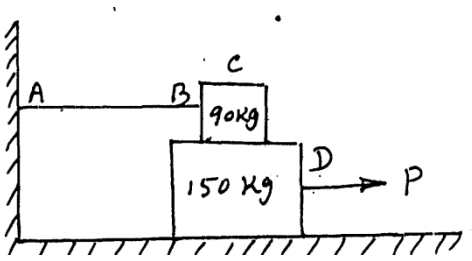
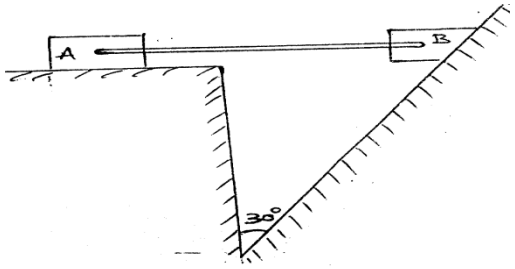
Module 3 part 2 Friction

1. The coefficients of friction are μ_s = 0.30 between all surfaces of contact. Find the smallest force 'P' required to start block 'D' moving if (i) Block 'C' is constrained by cable AB as shown, (ii) Cable AB is removed. (Ans : T = 270, P = 990)

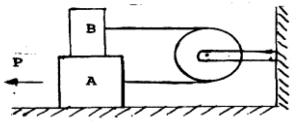


2. Two blocks A and B which are connected by a horizontal link AB are supported on rough planes as shown in Fig. The coefficient of friction for the block A and the floor is 0.4. The angle of friction between the block B and the inclined plane is 20°. Find the smallest weight of the block A for which the equilibrium can exist, if weight of block B is 2000 N.

(Ans : P = 1678.2 , W = 4195.5)

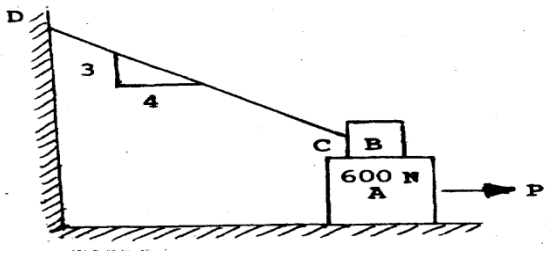


3. In fig. block B of weight 80 N rests on another block A of weight 160 N. A string passing round a frictionless pulley connects both these blocks as shown. What would be the value of the horizontal force P to drag the block A towards left? Coefficient of friction for all sliding surfaces is 0.25.(Ans : T = 20 , P = 100)



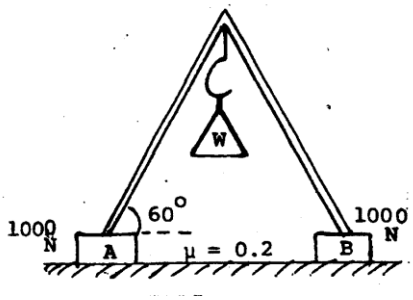
4. Calculate the force P required to cause the block A of weight 600 N to slide under in the the block B of weight 200 N as shown in fig. What will then be the tension in the string CD ? Assume the coefficient of friction for all surfaces of contact as 0.2.

(Ans: T = 43.48, P = 189.56)



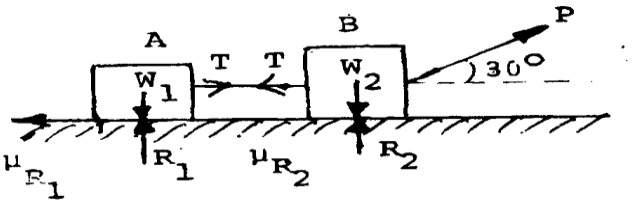
5. Find the value of load W so that the blocks A & B are just on the point of sliding. μ between ground & block = 0.2.

(Ans: P = 611.16, W = 1058.56)



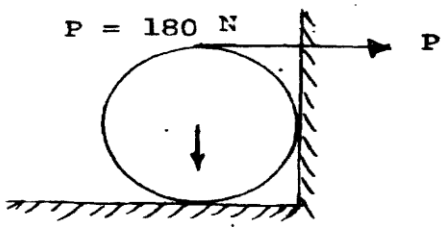
6. In figure shown the two blocks (W_1 = 30 N & W_2 = 50 N) are on rough, horizontal surface. Coefficient of friction between block A' and ground is 0.3, that between 'B' and ground is 0.2. Find the minimum value of force P' to just move the system. Also find the tension in the string.

(Ans: T = 9, P = 19.67)



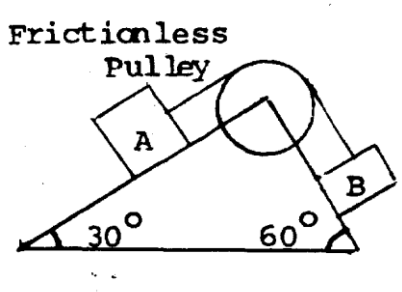
7. Fig. shows a cylinder of mass 100 kg resting on a floor and against a wall. If the coefficient of friction between the surfaces of contact is 0.25, find whether the cylinder will slip with the tangential horizontal force of 180 N.

(Ans: P_{MIN} = 357. 15 N, Will not slip)

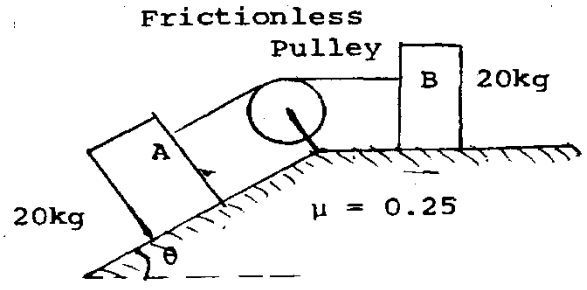


8. Two blocks A and B are placed on inclined planes as shown in fig. The block A weighs 1 KN. Determine maximum and minimum weight of the block B for maintaining the equilibrium of the system. μ = 0.25.

(Ans : W_{Max} = 966.94 , W_{Min} = 266.1)

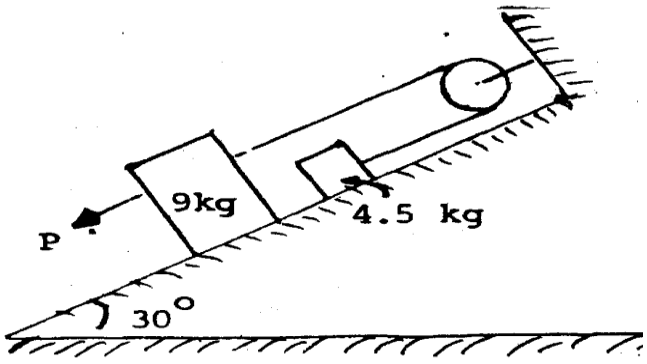


9. Find the value of θ if the blocks A and B shown in fig. have impending motion. Given Block A = 20kg, Block B = 20kg & μ = 0.25. (Ans: θ = 28.08°)



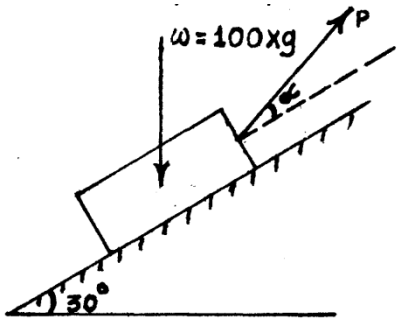
10. Determine the force P to cause motion to impend if the coefficient of friction for both blocks and the plane shown in fig. is 0.25. The force P and the ropes are parallel to the plane. The pulley is frictionless.

(Ans : T = 32.24 , P = 6.73)



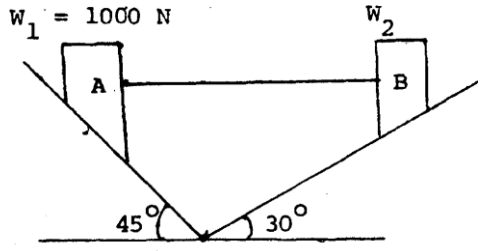
11. Determine the minimum value and the direction of a force P required to cause motion of a 100 kg block to impend upon a 30º plane. The coefficient Of friction is 0.20.

(Ans : α = 11.3° , P_{Min} = 660)



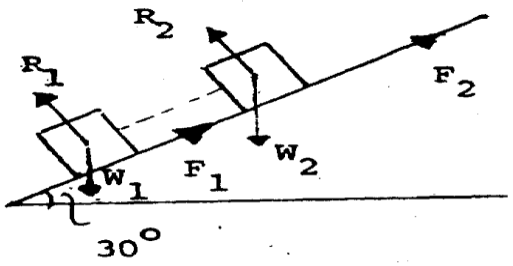
12. Two loads W_1 and W_2 resting on two inclined planes are connected by a horizontal bar AB as shown in Fig. If W_1 equals 1000 N, determine the minimum and the maximum values of W_2 for which equilibrium can exist. The angle of limiting friction is 20° at all rubbing faces.

(Ans : W_{Max} = 12162 , W_{Min} = 2144.51)



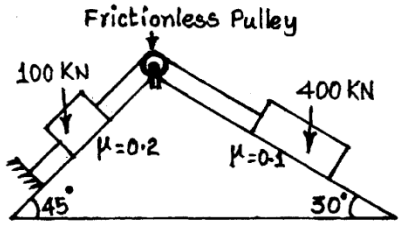
13. Two bodies rest on an inclined plane at an angle 300 to the horizontal. The bodies are connected together by means of a string. The angle of repose of the first body = 20° and for the second body = 40º. Find the tension in the string and weight W_2 of the body if W_1 = 300 N.

(Ans : T= 55.43, W_2 = 243.71)

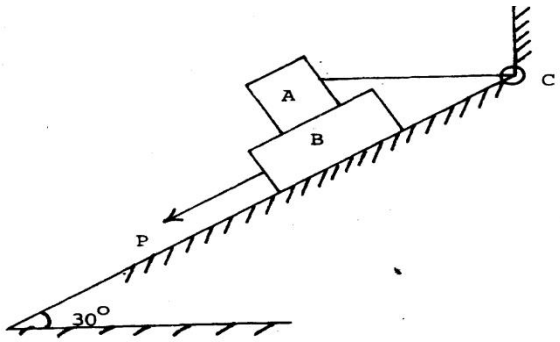


14. Find the tensions in the chords of the inclined plane system shown in figure.

(Ans : $T_1 = 165.36$, $T_2 = 80.51$)

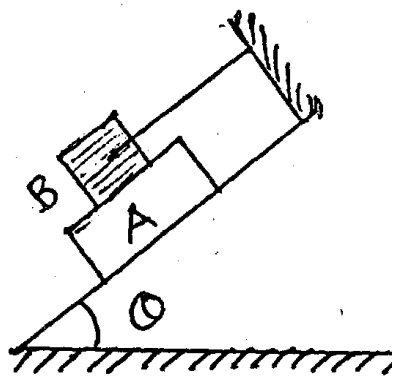


15. Block A of mass 30 Kg. rests on block B of mass 40 Kg. Block A is restrained from moving by a horizontal rope tied at point C, what force P applied parallel to the plane inclined at 30° with horizontal is necessary to start block B down the plane. Take coefficient of friction for all surfaces as 0.35. (Ans : T = 348.67, P = 225.14)



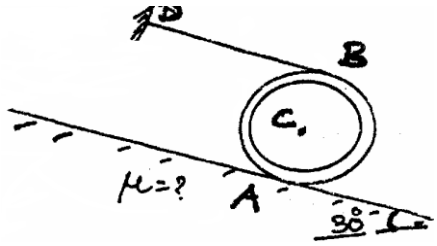
16. What should be the value of ‘θ’ so that the motion of block ‘A’ impends down the plane? The coefficient of friction ‘μ’ for all the surfaces is 1/3. Mass of A = 40 Kg & Mass of B = 13.5 Kg.

(Ans : 29.1°)

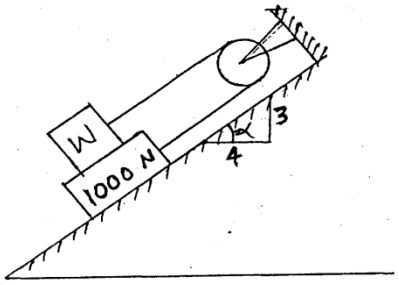


17. A thin hoop of radius 1 m and weight 500 N rests on an rough incline. What minimum Co-efficient of friction is needed for this configuration? What is tension in the wire, which is parallel to incline?

(Ans : 0.2887)



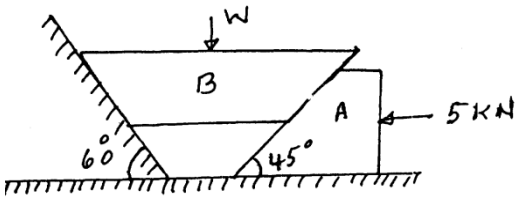
18. Determine the minimum weight W to prevent downward motion of the 1000 N body. Take μ= 0.2 between the rope and the fixed drum and μ = 0.3 for other surfaces of contact.(Ans :



Wedge Friction

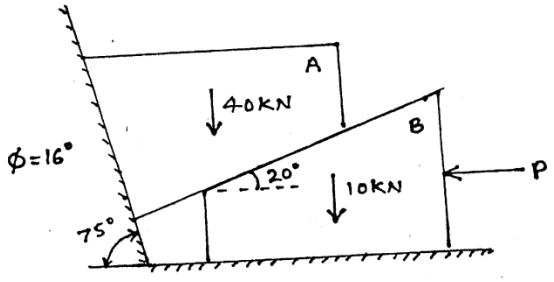
1. A horizontal force of 5 kN is acting oii the wedge as shown in Figure. The coefficient of friction at all rubbing surfaces is 0.25. Find the load ‘W’ which can be held in position. The weight of block ‘B’ may be neglected.

(Ans: 22.55)

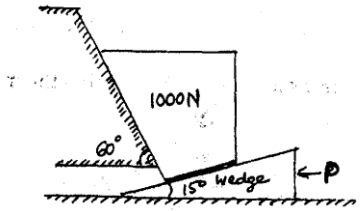


2. Find the force “P” applied to the lower block “B” so as to just start the upward motion of block “A”. The angle of friction for all contact surfaces is “Φ = 16°”.

(Ans: 43.93)

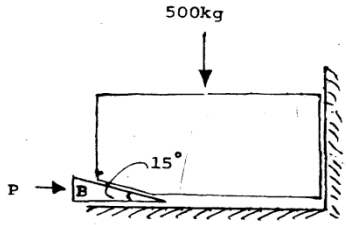


3. A block weighing 1000 N is to be raised against a surface inclined at 60° to the horizontal by means of a 15° wedge as shown in figure. Find the horizontal force P which will just start the block to move if the μ between all the surfaces of contact be 0.2. Assume the wedge to be of negligible weight. (Ans: 594.6)



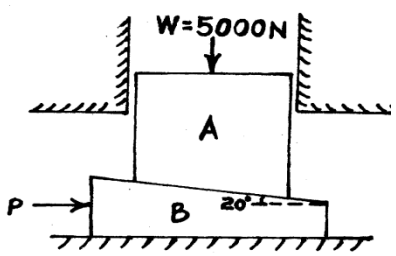
4. The wedge B is used to raise the weight of 5 KN resting on a block A. What horizontal force P is required to do this, if the coefficient of friction for all the surfaces of contact is 0.2?

(Ans: 3850.52)

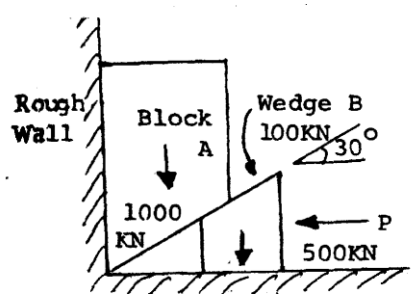


5. The block A as shown in fig. supports a load W = 5000 N and is to he raised by forcing the wedge B under it. The angle of friction for all surfaces in contact is 15°. Determine the

force P which is necessary to start the wedge under the block. The block and wedge have negligible weight. (Ans: 5958.77)

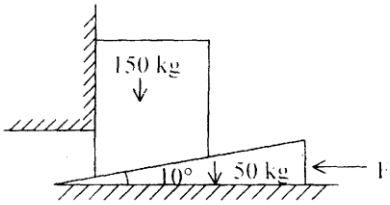


6. Wedge B (100 KN) is driven as shown in the fig, with a force P = 500 KN. The block A weighs 1000 KN and wedge 100 KN. If μ at all surfaces of contact be 0.3, determine whether the force of 500 KN applied to the wedge is enough to raise the block A. (Ans: Pmin = 2026.95)

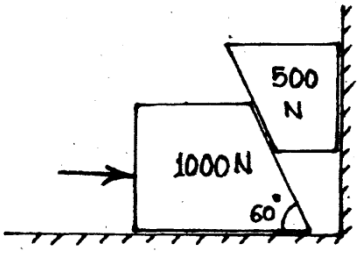


7. A block of mass 150 kg is raised by a 10° wedge weighing 50 kg under it and by applying a horizontal force at it as shown in figure. Taking coefficient of friction surfaces of contact as 0.3, find what minimum force should he applied to raise the block.

(Ans: 1568.46)

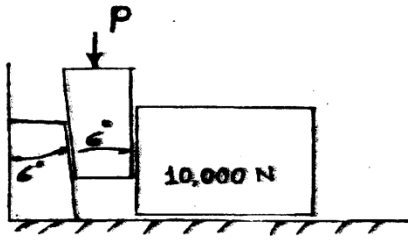


8. Referring to the figures, the coefficients of frictions are as follows. 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks. Find the minimum value of a horizontal force P. applied to the lower block that will hold the system in equilibrium. (Ans: 81.07)

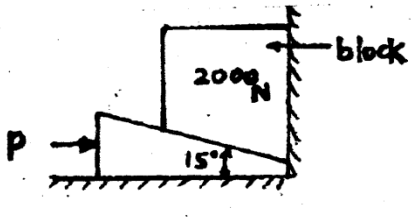


9. Two 6° wedges are used to push a block horizontally as shown in Fig. Find minimum force P required to push the block of wt. 10 KN. Take μ = 0.25 for all surfaces.

(Ans: 1639.2)

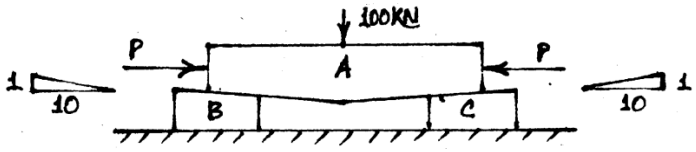


10. To raise a heavy stone block weighing 2000 N, the arrangement shown is used. What horizontal force P will be necessary to apply to the wedge in order to raise the block if the μ for all continuous surfaces is μ = 0.25? Neglect the weight of the wedge. (Ans: 1870)



11. Calculate the magnitude of the horizontal force P acting on the wedges B and C to raise a load of 100 kN resting of A. Assume μ between the wedges and the group as 0.25 and between the wedges and A as 0.2. Also assume symmetry of loading and neglect the weight of A, B and C. Wedges are resting on horizontal surface and their slope is 1: 10.

(Ans: 27.81)

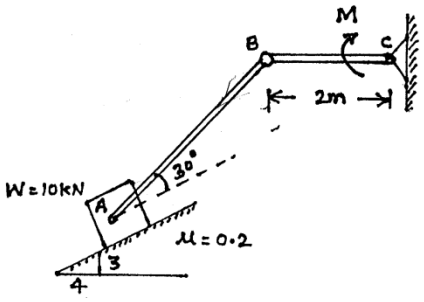


Ladder Friction

1. The following figure shows A block “A” held in equilibrium on an inclined plane by a moment “M” applied to link “BC” link AB and link BC are hinged at “B”. The weight of the block is 10 KN. The rod BC is 2m long. Assume the links to be weightless and hinges to be

ideally smooth. Calculate “M” to just start the motion of the block upwards. Take μ between block and the plane to be 0.2.

(Ans : P = 7.866 , M = 14.467)

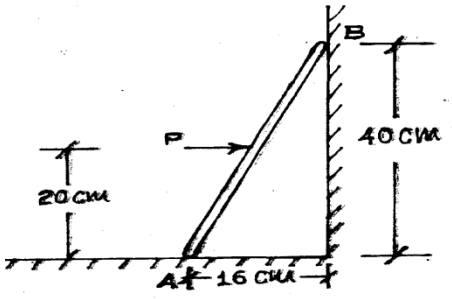


2. A uniform ladder of length 4 m rests against a rough vertical wall with its lower e,d on a cough on a floor, the ladder being inclined at 50° to the horizontal. The co-efficient of friction between the ladder & the wall is 0.3 and that between the ladder and the floor is 05. A man of weight 500 N ascends up the ladder. What is maximum length up along the ladder .the man will be able to ascend before the ladder commences to slip. The weight of the ladder is 1000 N. (Ans : 3.783)

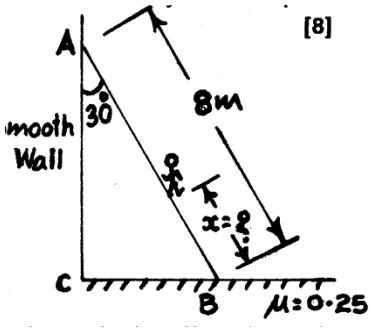
3. A uniform ladder weighing 100 N and 5 meters long has lower end B resting on the ground and upper end A resting against a vertical wall. The inclination of the ladder with horizontal is 60°. If the coefficient of friction at all surfaces of contact is 0.25, determine how much distance up along the ladder a man weighing 600 N can ascend without causing it to slip. (Ans : 2.3)

4. A 100 N uniform rod AB is held in the position shown in Fig. If coefficient of friction is 0.15 at A and B. Calculate range of values of P for which equilibrium is maintained.

(Ans: P_{max} = 80.58, P_{min} = 8.29)

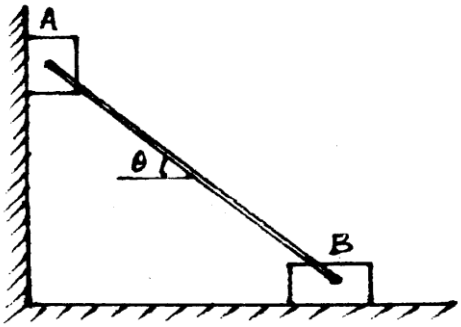


5. A weightless ladder of length in is resting against a smooth vertical wall and rough horizontal ground as shown in the figure .The coefficient of friction between ground and ladder is 0.25. A man of weight 500 N wants to climb up the ladder. Find how much distance along the ladder the man can climb without slip. A second person weighing 800 N wants to climb up the same ladder. Would he climb less than the earlier person? Find his distance covered. (Ans : 3.464)



[8]

6. Two identical blocks A and B are connected by rod and rest against vertical and horizontal planes respectively as shown in the figure. If sliding impends when θ = 45°, determine the coefficient in friction μ assuming it to be the same at both floor and wall. (Ans : 0.414)



7. An non-homogeneous ladder as shown in the figure rests against a smooth wall at A and a rough horizontal floor at B. The mass of the ladder is 30 kg and is concentrated at 2 m from the bottom. The coefficient of static friction between the ladder and the floor is 0.35. Will the ladder stand in 60° position as shown ?

(Ans : yes)