1. Use a triple integral to find the volume of the 3D-region which is enclosed by the surfaces $y = x^2$, $y = 2x$, $z = x$, and $z = 4$. 
(15) 2. A mass distribution occupies the 3D-region which is enclosed by the surfaces \( z = x^2 + y^2 \) and \( z = 4 \). The mass density function is \( \delta = 2z \) units of mass/unit volume. Find the total mass in the region.
3. A mass distribution occupies the 3D-region which is enclosed by the surfaces \( z = (x^2 + y^2)^{\frac{1}{3}} \) and \( z = 2 \). The mass density function is \( \rho = x^2 + y^2 + z^2 \) units of mass /unit volume.

Use a triple integral in spherical coordinates to find the total mass in the region.
4. Find the surface area of that part of the paraboloid \( z = 16 - x^2 - y^2 \)
which is between the cylinders \( x^2 + y^2 = 1 \) and \( x^2 + y^2 = 4 \).
5. Show that the force field \( \mathbf{F} = (2xy + 2) \mathbf{i} + (x^2 + y^{-1}) \mathbf{j} \) is conservative in the region \( y > 0 \) by finding a potential function for it. Then use this potential function to calculate the work done by \( \mathbf{F} \) as it acts on an object which moves in the upper half plane from \((0,2)\) to \((2,1)\).
(15) 6. The force field \( F = y^2 \; i + x \; j \) acts on an object as it moves in the plane. Calculate the work done by \( F \) as the object moves from \((5,0)\) to \((-4,3)\) along the parabola \( x = 5 - y^2 \).
7. Use Green's theorem to evaluate the line integral

\[ \int_C (3x + 24y + y^3) \, dx + (2x + 5y + 3xy^2) \, dy \]

where \( C \) is the closed curve in the plane consisting of the sides of the triangle with vertices \((1,1), (3,1)\) and \((1,3)\) directed counterclockwise.