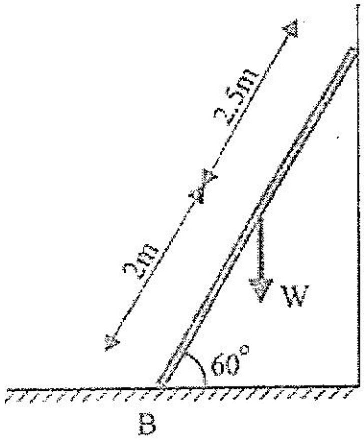


Figure 3.1.5

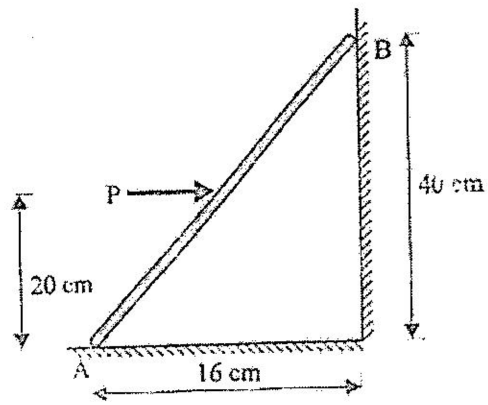


Figure 3.1.6

6. A 100N uniform rod AB is held in position as shown in Figure 3.1.6. If μ=0.15 at A and B calculate range of value of P for which equilibrium is maintained.

(8.29N < P < 80.58N)

7. A block of mass 150kg each raised by a 10^0 wedge weighing 50kg under it and by applying a horizontal force at it as shown in Figure 3.1.7. Taking μ between all surfaces of contact as 0.3, find what minimum force should be applied to raise the block.

(F=1538.2N)

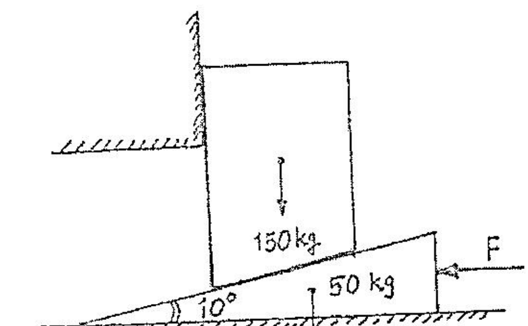


Figure 3.1.7

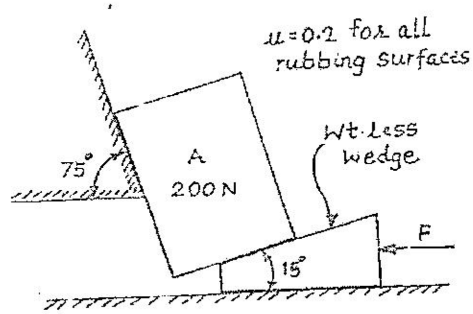


Figure 3.1.8

8. Refer to the Figure 3.1.8, draw FBD for different bodies, and find the minimum value of force F to move the block A up the plane.

(F=134.6 N)

3.2 FRICTION PRACTICE PROBLEMS

1. A block of weight 200 N rests on a horizontal surface. The coefficient of friction between the block and the horizontal is 0.4. Find the frictional force acting on the block if a horizontal force of 40 N is applied to the block. Refer Figure 3.1.9.

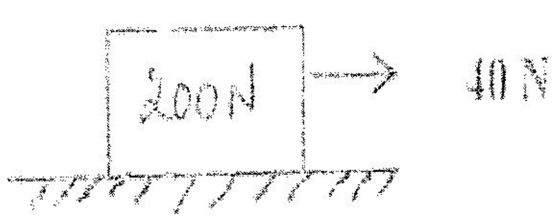
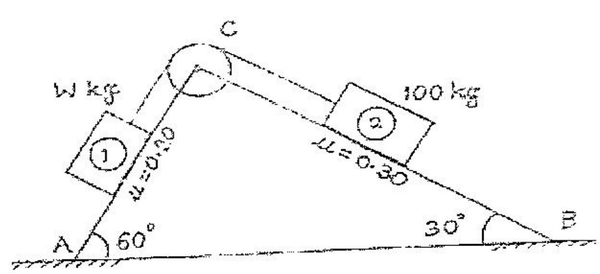


Figure 3.1.9



. Figure 3.1.10

3.1 FRICTION

3.1.1. FRICTION – CLASS WORK QUESTIONS

1. A wooden block rests on a horizontal plane as shown in Figure 3.1.1 Determine the force P required. a) Pull it (b) Push it. Weight of the block is 100N & μ=0.4

(37.4N, 46.38N)

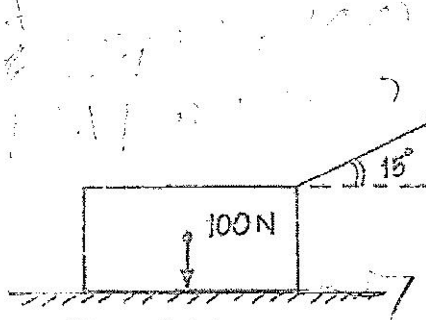


Figure 3.1.1

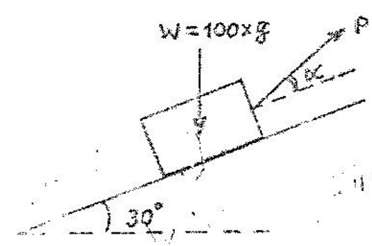


Figure 3.1.2

2. Determine the minimum value and the direction of force P required to cause motion of a 100kg block to intend upon 30^0 plane. μ=0.2. Take g=10m/s2. Refer figure 3.1.2.

(α=11.31^0, P=660.13N)

3. Find tensions in the cords of the inclined plane system shown in Figure 3.1.3. Assume that system of blocks is in impending motion.

(165.36kN in the cord connecting two blocks, 80.51kN in the support cord)

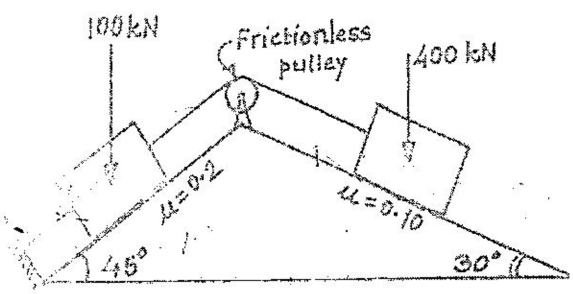


Figure 3.1.3

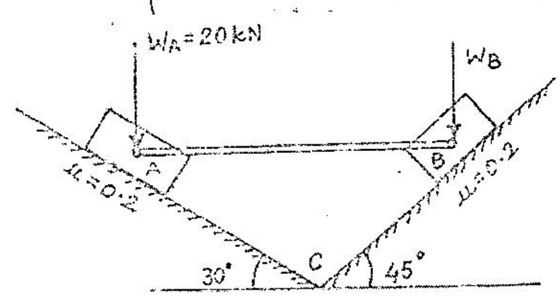


Figure 3.1.4

4. Find the weight Wmin if weight WA is 20kN. Is to be kept in equilibrium with pin connected rod AB in horizontal position. Find also maximum value of W_B for the same purpose. Refer Figure 3.1.4

(Wmin=4.511kN, Wmax=26.365kN)

5. A non-homogeneous ladder as shown in Figure 3.1.5 rest against a smooth wall at A and a rough horizontal floor the mass of ladder is 30kg and is concentrated at 2m from bottom. μ=0.3 at floor. Will the ladder stand in 60° position as shown?

(Ladder will stand in position)

2. Two inclined planes AC and BC inclined at 60^0 and 30^0 to the horizontal meet at ridge C. A mass of 100kg rest on the inclined plane BC and is tied to a rope which passes over a smooth pulley at the ridge, the other end of rope being connected to a block of W kg mass resting on the plane AC. Determine the least and greatest value of W for the equilibrium of the whole system. Refer Figure 3.1.10.

(Wmin=243.92N, Wmax=973.07N)

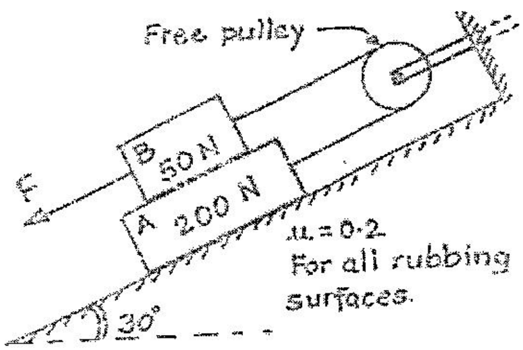


Figure 3.1.11

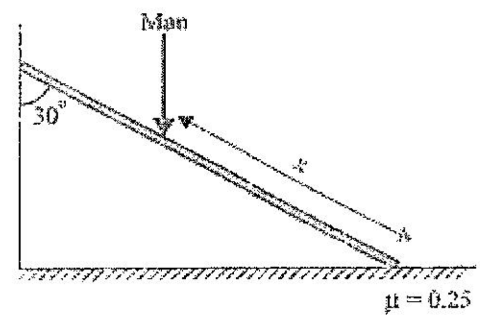


Figure 3.1.12

3. Find minimum value of F to move block A up the plane. μ=0.2 for all rubbing surfaces. Refer Figure 3.1.11.

(135.62N)

4. A weightless ladder of length 8m is resting against a smooth vertical wall and rough horizontal ground as shown in Figure 3.1.12. The μ between the ground and the ladder is 0.25. A man weighing 500N wants to climb up the ladder. Find how much distance along the ladder the man can climb without slip. A second person weighing 800N want to climb up0 the same ladder. Would he climb less than the earlier person? Find his distance covered.

(X=3.46m)

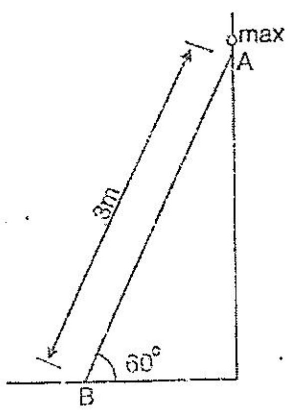


Figure 3.1.13

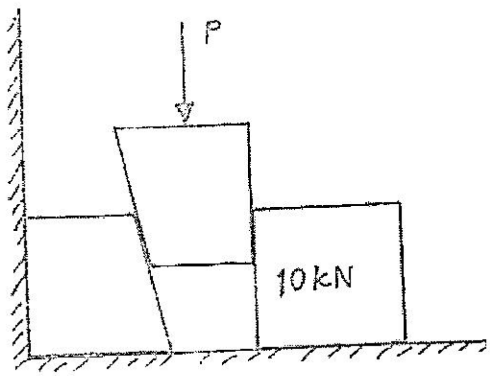


Figure 3.1.14

5. A uniform ladder 3m long weighs 200N, it is placed against a wall 60° with floor as shown in Figure 3.1.13. μ between the wall and ladder is 0.3 and that between floor and ladder is 0.4. The ladder in addition to its own weight has to support a man weighing 800N at its top at A. (i) Calculate the horizontal force F to be applied to the floor level to prevent slipping. (ii) If the force F is not applied, what would be the minimum inclination of the ladder with the horizontal so that there is no slipping of it with the man at the top.

(F=96.048N, Θ=65.75°)

6. Two 6° wedges are used to push a block horizontally as shown in Figure 3.1.14. Calculate the minimum force P required to push the block of weight of 10kN. Take μ=0.25.

(1.639kN)

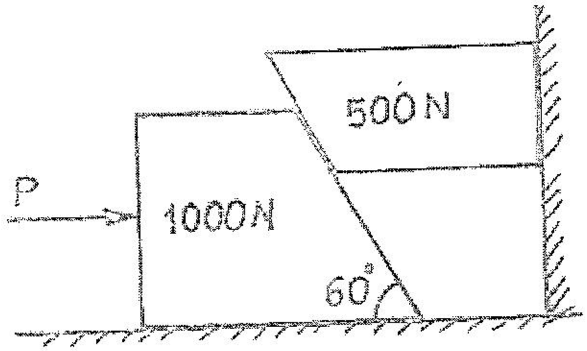


Figure 3.1.16

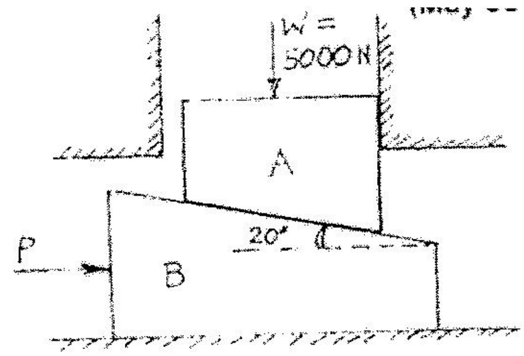


Figure 3.1.17

7. Referring to the figure 3.1.16, μ is 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks. Find the minimum value of a horizontal force applied to the lower block that will hold the system in equilibrium.

{MU, Dec 2016, 8 Marks}

(81.02N)

8. The block A as shown in the Figure 3.1.17 supports a load W=5000N and is to be raised by forcing the wedge B under it. Determine the force P which is necessary to start the wedge under the block. The block and wedge having negligible weight. μ=0.27 for all surfaces.

(P=6010.2N)

3.1.3 FRICTION ASSIGNMENT& TUTORIAL QUESTIONS

1. A support block piece acted upon by two forces as shown in figure 3.1.18. The coefficient of friction between the block and inclined are μ_s=0.35, μ_k=0.25. Determine the force P required (a). To start the block moving up the plane. (b) To keep it moving up. (c) To prevent it from sliding

((a)P=780.8N, (b)P=649N, (c)P=80N)

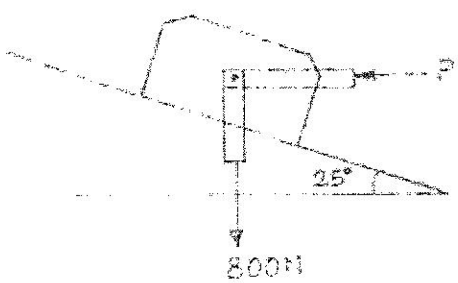


Figure 3.1.18

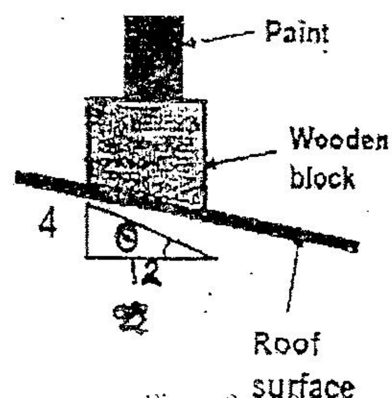


Figure 3.1.19

2. A paint box weighing 9kg is kept on a wooden block weighing 1.2 kg (refer Figure 3.1.19). Determine the magnitude and direction of the friction force exerted by the roof surface on the wooden block and normal force exerted by the roof on the wooden block

[F=31.63N, N=94.92N]