# EASTERN UNIVERSITY, SRI LANKA

## FIRST EXAMINATION IN SCIENCE – 2014/2015

## FIRST SEMESTER (August/September 2016)

## PH 101 MECHANICS I

ime: 01 hour

nswer ALL Questions

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01. Describe the physical meanings of *speed*, *acceleration*, and *momentum* of a moving particle on a straight line.

A particle is moving on a straight line with constant acceleration $f$. If $x$ is the distance of the particle from a fixed point on the straight line, show that the equation is written by

$$\frac{d^2x}{dt^2} = f.$$

Hence, show that the above equation can be

$$\frac{dv}{dx} = \frac{f}{v}.$$

where $v$ is the speed of the particle.

Deduce that $v^2 = u^2 + 2fx$, if $v = u$ at $x = 0$.

A ball is projected vertically upwards with a speed in a resistance less medium. The ball could travel a maximum height of $h$. If the resistance of the medium is proportional to the square of the speed, then show that the ball can reach the maximum height of

$$\frac{v_t^2}{2g} \ln\left(\frac{2hg}{v_t^2} + 1\right),$$

where $v_t$ is the limiting velocity of the ball in the medium.

02. Define the following terms for a single particle;

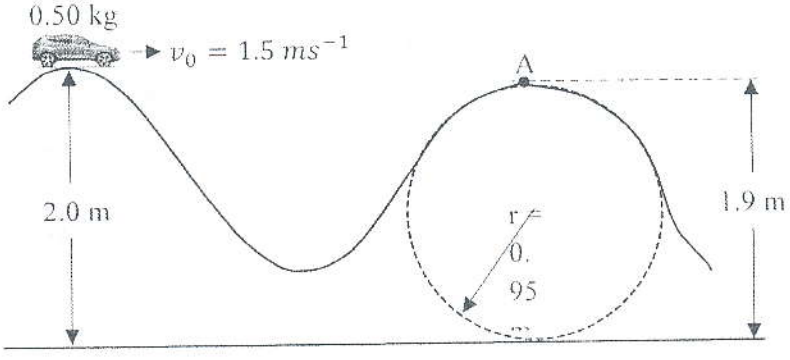
(i) kinetic energy,

(ii) potential energy, and

(iii) total energy.

Show that total energy is conserved when the forces acting on a particle is conservative.

A designer is working on a new roller coaster, and begins to design a model. In this model, of total mass 0.50 kg moves with negligible friction along the track shown in the below fi The car is given an initial speed $v_0 = 1.5$ m.s$^{-1}$ at the top of the first hill of height 2.0 m. P is located at a height of 1.9 m at the top of the second hill, the upper part of which is a cir arc of radius 0.95 m.




(a) Calculate the speed of the car at point A.

(b) Illustrate all the forces acting on the car at point A.

(c) Calculate the magnitude of the force of the track on the car at point A.

(d) In order to stop the car at point A, some friction must be introduced. Calculate the wo must be done by the frictional force in order to stop the car at point A.

(e) Explain how to modify the track design to cause the car to lose contact with the t point A before descending down the track. Justify your answer.