The Open University of Sri Lanka

B.Sc /B.Ed Degree Programme

Applied Mathematics - Level 04

APU2142/APE4142 – Newtonian Mechanics I

Open Book Test (OBT) - 2015/2016

Duration :- One Hour
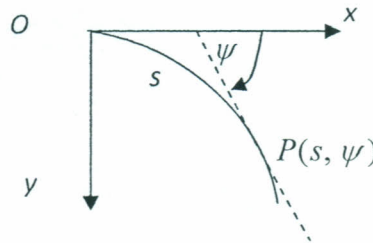
Date:- 08. 10. 2016   **Time:- 9:00 To 10:00**

Answer All Questions.

1. The figure shows a curve C that forms the vertical cross-section of a smooth surface. A particle P moves in a vertical plane along the curve C, whose intrinsic equation is:
    $s = a\tan\psi,\ 0 \le \psi < \pi/2$.

The coordinates (s, ψ) of P are measured relative to a fixed point O and a fixed horizontal line Ox. The particle is released from rest from the point where $\psi = \pi/6$ and slides down the surface along C.

(a) Show that, while the particle remains in contact with the surface, the speed v of the particle is given by $v^2 = 2ga\left(\sec\psi - \dfrac{2}{\sqrt{3}}\right)$.

(b) Show that the particle leaves the surface after it has travelled a distance $(\sqrt{39} - \sqrt{3})a/3$ along the curve.

2. A particle A, of mass m, is held at rest on a smooth horizontal table. One end of a light inextensible string of length l is attached to A. The string passes through a small smooth hole H in the table, and carries a particle B, of mass m, hanging freely at the other end. Initially $HA = a$ and the particle A is moving horizontally with speed $2\sqrt{ag}$ in a direction perpendicular to HA.

(a) If r is the distance HA after time t, show that $\dot{r}^2 = \dfrac{g}{r^2}(r-a)(2a^2 + 2ar - r^2)$.

(b) If the particle B reaches the table, show that the total length of the string cannot exceed $a\left(1 + \sqrt{3}\right)$.