1) Find the rectangular coordinates of the center of the sphere with spherical coordinate equation $\rho = 2 \sin(\phi) \sin(\theta)$.

2) Find the area of the region enclosed by one loop of the curve $r = 4 \sin(3\theta)$.

3) What types of curves will show up in the contour map for the function $f(x,y) = \frac{y}{x^2+y^2}$.

4) Find $\lim_{(x,y)\to(0,0)} \frac{x^2+y^2}{\sqrt{1+x^2+y^2}} - 1$.

5) Let $C$ be the curve resulting from the intersection of the hyperboloid $z^2 = x^2 - y^2$ and the plane $y = 4$. Find the slope of the tangent line to $C$ at the point $(5,4,3)$.

6) Find an equation for the tangent plane to the elliptic paraboloid $z = 2x^2 + 5y^2$ at the point $(2,1,13)$.

7) For $f(x,y) = \ln(x^2y + xy^2)$ find $\frac{\partial f}{\partial x}(2,3)$.

8) Given the equation $xy^2 + 3z = \frac{u^2}{2}$, find $\frac{\partial z}{\partial y}$.

9) Suppose that $z = f(x,y)$ and we are given that $f(1,1) = 15$, $\frac{\partial z}{\partial x}(1,1) = -2$ and $\frac{\partial z}{\partial y}(1,1) = 8$. If $\Delta x = -0.15$, $\Delta y = 0.5$ then find an approximation for $f(0.85, 1.5)$.

10) Find the domain of the vector function $\mathbf{r}(u,v) = \ln(u - v) \mathbf{i} + \sqrt{u} \mathbf{j} + \mathbf{k}$.

11) Find parametric representation for that part of the cone $x^2 = y^2 + z^2$, that lies behind the $y$-$z$ plane.

12) Find an equation for the tangent plane to the surface $x^2 - 3y^2 + z^2 + 2 = 0$ at the point $(1,1,1)$.

13) The temperature in the $x$-$y$ plane is given by $(x,y) \sin(x) + xy$. Find the direction from $(0,1)$ at which the temperature increases fastest.

14) $f(x,y) = xy$. Find the directional derivative $D_uf(1,1)$ where $u = \langle \frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2} \rangle$. 
15) A box made of steel has a base of 2 ft x 2 ft and a height of 5 ft. Suppose all four sides have metal thickness of 0.02 ft and the top and bottom each have thickness of 0.04 ft. Estimate the amount of steel, in ft³, used to construct that box.

16) Suppose \( z = f(x, y) \), \( x = 2u + v \) and \( y = 3u - 2v \). Given that \( \frac{\partial z}{\partial x} = 3 \) and \( \frac{\partial z}{\partial y} = -2 \) at the point \( x = 3, y = 1 \), Find \( \frac{\partial z}{\partial u} \) & \( \frac{\partial z}{\partial v} \).

17) If \( f(x, y, z) = yz + \sin(xz) + e^{xy} \) then find \( \nabla f(0, 7, 3) \).

18) Find an equation for the tangent plane to the parametric surface \( r(u, v) = (1+2u) \mathbf{i} + (-u+3v) \mathbf{j} + (u+v) \mathbf{k} \) at the point \((3, 2, 2)\).

19) If \( f(x, y) = e^{xyz} \) then find \( f_{y'x} \).

20) If \( z = f(x, y) = x^2 + 3xy - y^2 \), \( \Delta x = 0.04 \) and \( \Delta y = -0.02 \) then find both \( \Delta z \) and \( dz \).