EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE - 2002/2003

(APRIL/MAY 2004)

PH 204 MECHANICS II

Time: 01 hour.

Answer ALL Questions

(i) Starting from conservation of linear momentum, show that the general equation of motion for a rocket is

$$F = M\frac{dv}{dt} + C\frac{dM}{dt}$$

where M is the total mass of the rocket and pay load, C is the exhaust velocity and F is the external force acting on the rocket.

(ii) Show that the final velocity increment of a two stage rocket, when all fuel has been burnt is

$$V = -Clog\left[1 - \frac{\varepsilon M_1}{M_2 + p}\right] + Clog\left[1 - \frac{\varepsilon M_1}{M_1 + M_2 + p}\right]$$

where M_1 is the mass of the first stage rocket, M_2 is the mass of the second stage rocket, p is the mass of the payload and ε is the ratio of the initial fuel mass to initial rocket mass.

. State the Newton's law of gravitation. Using this law

(i) Find the variation of gravitational acceleration (g) with lattitude.

(ii) Find the radius of the orbit for a earth satellite.

(iii) Find the escape velocity of a particle from the earth surface.

An object is thrown with an initial velocity v from the earth surface. Using the Newton's law of gravitation show that the particle attains a maximum height h given by

$$h = \frac{R_e v^2}{(2gR_e - v^2)}$$

where R_e is the radius of the earth.