EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2003/2004

FIRST SEMESTER

(NOV/DEC 2004)

PH101 - MECHANICS I

Time: 01 hour.

Answer ALL questions

1. Define the terms velocity and acceleration in Kinematics. The position vector of a particle is given by $\underline{r} = x\underline{i} + y\underline{j} + z\underline{k}$. Write down the expressions for instantaneous velocity and acceleration of the particle.

(a) A particle's position vector is given by

$$|\underline{r}| = t^3 - 2t^2 + t + 2$$

Find

(i) Velocity of the particle at time t.
(ii) Acceleration of the particle at time t.
(iii) The time at which the velocity is zero.

(b) A particle's acceleration is given by

$$\underline{a} = 2t\underline{i} + 3\underline{j}$$

At time t = 0, particle is located at origin and moving with velocity $2\underline{i} + \underline{j}$. Find the velocity and displacement of the particle as a function of time.

2. Define work and power in Mechanics

A particle of constant mass m moves under the influence of a force field $\underline{F}$. Assuming that at times t_1 and t_2 the velocity of the particle is $\underline{v}_1$ and $\underline{v}_2$ respectively. Prove that

$$\int_{t_1}^{t_2} \underline{F}.d\underline{r} = \frac{1}{2}m|\underline{v}_2|^2 - \frac{1}{2}m|\underline{v}_1|^2$$

A particle of mass 1 Kg moves in a force field given by

$$\underline{F} = 3t^2\underline{i} + 2t\underline{j}$$

At t = 0, the particle has velocity $3\underline{i} + 4\underline{j}$.

Find

(i) The velocity and momentum of the particle as a function of time.
(ii) The kinetic energy of the particle when t = 1 and t = 2.
(iii) The work done in moving the particle from the point when t = 1 to the point when t = 2.
(iv) Impulse of the particle in moving the particle from t = 1 to t = 2.

Using the above results verify Work-Energy theorem and Newton's 2nd law of motion.