

Conversion Chart

Cartesian	Polar	Cylindrical	Spherical
$dA = dx dy$	$dA = r dr d\theta$		
$dV = dx dy dz$		$dV = dz r dr d\theta$	$dV = \rho^2 \sin \phi d\rho d\phi d\theta$
	$x = r \cos \theta$	$x = r \cos \theta$	$r = \rho \sin \phi$
	$y = r \sin \theta$	$y = r \sin \theta$	$z = \rho \cos \phi$
	$x^2 + y^2 = r^2$	$z = z$	$\theta = \tan^{-1} \left(\frac{y}{x} \right)$
	$\theta = \tan^{-1} \left(\frac{y}{x} \right)$		$x = \rho \sin \phi \cos \theta$
			$y = \rho \sin \phi \sin \theta$
			$z = \rho \cos \phi$
			$\rho = \sqrt{x^2 + y^2 + z^2} = \sqrt{r^2 + z^2}$

1. Find the volume of the solid enclosed by the cardioid of revolution $\rho = 1 - \cos \phi$
2. Find the volume of the solid bounded below by the sphere $\rho = 2 \cos \phi$ and above by the cone $z = \sqrt{x^2 + y^2}$ (For a picture, see §12.6, number 37)
3. Find the volume of the region that lies inside the sphere $x^2 + y^2 + z^2 = 2$ and outside the cylinder $x^2 + y^2 = 1$.
4. Find the volume of the region bounded above by the paraboloid $z = 9 - x^2 - y^2$, below by the xy -plane, and lying outside the cylinder $x^2 + y^2 = 1$.
5. Find the volume of the region enclosed by the cylinder $x^2 + y^2 = 4$ and the planes $z = 0$ and $y + z = 4$.
6. find the volume of the solid that is bounded above by the cylinder $z = 4 - x^2$, on the sides by the cylinder $x^2 + y^2 = 4$ and below by the xy -plane.