1. Sketch the domain of the functions given below. In the sketch, axes must be labeled and supplied with numbers, and the domain is shaded. See figure 14.4, *Thomas' Calculus*, p. 767.
   (a) $f(x,y) = \ln(x^2 + y^2 - 4)$.
   (b) $f(x,y) = \sqrt{\dfrac{x+y}{x-y}}$.
   (c) $f(x,y) = \sqrt{1 - x^2y^2}$.
2. The function f is defined by $f(x,y) = \sqrt{x^2 + y^2}$.
   (a) In the xy-plane, sketch three level curves, at level 0, 1 and 4, and label each level curve appropriately.
   (b) Make a 3D-sketch of the surface $z = f(x,y)$.
   Before making the sketch, determine what the intersection of the graph of f is with the coordinate planes, and sketch those first.

3. Write the following functions using polar coordinates r and θ, see *Thomas' Calculus*, page 647. Simplify as much as possible. In particular: retain only one power of r.

(a) $f(x,y) = \dfrac{xy}{\sqrt{x^2+y^2}}$

(b) $f(x,y) = \dfrac{x^2-y^2}{x^2+y^2}$

(c) $f(x,y) = \dfrac{x+2y}{\left(x^2+y^2\right)^{3/2}}$

(d) $f(x,y) = \dfrac{\sqrt{x^2-xy+y^2}}{(x^2+y^2)\sqrt{x^2+y^2}}$

4. Find $\dfrac{\partial f}{\partial x}$ and $\dfrac{\partial f}{\partial y}$ of the following functions:
   (a) $f(x,y) = x^2 - xy + y^2$
   (b) $f(x,y) = \cos^2(3x - y^2)$

5. Find second-order partial derivatives (g_{xx}, g_{xy}, g_{yx}, g_{yy}) of the function $g(x,y) = x^2y + \cos y + y \sin x$.

   See *Thomas' Calculus*, page 788, for definitions and theorems.

6. (a) Find the equation for the tangent plane to the surface $z = \sqrt{x^2 + y^2 - 18}$ at the point $P(3,5,4)$.
   (b) Find the linearization of $f(x,y) = \sqrt{x^2 + y^2 - 18}$ at $(3,5)$, and use the linearization to approximate $f(2.9, 5.1)$.

   See *Thomas' Calculus*, page 811, equation (4).