RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
First Year – Semester I Examination – June/July 2018

PHY 1201 – GENERAL PHYSICS

Time: Two (02) hours

Answer **All** Questions.

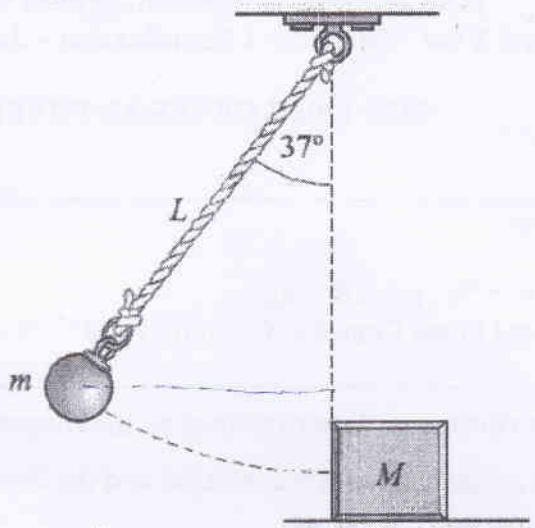
Gravitational field intensity, g = 9.8 N kg^{-1}
Universal Gravitational Force Constant, G = 6.67×10^{-11}N m^2 kg^{-2}

1. The motion of a rocket can be best explained by the conservation of linear momentum.
   a) Assuming the initial mass of a rocket is m_i and the final mass is m_f, show that the final velocity (v_f) of the rocket is given by $v_f = v_e \ln \frac{m_i}{m_f}$, where, v_e is the exhaust velocity of the rocket fuel with respect to the earth. (25 Marks)
   b) If the exhaust velocity is 2 km/s, find the velocity of the rocket once it burns down half of the rocket fuel. (25Marks)
   c) If the rocket uses 1200 Tons of rocket fuel and takes 20 minutes to reach earth orbit, calculate the thrust of the rocket engine. (25 Marks)
   d) Using Newton's 3rd low and conservation of momentum, explain the differences in motions between a rocket and a bullet fired from a gun. (25 Marks)

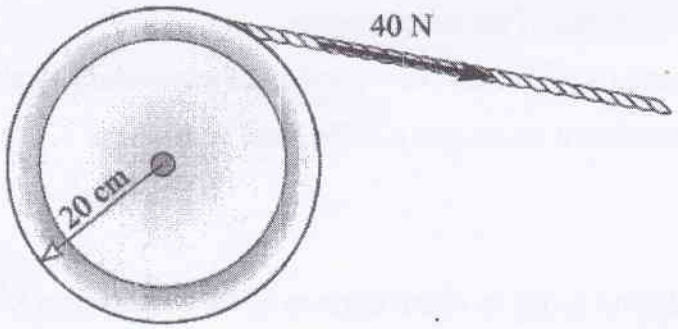
2. An elastic collision is one in which the sum of the translational kinetic energy of the object not changed during the collision.
   a) A 7500 kg truck travelling at 5.0 m/s east collides elastically with a 1500 kg car moving at 20 m/s in a direction 30^0 south of west. After collision, the two vehicles remain tangled together. Obtain two equations for the above collision considering the conservation of momentum along north and east directions. (20 Marks)
   b) With what speed and in what direction does the wreckage begin to move? (25 Marks)

c) If the truck comes to a complete stop after the collision what will be the direction and the velocity of the car after collision. (25 Marks)

d) A pendulum consisting of a ball of mass m is released from the position shown in the figure and strike a block of mass M. The block slides a distance D before stopping under the action of a steady friction force of 0.2 Mg. Find D if the ball rebounds to an angle of 20^0. (30 Marks)



3. As shown in the figure a constant force of 40 N is applied tangentially to the rim of a wheel with 20 cm radius. The wheel has a moment of inertia of 30 kg m^2.



Find,

a) the angular acceleration (25 Marks)

b) the angular speed after 4.0 s. (25 Marks)

c) the number of revolutions made in that 4.0 s. (25 Marks)

d) Show that the work done on the wheel in the 4.0 s is equal to the kinetic energy of the wheel after 4.0 s. (25 Marks)

4. A 1 kg object is located at a distance of 1.7×10^6 m from the center of a large object whose mass is 7.4×10^{22} kg.

   a) What is the size of the force acting on the smaller object? (20 Marks)

   b) What is the size of the force acting on the larger object? (20 Marks)

   c) What is the acceleration of the smaller object when it is released? (20 Marks)

   d) What is the acceleration of the larger object when it is released? (20 Marks)

   e) A satellite in a circular orbit at an altitude of 230 km above the earth's surface has a period of T = 89 minutes. What is the mass of the earth? (20 Marks)

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