EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2009/2010

FIRST SEMESTER (PROPER)

(June 2011)

PH 105 GENERAL PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. What do you mean by modulus of elasticity?

   i. Derive an expression for the moment of couple required to bend a uniform metallic bar into an arc of circle of small curvature.

   ii. A horizontal cantilever of uniform cross sectional length L carries a load W at the free end. Derive an expression for the deflection at a distance x from the clamped end of the cantilever.

   iii. Two cantilevers of same material have uniform and equal cross sectional areas, but have square and circular cross sections. Find the ratio of the lengths of the two cantilevers which show equal maximum deflection when their free ends are loaded with equal weights.

2. What do you understand by viscosity in fluids? Define the term *coefficient of viscosity* and obtain its unit and dimension.

i. Derive Stocke's formula by dimensional analysis for a freely falling sphere in an incompressible viscous fluid.

ii. Write down a general equation for a falling steel ball of density ρ_s in the glycerin medium of density ρ_g. Hence:

a. Show that the velocity v at any point is

$$v = \frac{a^2 g}{9\eta}(\rho_s - 2\rho_g),$$

where a is the radius of the steel ball, g is the gravitational acceleration and η is the viscosity of glycerin.

b. Deduce an equation at terminal velocity.

iii. A steel ball of radius 6 mm freely falls in a tank of glycerin.

a. Find its velocity at the instant when its acceleration is $g/2$.

b. What is the terminal velocity of the ball?

You may use $\rho_s = 8500\ \text{kg m}^{-3}$, $\rho_g = 1320\ \text{kg m}^{-3}$ and $\eta = 8.3 \times 10^{-1}\ \text{N s m}^{-2}$.