



**PH103 : Physics
Tutorial 2**

1. An ant crawls on the surface of the ball of radius b in a manner such that the ant's motion is given in spherical coordinate system by the equation :

$$r = b \quad \phi = \omega t \quad \theta = \frac{\pi}{2} \left[1 + \frac{1}{4} \cos(4\omega t) \right]$$

Find the speed of the ant as a function of the time t . What sort of path is represented by above equation?

2. The equation for the outer edge of a sphere of radius R is given by

$$x^2 + y^2 + z^2 = a^2$$

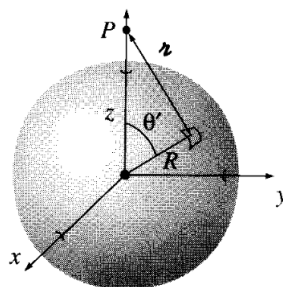
Find the volume of sphere in Cartesian, Cylindrical and Spherical coordinate system.

3. Find the volume of a cone of radius R and height H using suitable coordinate system.
4. Find the potential of a uniformly charged spherical shell having a surface charge density σ of radius R at point P as shown in below figure.

Hint

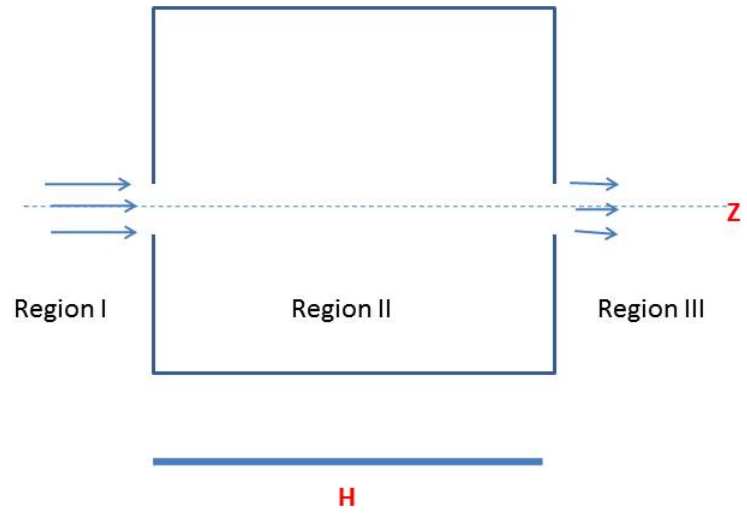
Use the law of cosines to express r :

$$r^2 = R^2 + z^2 - 2Rz \cos \theta'$$



5. Consider a liquid flowing into a circular aperture of radius a (as shown in figure) with an entering velocity $\vec{v}_I = \kappa \hat{e}_z$. In region II the fluid velocity is given as $\vec{v}_{II} = \frac{\alpha x - \gamma y}{\sqrt{x^2 + y^2}} \hat{e}_x + \frac{\alpha y + \gamma x}{\sqrt{x^2 + y^2}} \hat{e}_y + \beta \hat{e}_z$. At a distance H from the circular aperture, a wall is placed with another circular opening with same radius. Find the mass of liquid exiting from region II to region III.

Figure shown in next page



Note : Both the circular apertures are in same line