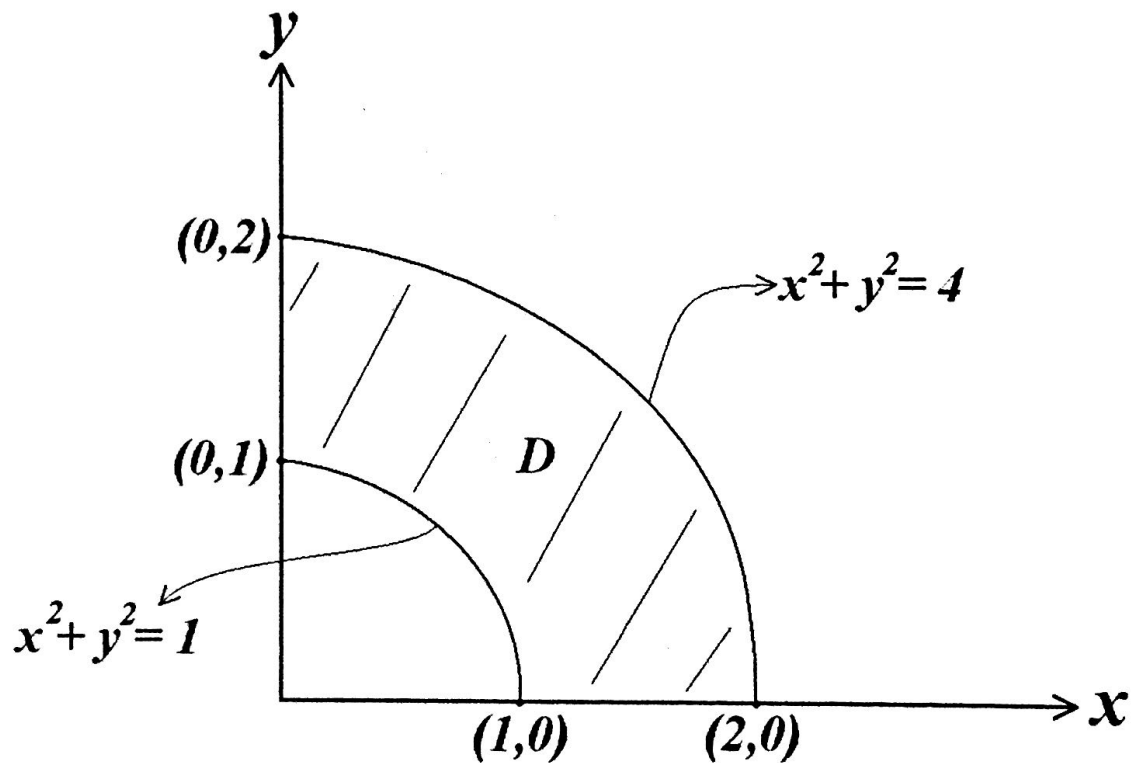
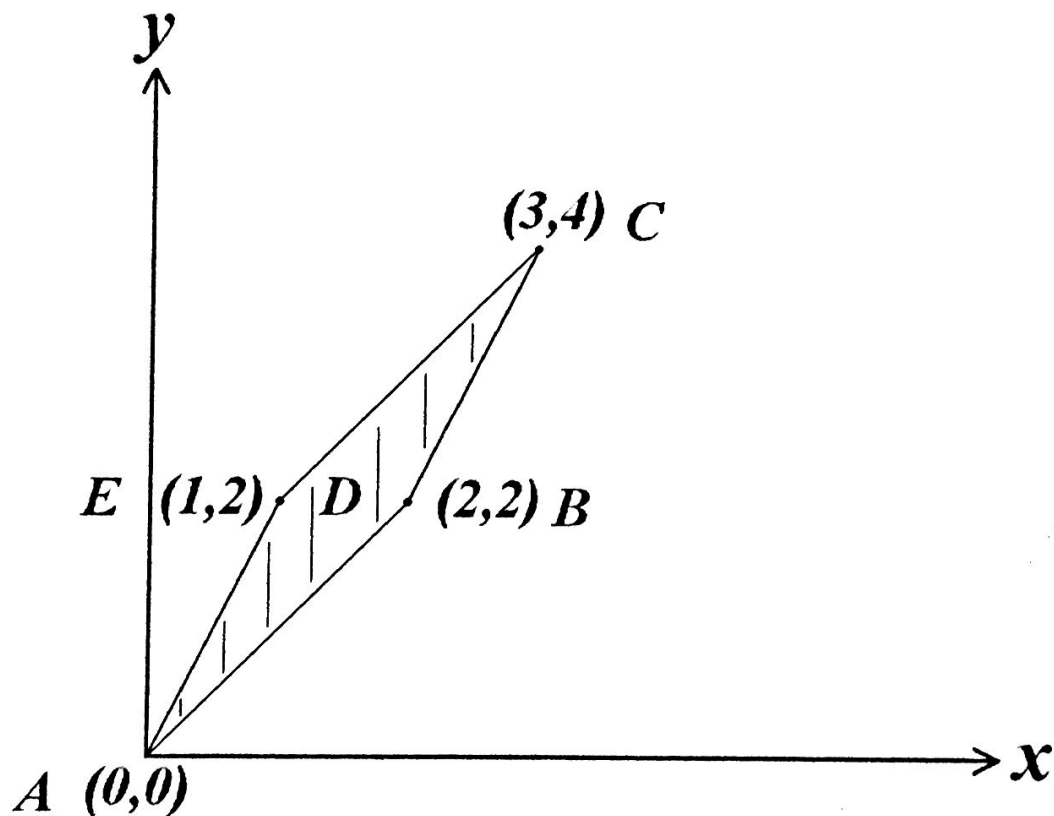


Example 3: Evaluate $\iint_D \log(x^2 + y^2) dx dy$
where D is the region given below.



Example 4: Let D be the parallelogram with vertices $(0, 0)$, $(1, 2)$, $(2, 2)$, $(3, 4)$.

Evaluate $\iint_D xy \, dx \, dy$ by making the change of variables $x = u - v$, $y = 2u - v$.



Cylindrical Coordinates (ρ, ϕ, z)

$$x = \rho \cos \phi, \quad y = \rho \sin \phi, \quad z = z \quad (\rho \geq 0)$$

$$\text{Jacobian} = \det \begin{bmatrix} \frac{\partial x}{\partial \rho} & \frac{\partial x}{\partial \phi} & \frac{\partial x}{\partial z} \\ \frac{\partial y}{\partial \rho} & \frac{\partial y}{\partial \phi} & \frac{\partial y}{\partial z} \\ \frac{\partial z}{\partial \rho} & \frac{\partial z}{\partial \phi} & \frac{\partial z}{\partial z} \end{bmatrix}$$

$$= \det \begin{bmatrix} \cos \phi & -\rho \sin \phi & 0 \\ \sin \phi & \rho \cos \phi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \det \begin{bmatrix} \cos \phi & -\rho \sin \phi \\ \sin \phi & \rho \cos \phi \end{bmatrix}$$

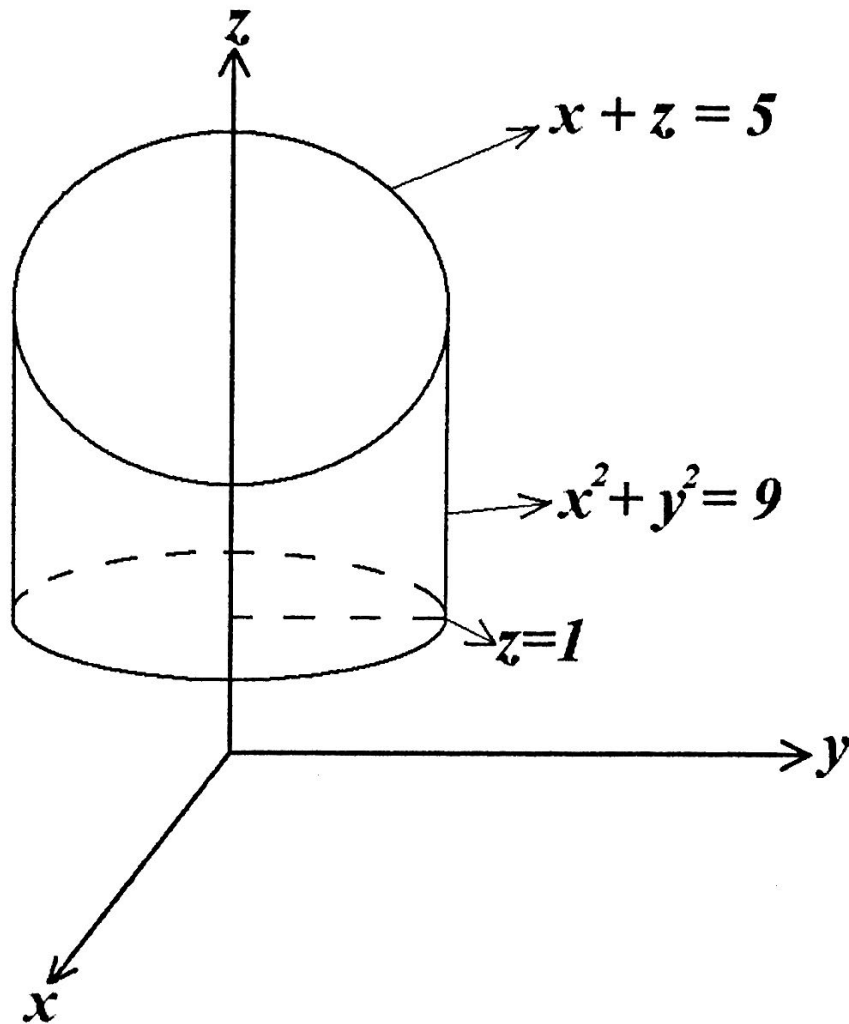
$$= \rho \cos^2 \phi + \rho \sin^2 \phi$$

$$= \rho$$

$$\iiint_D f(x, y, z) \, dx \, dy \, dz$$

$$= \iiint_{D^*} f(\rho \cos \phi, \rho \sin \phi, z) \rho \, d\rho \, d\phi \, dz$$

Example 5: Redo Example 7 from triple integrals to find the volume of the solid below.



Example 6: Redo Example 6 from triple integrals to find $\iiint_D x \, dV$ for region below.

