The Open University of Sri Lanka

B.Sc/B.Ed. Degree Programme

Open Book Test (OBT) - 2016/2017

Applied Mathematics - Level 04

APU2142/APE4142 Newtonian mechanics I

Duration: One Hour

Date: 30.09.2017   **Time: 09.00am - 10.00am**

Answer __ALL__ questions.

1. A particle of mass m rests on a smooth horizontal table attached to a fixed point on the table by a light elastic string of natural length $'a'$ and modules mg. Initially a string is just taut and the particle is projected along the table in a direction perpendicular to the line of the string with velocity $\sqrt{\dfrac{4ag}{3}}$. Prove that if r is the distance of the particle from the fixed point at time t then

$$\frac{d^2r}{dt^2} = \frac{4ga^3}{3r^3} - \frac{g(r-a)}{a}.$$

Prove that the string will extend until it's length is $2a$ and that the velocity of the particle is then half of it's initial velocity.

2. A smooth wire in the form of an arc of a cycloid with equation $s = 4a\sin\psi$, is fixed in a vertical plane with the vertex downwards and the tangent at vertex horizontal. A small bead of mass m is threaded on the wire and is projected from the vertex with speed $\sqrt{8ag}$. If the resistance of the medium in which the motion take place is $mv^2/8a$, where v is the speed of the bead, then find an expression for v in intrinsic coordinate. Show also that the bead comes to instantaneous rest at a cusp ($\psi = \pi/2$).