1) Evaluate the iterated integral: $\int_1^2 \int_0^{2z} \int_0^{lnx} xe^{-y} dydxdz$

2) a) Write the equation $x^2 - x + y^2 + z^2 = 1$ in cylindrical coordinates.

b) Change the point $(\rho, \theta, \phi) = (3, \pi/2, 3\pi/4)$ given in spherical coordinates to rectangular coordinates.

3)a) Evaluate $\int\int\int_E \sqrt{x^2 + y^2} dV$, where
(i) E is the region lies inside the cylinder $x^2 + y^2 = 16$ and between the planes $z = -5$ and $z = 4$.

(ii) E is the solid lies between the spheres $\rho = 2$ and $\rho = 3$.

b) Use spherical coordinates to find the volume of the solid that lies above the cone $z = \sqrt{x^2 + y^2}$ and below the sphere $x^2 + y^2 + z^2 = 2z$ (sketch the solid roughly)

4) Let $\mathbf{u} = (1, 2, 3)$ and $\mathbf{v} = (0, 1, 4)$.

a) Find $\|\mathbf{u} - 2\mathbf{v}\|$.

b) Find $cos\theta$, where θ is the angle between the vectors $\mathbf{u}$ and $\mathbf{v}$.

c) Find $\mathbf{v} \times (\mathbf{u} - 2\mathbf{v})$

d) If the vectors $\mathbf{u}$, $\mathbf{v}$ and the vector $\mathbf{w} = \mathbf{u} - 2\mathbf{v}$ have the same initial point, decide whether the vectors $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$ lie in the same plane or not.

5) Consider the planes $3x - y + z - 4 = 0$ and $x + 2z + 1 = 0$.
a) Determine whether the two planes are perpendicular or not.

b) Find the distance between the point (1,1,1) and the plane $3x - y + z - 4 = 0$.

c) Find the equation of the plane passing through the point $P(1, 2, 3)$ and which is parallel to plane $x + 2z + 1 = 0$.