The Open University of Sri Lanka

B.Sc/B.Ed. Degree Programme

No Book Test (NBT) - 2016/2017

Applied Mathematics - Level 04

APU2142/APE4142 Newtonian mechanics I

Duration: One Hour

Date: 11.11.2017   Time: 02.30pm - 03.30pm

Answer **ALL** questions.

1. A raindrop falls through a stationary cloud. Its mass m increases by accretion uniformly with the distance x fallen, so that $m = m_0(1 + kx)$, where k is a positive constant. Given that its speed v is zero when $x = 0$, show that

$$v^2 = \frac{2g}{3k} \left[1 + kx - \frac{1}{(1 + kx)^2} \right].$$

2. A rocket of initial total mass M propels itself by ejecting mass at a constant rate μ per unit time with speed u relative to the rocket. If the rocket is at rest directed vertically upwards. Show that it will not initially leave the ground unless $\mu u > Mg$. Assuming this condition to hold, show that the velocity of the rocket after time t is given by $u \ln \left(1 - \frac{\mu t}{M} \right) - gt$.

   Show also that when the mass of the rocket has been reduced to half of the initial value, its height above the ground will be $\frac{Mu}{2\mu} \left(\ln 2 - 1 - \frac{Mg}{4\mu u} \right)$.

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