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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree
First Year – Semester II Examination - February/March 2013

PHY 1201- GENERAL AND THERMAL PHYSICS

Answer any FOUR questions   TIME: 2 Hours

Acceleration due to gravity $g = 9.8$ m s^{-2}

Use of a non-programmable calculator is permitted

1. Write short notes on

   a) Fundamental forces of nature

   b) Moment of inertia

   c) Escape velocity

   d) Dynamic lift

2. a) What is an inertial frame of reference?

   b) Show that all other frames of reference moving with a constant velocity relative to an inertial frame are also inertial frames.

   c) A passenger in a train moving at 30 m s^{-1} passes a man standing on a station platform at $t = t' = 0$. Twenty seconds after the train passes him, the man on the platform determines that a bird flying along the track in the same direction as the train is 800 m away. What are the co-ordinates (x', y', z', t') of the bird as determined by the passenger?

3. a) State the law of conservation of linear momentum.

   b) Show that for an elastic one dimensional collision, the relative velocity of approach before collision is equal to the relative velocity of separation after collision.

   c) A ball of mass 4 kg travelling with a speed of 2 m s^{-1} strikes a rigid wall perpendicularly and rebounds elastically. If the ball is in contact with the wall for 0.05 s, what is the average force?

4. What is meant by the term "precession"?

   A solid conical top of mass M, height h and radius R is spinning about its symmetry axis OO' makes an angle θ with the vertical. (Figure)

   a) Find the angular speed, Ω at which the top precesses about the vertical.

   b) If h $= 10$ cm, R $= 3$ cm and if the top is spinning at 5800 rotations per minute, find the angular speed of precession.

   Note: The center of mass of the top is located along OO' at a distance $3h/4$ from the vertex O and the moment of inertia I about the axis OO' is given by $I = \dfrac{3}{10} MR^2$.
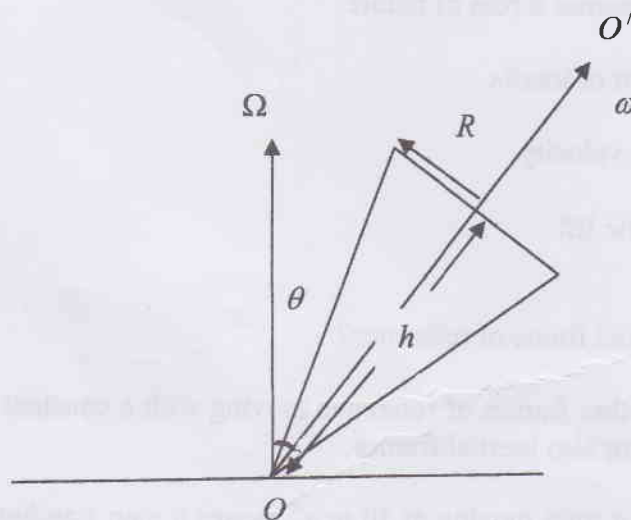
Figure

5. a) What is it meant by "incompressible fluid"?

   b) Show that,

$$\text{speed of flow} \quad \alpha \quad \frac{1}{\text{area of cross section}}$$

   c) A cross sectional area A_0 of the aorta (the major blood vessel emerging from the heart) of a normal resting person is 3 cm^2 and the speed of blood v_0 through it is 30 cm s^{-1}. A typical capillary (diameter $\approx 6 \ \mu m$) has a cross sectional area A_0 of 3 x 10^{-7} cm^2 and a flow speed v of 0.05 cm s^{-1}. How many capillaries dose such a person have?