1) a) Find the first partial derivatives to the function $F(x,y) = xy \int_{y^2}^{2x} \sin e^{2t} dt$.

b) Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if $yz + \cos x \ln y = z^3$.

2) a) If $z = f(x^2 - y^2)$ and f is differentiable, show that $y\frac{\partial z}{\partial x} + x\frac{\partial z}{\partial y} = 0.$

b) Show that $lim_{(x,y)\to(1,0)} \frac{xy-y}{(x-1)^2+y^2}$ does not exist.

3) Evaluate the double integrals:

a) $\int_0^1 \int_{-3}^3 \frac{xy^2}{x^2+1} dy\, dx$

b) $\int_0^1 \int_x^1 e^{x/y} dy\, dx$

c) $\int_0^2 \int_0^{\sqrt{4-x^2}} \cos(x^2+y^2)\, dydx.$

4) a) Find the area of the part of the surface $z = xy$ that lies within the cylinder $x^2 + y^2 = 4$.

b) Evaluate the triple integral: $\int_0^{\pi/2} \int_0^y \int_0^x \cos(x + y + z) dz dx dy$.

5) a) Find the volume of the solid that is enclosed by the cone $z = \sqrt{x^2 + y^2}$ and the sphere $x^2 + y^2 + z^2 = 2$.

b) Evaluate $\iiint_E (x^2 + y^2 + z^2)^{\frac{3}{2}}\, dV$, where E lies between the spheres $x^2 + y^2 + z^2 = 1$ and $x^2 + y^2 + z^2 = 4$.