

The Open University of Sri Lanka
 B.Sc./B.Ed. Degree, Continuing Education Programme
 Open Book Test (OBT) - 2021/2022
 Level 4 - Applied Mathematics
 ADU4301 – Newtonian Mechanics I



Date :31-12-2-22

Time: 10:30a.m. To 11:30a.m.

Answer All Questions.

1. A particle is projected vertically upwards with a velocity u and moves in a medium offering resistance kv^4 per unit mass. Let x be the distance travelled and v be the velocity of the particle at time t , then show that

$$2kx = \sqrt{\frac{k}{g}} \left[\tan^{-1} \left(\frac{u^2}{\sqrt{g/k}} \right) - \tan^{-1} \left(\frac{v^2}{\sqrt{g/k}} \right) \right].$$

Hence, show that the maximum height H attained by the particle from the point of projection is given by $H = \frac{\alpha}{2\sqrt{kg}}$, where $g \tan^2 \alpha = ku^4$.

If the particle has velocity w velocity downwards on reaching the point of projection, show that $w^2 = \sqrt{g/k} \tanh \alpha$.

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

