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## GROUP 1

**SUBJECT: PHYSICS 1**

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**Question 1 (20 pts)** An object of mass 0.4 kg was moving horizontally to the left at 20 m/s. After a collision with a wall, it moves at  $45^\circ$  upward and to the right, at 30 m/s. The collision time is 0.001 s.

- a/ Draw the diagram of the velocities to show the average force acting on this object.  
b/ Determine the magnitude and the direction of the average forces acting on this object and on the wall.

**Question 2 (20 pts)** A small ball is released from rest at the point A of a hemisphere with radius 0.5 m. The ball slides down to the lowest point B of the hemisphere (Fig.1) with speed 2.8 m/s. Knowing that the work of friction on the ball when it moves from A to B is 0.22 J.

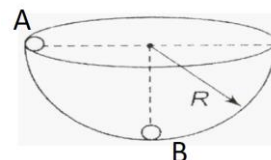


Fig.1

- a/ What is the work of normal force on the ball? Find the mass of the ball.  
b/ What is the normal force on the ball due to the bottom B of the hemisphere?

**Question 3 (20 pts)** A light spring is fixed at one end, the other end is attached to a cube of mass 0.5 kg. At first, the spring is compressed a distance of 0.2 m. When released, the cube moves on a horizontal plane. The coefficient of kinetic friction between the plane and the cube is 0.41. The spring constant is 100 N/m.

- a/ What is the distance of travel of the cube before coming to rest?  
b/ Find the speed of the cube when it returns to its first position for the first time?

**Question 4 (20 pts)** Suppose a helicopter can be raised if all of the rotational kinetic energy of its four blades could be used to lift it. The total loaded mass of a helicopter (included the mass of four blades) is 1000 kg. This helicopter is raised to the height of 53.7 m.

- a/ Compute the rotational kinetic energy of one blade of this helicopter.  
b/ Each blade is  $L = 4$  m long and has the mass of  $M = 50$  kg. The moment of inertia of each blade with respect to its axis is given by:  $I = \frac{ML^2}{3}$ . Compute the angular speed of each blade (in revolutions/min).

**Question 5 (20 pts)** A disc of moment of inertia of  $2 \times 10^{-4}$  kg.m<sup>2</sup> with respect to its vertical axis is rotating in a horizontal plane at 100 rev/min. A ball of wax falls slowly on the disc and sticks to it at a distance of 5 cm from the axis. The new angular speed of the system is then 80 rev/min.

- a/ Find the mass of the ball.  
b/ Is this collision between the disc and the ball elastic? Explain your answer.

**END OF QUESTION PAPER**