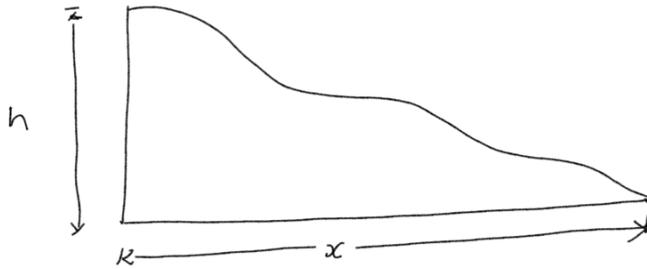


## Test-2

1) An object of mass  $m$  is sliding down a hill of arbitrary shape and, after traveling a certain horizontal path, stops because of friction. The friction coefficient may be different for different segments of the entire path but it is independent of the velocity and direction of motion. Find the work that a force must perform to return the object to its initial position along the same path.

– 10 marks

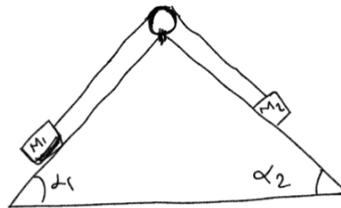


2) A triangular prism of mass  $M$  is placed one side on a frictionless horizontal plane as shown in Fig. 1. The other two sides are inclined with respect to the plane at angles  $\alpha_1$  and  $\alpha_2$  respectively. Two blocks of masses  $m_1$  and  $m_2$ , connected by an inextensible thread, can slide without friction on the surface of the prism. The mass of the pulley, which supports the thread, is negligible.

a). Express the acceleration  $a$  of the blocks relative to the prism in terms of the acceleration  $a_0$  of the prism.

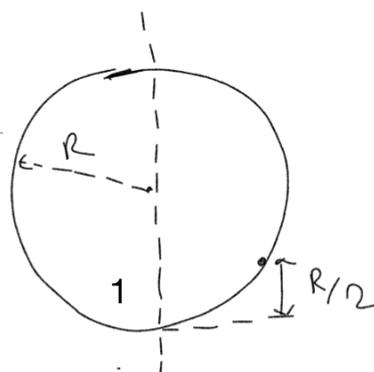
b). Find the acceleration  $a_0$  of the prism in terms of quantities given and the acceleration  $g$

c). At what ratio  $m_1/m_2$  the prism will be in equilibrium? – 20 marks



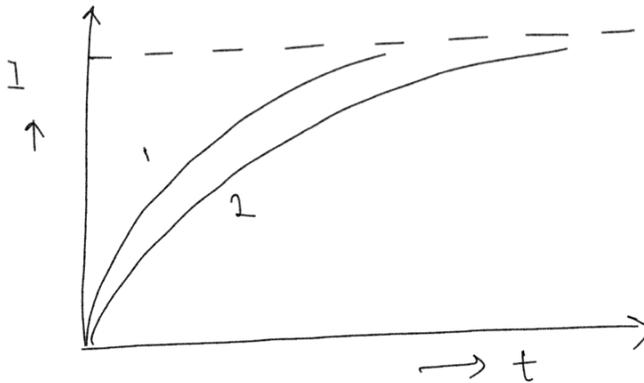
3) A hollow sphere of radius  $R = 0.5$  m rotates about a vertical axis through its centre with an angular velocity of  $\omega = 5 \text{ s}^{-1}$ . Inside the sphere at the height of  $R/2$  (Fig. 6). ( $g = 10 \text{ m/s}^2$ )

. Inside the sphere a small block is moving together with the sphere at the height of  $R/2$ .



- a) What should be at least the coefficient of friction to fulfill this condition?  
 b) Find the minimal coefficient of friction also for the case of  $\omega = 8 \text{ s}^{-1}$ . — 15 marks

4) When a certain circuit consisting of a constant EMF, an inductance, and a resistance is closed, the current in it increases with time according to curve 1 (see the figure accompanying the problem). After one parameter ( $G$ ,  $L$ , or  $R$ ) is changed, the increase in current follows curve 2 when the circuit is closed a second time. Which parameter was changed and in what direction? — 10 marks



5) A train  $S_1$ , moving with a uniform velocity of  $108 \text{ km/h}$ , approaches another train  $S_2$  standing on a platform. An observer  $O$  moves with a uniform velocity of  $36 \text{ km/h}$  towards  $S_2$ , as shown in figure. Both the trains are blowing whistles of same frequency  $120 \text{ Hz}$ . When  $O$  is  $600 \text{ m}$  away from  $S_2$  and distance between  $S_1$  and  $S_2$  is  $800 \text{ m}$ , the number of beats heard by  $O$  is — (Speed of sound  $= 330 \text{ m/s}$ ) — 10 marks

6) Two  $20\text{-g}$  flatworms climb over a very thin wall,  $10 \text{ cm}$  high. One of the worms is  $20 \text{ cm}$  long, the other is wider and only  $10 \text{ cm}$  long. Which of them has done more work against gravity when half of it is over the top of the wall? What is the ratio of the amounts of work done by the two worms? — 10 marks

7) A plate, bent at right angles along its centre line, is placed onto a horizontal fixed cylinder of radius  $R$  as shown in figures. How large does the coefficient of static friction between the cylinder and plate need to be if plate is not to slip off the cylinder?. — 10 marks



