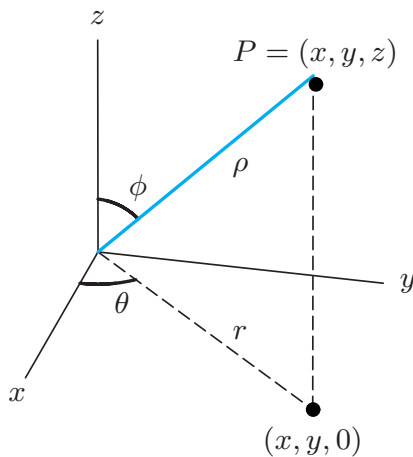


Problem 1: Using the diagram below, write down equations that relate the spherical coordinates (ρ, θ, ϕ) of a point to its cartesian (rectangular) coordinates (x, y, z) .



Problem 2:

(a) Plot the point with spherical coordinates $(2, \pi/4, \pi/3)$ and find its cartesian coordinates.

(b) Find the spherical coordinates of the point with cartesian coordinates $(0, 2\sqrt{3}, -2)$.

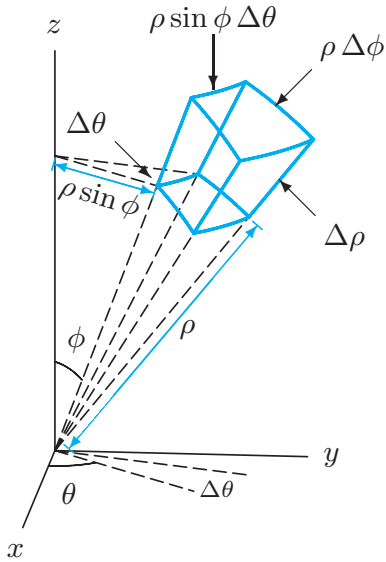
Problem 3:

(a) Describe the equation whose equation in spherical coordinates is $\rho = 1$.

(b) Give an equation in spherical coordinates for the cone $z = \sqrt{x^2 + y^2}$.

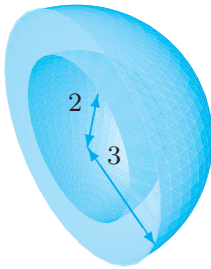
(c) Give an equation in spherical coordinates for the plane $z = 10$.

Problem 4: Using the diagram below, express the volume element dV in spherical coordinates.

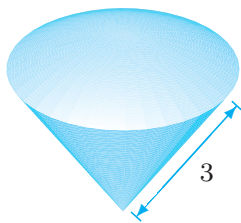


Problem 5: For each object below, set up a triple integral of a function f over the object.

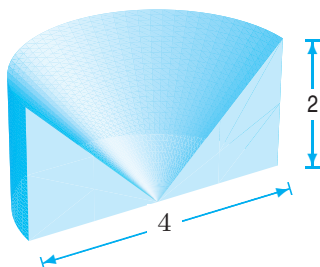
(a)



(b) A piece of a sphere, angle at the center is $\pi/3$.



(c)

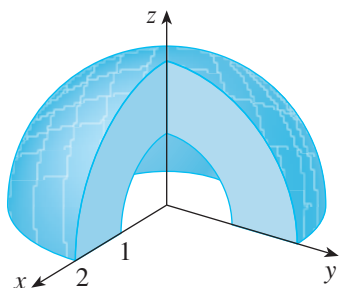


Problem 6: Evaluate

$$\int_W \sin(\phi) \, dV$$

where W is the region $0 \leq \theta \leq 2\pi$, $0 \leq \phi \leq \pi/4$, and $1 \leq \rho \leq 2$.

Problem 7: Compute the volume of the solid pictured below.



Problem 8: Evaluate

$$\int_W (x^2 + y^2) \, dV,$$

where W lies between the spheres $x^2 + y^2 + z^2 = 4$ and $x^2 + y^2 + z^2 = 9$.