The Open University of Sri Lanka
B.Sc./B.Ed. Degree, Continuing Education Programme
Open Book Test (OBT) - 2023/2024
Level 4 - Applied Mathematics
ADU4301 – Newtonian Mechanics I

Date :23-12-2023 **Time: 10:30 a.m. To 11:30 a.m.**

Answer All Questions.

1. A particle of unit mass is projected vertically upwards with velocity V in a medium for which the resistance is kv per unit mass when the speed of the particle is v.

   (a) Let x be the distance travelled at time t, then show that

   $$x = \frac{1}{k}(V - v) + \frac{g}{k^2}\ln\left(\frac{g+kv}{g+kV}\right).$$

   Hence, show that the maximum height H attained by the particle from the point of projection is given by $H = \frac{V}{k} + \frac{g}{k^2}\ln\left(\frac{g}{g+kV}\right)$.

   (b) If the particle returns to the point of projection, with speed U after time T then show that

   (i) $U + V = \frac{g}{k}\ln\left(\frac{g+kV}{g-kU}\right)$ and

   (ii) $U + V = gT$.

2. A particle, of mass m, is held on a smooth table. A string attached to this particle passes through a hole in the table and connects to a particle of mass $3m$. Motion is started by a particle on the table being projected with velocity V at right angles to the string. If a is the original length of the string on the table , show that when hanging particle has descended a distance $a/2$ (assume to be possible) its velocity will be $\frac{\sqrt{3}}{2}\sqrt{ga - V^2}$.