ESO 204: Mechanics of Solids (2008-09 I Semester)

Assignment No.1 (Due on 12 August, 2008)

1.1 A drum of 600 mm radius with mass centre G has a weight of 16 kN and rests on a cradle consisting of two long rollers of 240 mm diameter. The rollers rest on a smooth horizontal surface and are prevented from separating by a horizontal links, one at each end of the rollers. Calculate the tension T in each link and the reaction R between the drum and each roller (Fig 1.1).

1.2 The 1.5 kN beam AB carries a 2.5 kN load at B. The beam is held by a fixed support at A and by cable CD which is attached to the counterweight W. (a) If W = 6.5 kN determine the reactions at A. (b) Determine the range of W for which the magnitude of the moment at A does not exceed 2.5 kNm.(Fig 1.2)

1.3 A 1.5m x 2.0m signboard of uniform density weighs 1.35 kN and is supported by a ball & socket at A and by two cables. Determine the tension in each cable and the reaction at A. (Fig 1.3)

1.4 An electric motor is mounted on a three-point support as shown (Fig 1.4). The motor weighs 100N, which may be assumed to act at the center of the motor. Before starting, the belt tensions are 140N each. When running, the motor is delivering a torque of 3Nm. What are the reactions at supports A, B, and C when the motor is running? (Hint: Assume the supports A, B, and C transmit no torque or moments and are frictionless. Also assume that the mean tension in the belt remains unchanged.)

1.5 A 1000N wheel rolls on its hub up the circular incline under the action of a 250N weight attached to a cord around the rim. Determine the angle θ at which the wheel comes to rest, assuming the friction is sufficient to prevent slippage. What is the minimum coefficient of friction that will permit this position to be reached with no slipping?(Fig 1.5)

1.6 In building construction it is common to build a floor or a roof on temporary supports which permit leveling up before setting the permanent columns in place. The sketch (Fig 1.6) shows one of the ways in which this leveling up is performed. The temporary column C supports a weight of 10kN. Driving in the wedge at B lifts one end of the rigid bar AB and hence lifts C by half as much. (a) Estimate the minimum force between hammer and wedge that will cause the wedge to move farther in, assuming all coefficients of friction are 0.3. (b) What would happen if the coefficients of frictions were too small? What is the value of the coefficient of friction, which marks the borderline between desirable and undesirable performance?

1.7 A paper towel dispenser carries two rolls of paper as shown (Fig 1.7). The one in use is roll A and the other is the fresh roll B. The roll in use is pinned at its centre whereas the fresh roll is supported at C & D by the container and the roll A, respectively. The coefficient of static friction at the points of contact C and D are 0.2 and 0.5, respectively. The masses of rolls are m_A = 1kg and m_B =2.5kg. Determine the initial vertical pull P necessary in order to pull down a paper towel.[**Extra credit problem**]

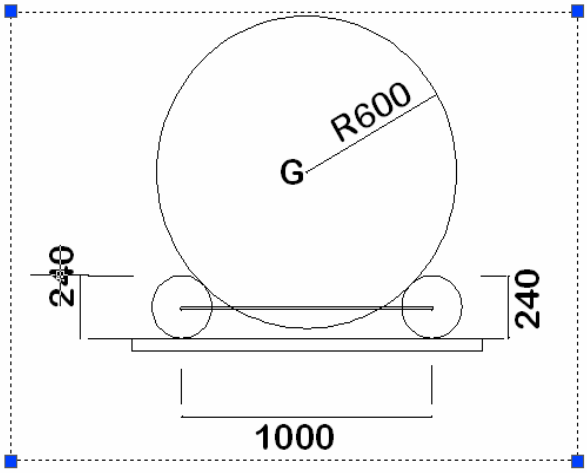

Fig 1.1 (All dimensions are in mm)

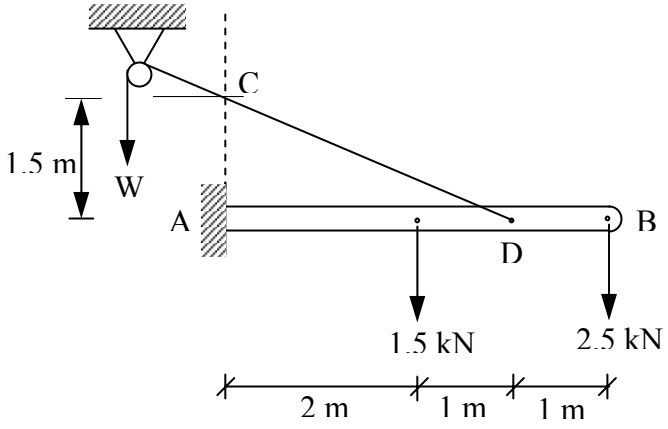

Fig 1.2

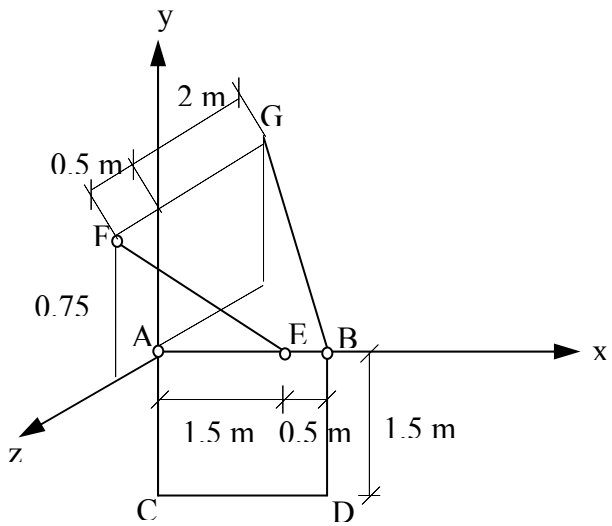

Fig 1.3

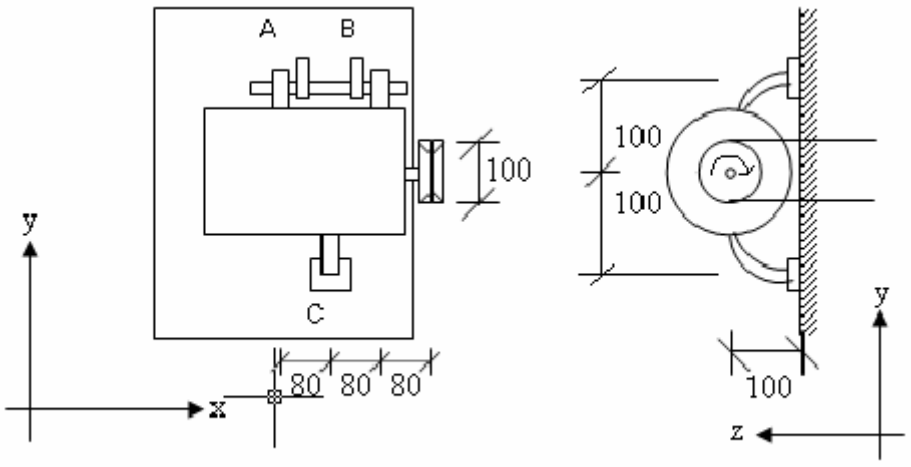

Fig 1.4

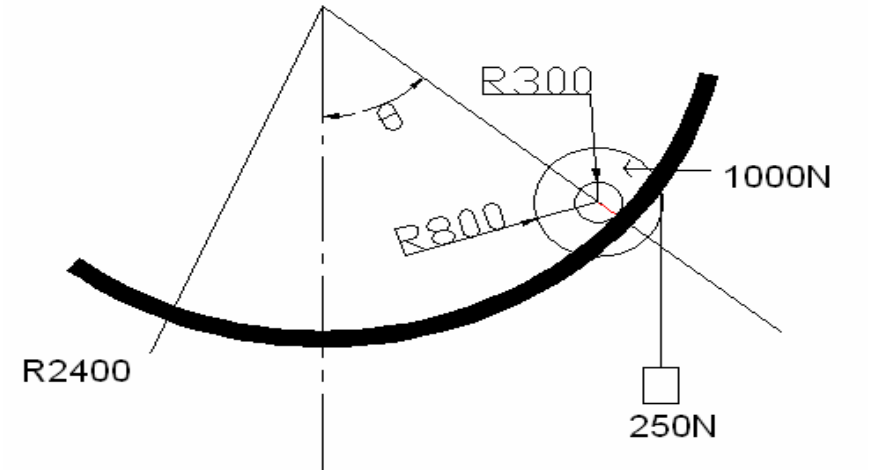

Fig 1.5

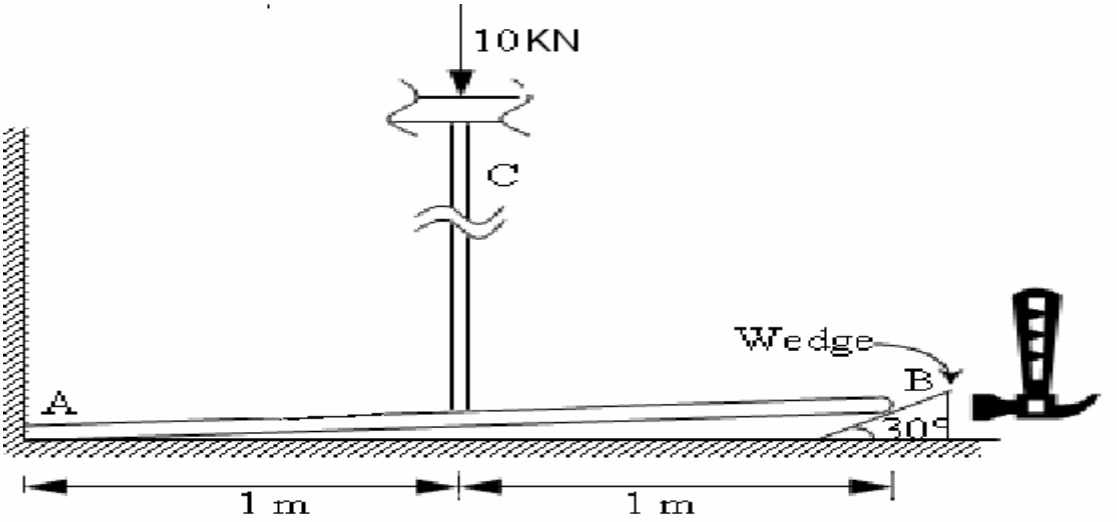

Fig 1.6

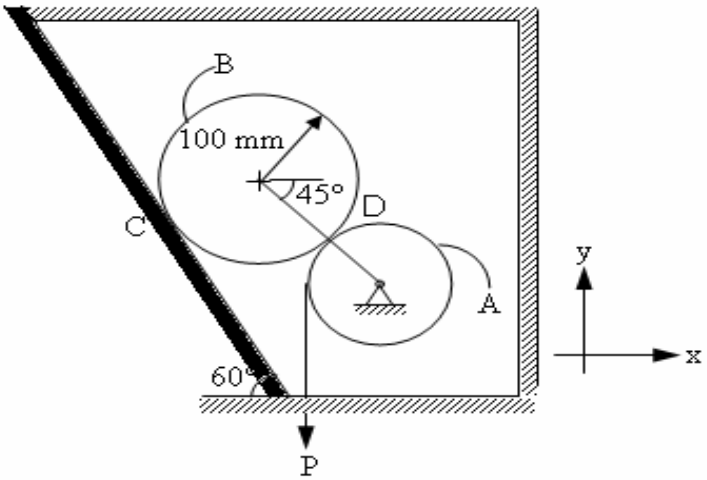

Fig 1.7