EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2001/2002

(APRIL 2002)

REPEAT

PH101 - Mechanics I

Time: 01 hour.

Answer All questions.

Q1 (a) Distinguish between average velocity and instantaneous velocity. Under what condition is the average velocity equal to instantaneous velocity.

A particle located at position $x = 0$ at time $t = 0$ starts moving along the positive X-direction with a velocity v that varies as $v = k\sqrt{x}$. How do the *displacement, velocity* and *acceleration* of the particle vary with time t. What is the average velocity of the particle over the first d distance of its path.

(b) A particle, **P**, is initially a distance a from a fixed point,**O**, and is given an initial velocity u in the direction **OP**. The acceleration of the particle for $t \geq 0$ is directed towards **O** and of magnitude $\frac{G}{x^2}$, where G is a positive constant and x is the distance of the particle from **O** along the straight line **OP** produced.

(i) Show that for $u^2 \geq \frac{2G}{a}$, the particle will not return to its initial position. Write down the possible escape velocity.

(ii) What happens if $u^2 < \frac{2G}{a}$?

Q2 (a) Explain briefly what you mean by *Kinetic energy, Potential energy, Work done, Work-Energy principal and Conservative force.* A force **F** that is directed along an x axis acts on a particle as the particle moves from $x = 1.0\ m$ to $x = 4.0\ m$ and then back to $x = 1.0\ m$. What is the net work done on the particle by force **F** for the round trip if the values of the force during the outward and the return trips are (i) $2.0x$ and $-2.0x$, (ii) $3.0x^2$ and $3.0x^2$. Here, x is in *meters* and **F** is in *Newtons*. In which situation(s) is the force conservative?

(b) Can a body have momentum without energy? Explain.

(c) Show that when a spring is compressed a distance x from its natural length, the actual potential energy of the spring is given by $\frac{1}{2}kx^2$, where k is the spring constant.

The spring of a spring gun is compressed a distance of 3.2 cm from its relaxed state, and a ball of mass 12 g is put in the barrel. With what speed will the ball leave the barrel when the gun is fired? The spring constant k is 7.5 Ncm^{-1}. Assume no friction and a horizontal gun barrel. Also assume that the ball leaves the spring and the spring stops when the spring reaches its relaxed length.

Re