Tutorial # 5

Instructors: Santabrata Das and Uday Narayan Maity

PH 101: Physics I (2019)

Due on: 11th September, 2019

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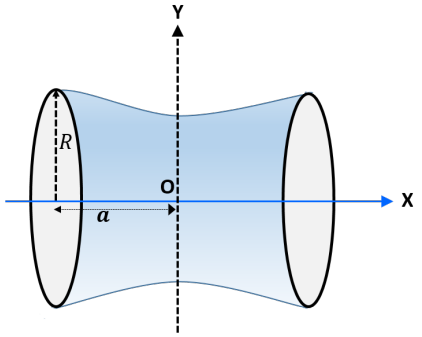
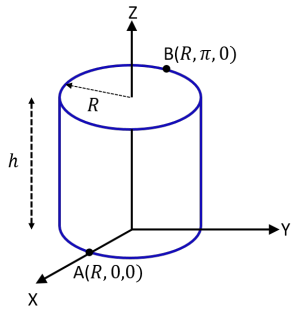
1. The cost of flying an aircraft at an altitude z is e^{-kz} per unit distance of flight path, where k is a positive constant. Consider an airplane that takes off from $(x = -a, z = 0)$ to land at $(x = a, z = 0)$. Assume that the airplane flies in the xz-plane and Earth's surface (xy- plane) is flat. Show that the trajectory that minimizes the travel cost has the form, $z = \frac{1}{k} ln \left(\frac{\cos kx}{\cos ka}\right)$.

2. A soap film is formed between two co-axial rings, each of radius R, located at, $x = \pm a$. Find the function, $y(x)$, that describes the surface of the film (see figure). Note that the area of the surface (which is the "surface of revolution" of the function $y = f(x)$ in question, will be minimum in order to reduce its surface energy due to surface tension. Ignore gravity).



3. Find the geodesic (shortest path) on the surface of a cylinder of radius R and height h, employing **cylindrical coordinate** system. Find the total length of this path between points $A(R, 0, 0)$ and $B(R, \pi, h)$. Coordinates of A and B are given in cylindrical coordinate system.



4. Find an expression for the geodesic (shortest path) on the surface of a cone of half angle, α.