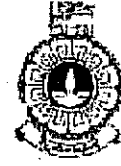


The Open University of Sri Lanka  
 B.Sc /B.Ed Degree Programme  
 Applied Mathematics - Level 04  
 APU 2142 – Newtonian Mechanics I  
 Open Book Test (OBT) - 2010/2011



Duration :- One and half hours

Date:- 15. 03. 2011

Time:- 4.00 p.m. - 5.30 p.m.

Answer All Questions.

1. A particle moving in a straight line, is subject to a retardation of  $kv^n$  where  $v$  is the speed at time  $t$ . Find  $v$  as a function of  $t$ . Show that, if  $n < 1$ , particle will come to rest at a distance  $\frac{u^{2-n}}{k(2-n)}$  from the point of projection at a time  $\frac{u^{1-n}}{k(1-n)}$  where  $u$  is the initial speed.

What happens when

- (i)  $1 < n < 2$       (ii)  $n > 2$ .

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

If  $r$  is the distance  $AH$  after time  $t$ , show that  $\dot{r}^2 = gh \left( 1 - \frac{a^2}{r^2} \right) + g(a - r)$ .

Show also that if the particle  $B$  reaches the table, then the total length of the string cannot

exceed  $\frac{1}{2} \left[ h + \sqrt{h^2 + 4ah} \right]$ .

3. A smooth wire is bent into the form of an arch of a cycloid with intrinsic equation:

$s = 4a \sin \psi$ ,  $-\frac{\pi}{2} \leq \psi \leq \frac{\pi}{2}$ , where  $a$  is a positive constant. The wire is fixed in a vertical plane with its axis vertical and its vertex  $O$  at its lowest point. A bead  $P$ , of mass  $m$ , moves under gravity on this wire. Given that the bead is projected from the vertex  $O$  with speed  $2\sqrt{ga}$ , show that when  $P$  reaches the point at which the tangent is inclined at an angle  $\theta$  to the horizontal:

(a) its speed is  $2\sqrt{ga} \cos \theta$ ,

(b) the normal contact force exerted by the wire on the bead is  $2mg \cos \theta$ .