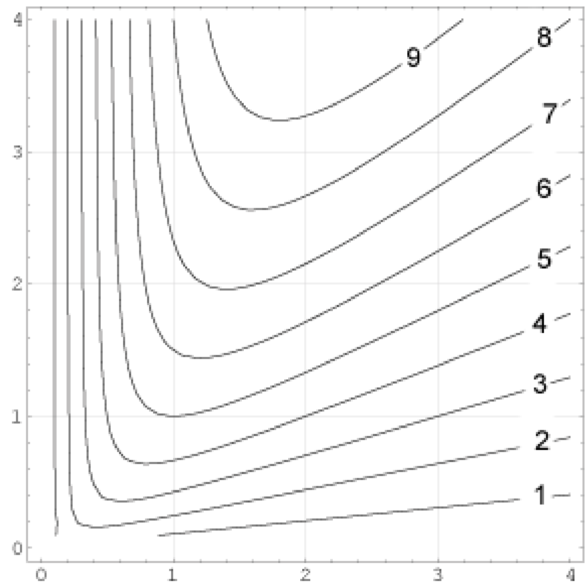
MA 234-01 **§13.1–14.3**	**Test #1**	*score*	**Name:** ____________ **24 April 1997**

1. Suppose the level curves for a function $f(x,y)$ are as given. Use the level curve diagram to do the following.



   (a) Estimate the values of $f_x(1,1)$ and $f_y(1,1)$. *(10 points)*

   (b) Estimate the value of $f_u(2,1)$ where u is a unit vector making an angle of $-\frac{Pi}{4}$ with the positive x-axis. *(10 points)*

   (c) Draw the gradient vector at the point (2,2), $\nabla f(2,2)$ on the level curve diagram. Place the tail of the vector at (2,2). *(10 points)*

2. Let $f(x,y) = \sqrt{x^2 + y^4}$. Compute the differential of f and simplify the result. *(12 points)*

3. A right circular cylinder is changing its radius and height with respect to time. Determine the rate of change of the volume of the cylinder when the radius is 3 inches and the height is 5 inches of the radius is increasing at 2 in/sec and the height is decreasing at 3 in/sec. *(11 points)*

4. Find the second degree Taylor polynomial about the origin of the function $f(x,y) = \sin(xy)$. From this Taylor polynomial, conclude that the origin is a critical point of f and use the Taylor polynomial to determine which type of critical point you have found. *(12 points)*

5. Find all critical points for the function $f(x,y) = 8x^3 + y^3 - 12xy + 6$ and classify them according to type (local maximum, local minimum, or saddle). *(20 points)*

6. Use the method of Lagrange multipliers to begin finding the extrema of the function $f(x,y,z) = x + 2y + 3z$ subject to the constraint that the points are on the unit sphere $x^2 + y^2 + z^2 = 1$. You do not have to complete the problem – just write down a system of equations which you would solve to find the critical points. *(15 points)*