EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2007/2008

FIRST SEMESTER (PROPER/REPEAT)

(March/April 2010)

PH 105 GENERAL PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. State and prove **Archimedes law**.

   A cylindrical container of length **L** is fully filled with a liquid which has mass density **ρ**. It is placed on a weigh-scale (which measures the downward force on the pan of the scale), and the scale reading is **W**. A light ball (which would float on the liquid if allowed to do so) of volume **V** and mass **m** is pushed down below the surface of the liquid with a fixed rigid rod of negligible volume, as shown in the figure (i).

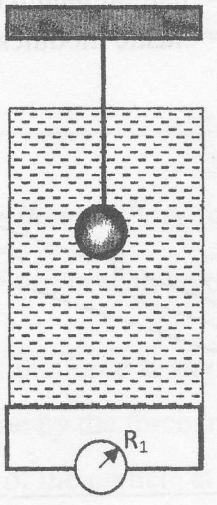

figure (i)

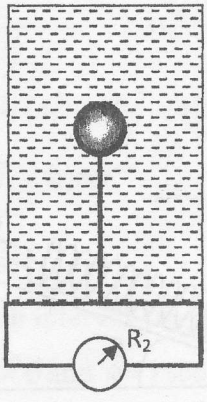

figure (ii)

(a) What is the mass **M** of liquid which overflowed while the ball was being pushed into the container?

(b) What is the reading $\mathbf{R_1}$ on the scale when the ball is fully immersed?

(c) If instead of being pushed down by a rod, the ball is held in place by a fine string attached to the bottom of the container as shown in figure (ii). What is the tension **T** in the string?

(d) In part(c), what is the reading $\mathbf{R_2}$ on the scale?

(e) If the string is cut, what will be the initial acceleration $\boldsymbol{a}$ of the ball? Assume that viscosity effects are negligible.

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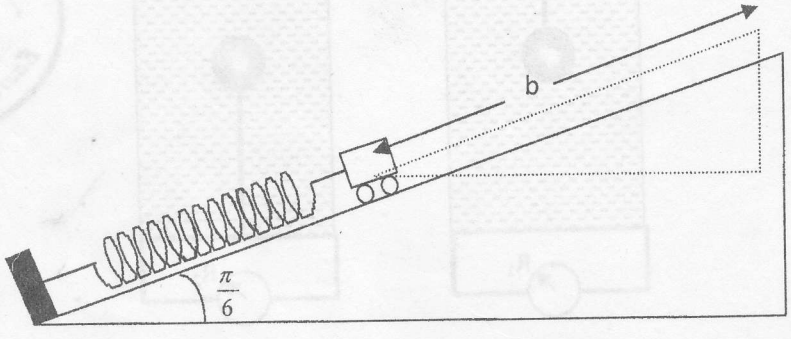
2. State the meanings of the terms **Stress** and **Strain.**

Using the terms **Stress** and **Strain,** show that the Hooke's Law is given by;

$$F = ke, \text{ where } k = \frac{\lambda}{l}$$

Hence show that the energy stored in an elastic string is given by;

$\lambda e^2 / 2l$ where, F = force acting on a string
k = constant
e = extension on a string
l = natural length of the string
λ = elastic modules



A trolley of mass ***m*** runs down a smooth track of constant inclination $\frac{\pi}{6}$ to the horizontal, carrying at its front a light spring of natural length ***a*** and elastic modulus $\frac{mga}{c}$, where ***c*** is a constant. The spring obeys Hooke's law up to the point, when it is fully compressed by a length of $\frac{a}{4}$. When the trolley has traveled a distance ***b*** from rest, the spring meets a fixed stop.

(a) Determine the elastic energy stored in the spring

(b) Show that, when the spring has been compressed to a distance x, where $x < \frac{3a}{4}$, the speed v of the trolley is given by $\frac{cv^2}{g} = c(b+x) - x^2$.

(c) Given that $c = \frac{a}{10}$ and $b = 2a$, find the total distance covered by the trolley before it momentarily comes to rest for the first time.