Problems Based on Friction

2005–2006 (Sem. I) (TME101)

1. Explain the following: (i) Laws of static friction, (ii) Useful uses of friction.
2. A ladder of length l rests against a wall, the angle of inclination being 45°. If the co-efficient of friction between the ladder and the ground and that between the ladder and the wall be 0.5 each what will be the maximum distance on the ladder to which a man whose weight is 1.5 times the weight of ladder may ascend before the ladder begins to slip?

2005–2006 (Sem. II) (TME201)

1. What is the characteristic of frictional force? Describe the Laws of coulomb friction, explaining the concept of Equilibrium of bodies involving dry friction.
2. A body of weight 500 N is pulled up along an inclined plane having an inclination of 30° with the horizontal. If the coefficient of friction between the body and the plane is 0.3 and the force is applied parallel to the inclined plane, determine the force required.

2006–2007 (Sem. II) (TME201)

1. Explain the followings: (i) Angle of repose and its applications (ii) Belt friction and its applications.
2. A ladder 3 m long and weighing 250 N is placed against a wall with end B at floor level and A on the wall. In addition to self weight, the ladder supports a man weighing 1200 N at 2.5 m from B on the ladder. If co-efficient of friction at wall is 0.25 and at floor is 0.35 and if ladder makes an angle 60° with the floor, find the minimum horizontal force which if applied at B will prevent the slipping of the ladder.

2006–2007 (Sem. II) (ME202)

1. A belt is running over a pulley of diameter 1000 mm at 450 rpm. The angle of contact is 150° and the coefficient of friction is 0.35. If the maximum tension in the belt is limited to 1 kN, determine the power transmitted by it.

2006–2007 (Sem. I & II) (TME101/TME201) [SCOP]

1. A weight 500 N just moving down a rough inclined plane supported by a force of 200 N acting parallel to the plane and it is at the point of moving up the plane when pulled by a force of 300 N parallel to the plane, find the inclination of the plane and the coefficient of friction between the machined plane and the weight.

2007–2008 (Sem. I) (TME101)

1. Explain the Law of friction.
2. A flat belt running at a speed of 500 m/min drives a pulley. Determine the power transmitted by the belt, if the maximum tension on the tight side of the belt is 1200 N. Neglect the centrifugal tension effect. The angle of lap is 160° and the coefficient of friction between the belt and pulley material is 0.3.

2007–2008 (Sem. II) (TME201)

1. Explain the following: (i) Laws of dry friction, (ii) Belt friction and its applications.
2. A block of stone weighing 50 kN rests on a horizontal floor. If the coefficient of friction between floor and block is 0.3 and if a man pulls the block through a string which makes an angle α with the horizontal, find for what value of the force necessary to move the block will be minimum. Find this force also.

2008–2009 (Sem. I) (EME102)

1. Derive the following expression for the belt, where all symbols have their usual meaning, $T_1 > T_2$, in belt-pulley arrangement for power transmission.

$$\frac{T_1}{T_2} = e^{\mu\theta}.$$

2008–2009 (Sem. II) (EME202)

1. Explain the following: (i) Laws of static friction, (ii) Limiting angle of friction.

2009–2010 (Sem. I) (EME102)

1. Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between belt and pulley is 0.25, angle of lap 160° and maximum tension in the belt is 2.5 kN.

2009–2010 (Sem. I) (TME101) [COP]

1. Explain the Cone of friction.
2. A long ladder 15 m long resting on horizontal floor and leans against a vertical wall for which $\mu_f = 0.25$ and $\mu_w = 0.15$ respectively. Determine the angle of inclination of ladder with the floor when the ladder is just about to slip.

2009–2010 (Sem. II) (EME202)

1. Derive an expression for the ratio of belt tensions in a flat belt drive.
2. Explain briefly different types of friction.

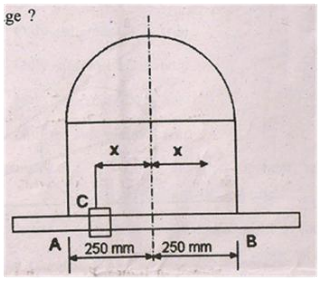
2009–2010 (Sem. II) (TME201) [COP]

1. Explain the Angle of friction.
2. Derive the following expression for the belt, where all symbols have their usual meaning.

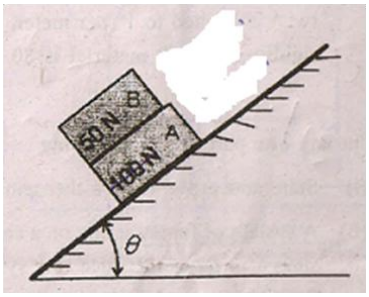
$$\frac{T_2}{T_1} = e^{\mu\theta}.$$

2010–2011 (Sem. I) (EME102)

1. Rod AB of weight 500 N is supported by a cable wrapped around a semi-cylinder having coefficient of friction of 0.2. A weight C weighing 100 N can slide without friction on rod AB. What is the maximum range x from centerline the mass C can be placed without causing slippage?



2. Blocks *A* and *B*, of weight 150 N and 200 N, respectively rest on an inclined plane as shown in the figure. The coefficient of friction between the two blocks is 0.3 and between block *A* and inclined plane is 0.4. Find the value of θ for which either one or both the blocks start slipping. At that instant, what is the friction force between *B* and *A*? Between *A* and inclined plane?



2010–2011 (Sem. I) (TME101) [COP]

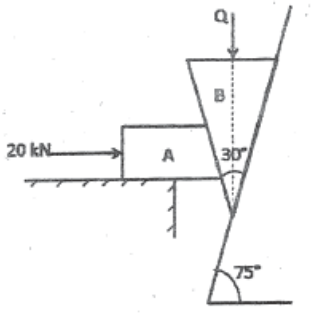
1. Explain Angle of Repose.

2. Why kinetic coefficient of friction is always less; than static coefficient of friction?

3. A belt is running over a pulley with a diameter of 1.2 m at 300 rpm. The angle of contact is 150° and. coefficient of friction is 0.35. If the maximum tension in the belt is 500 N, determine the power transmitted by it.

2010–2011 (Sem. II) (EME202)

1. Figure shows a wedge *B* held between the block *A* and the surface *C*. A horizontal push of 20 kN is acting on block *A*. Find the vertical force *Q* on the wedge *B* so as to just move it downward. Assume coefficient of friction as 0.3 for all contact surfaces of contact.



2010–2011 (Sem. II) (EME202) (MTU)

1. Explain the Laws of friction.

2010–2011 (Sem. II) (TME201) [COP]

1. Explain the following:
(i) Angle of repose and its applications, (ii) Belt friction and its applications.

2. A ladder 3 m long and weighing 250 N is placed against a wall with end *B* at floor level and *A* on the wall. In addition to self weight, the ladder supports a man weighing 1200 N at 2.5 m from *B* on the ladder. If co-efficient of friction at wall is 0.25 and

at floor is 0.35 and if ladder makes an angle 60° with the floor, find the minimum horizontal force which if applied at *B* will prevent the slipping of the ladder.

2011–2012 (Sem. I) (EME102)

1. A rope supports two masses as shown in the Fig. 6. Find minimum value of '*m*' for equilibrium and corresponding tension in the rope between two fixed drums *A* and *B*. Take coefficient of friction between drum and rope as 0.25.

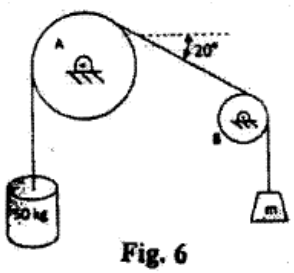


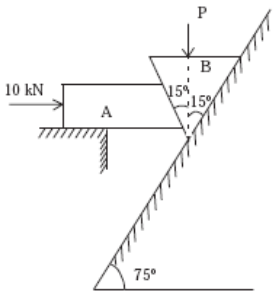
Fig. 6

2011–2012 (Sem. I) (EME102) (MTU)

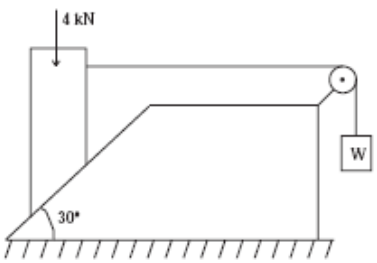
1. Explain the difference between coefficient of friction and angle of friction.
2. Explain Laws of coulomb friction.
3. Derive an expression for the ratio of belt tensions.
4. A man climbs on a 5 m long ladder. The ladder makes an angle of 60° from the horizontal. The other end of the ladder is supported on a vertical wall. The coefficient of friction between the ladder and wall is 0.2 and between the ladder and floor is 0.3. The weights of ladder and man are 150 N and 800 N, respectively. How far can the man climb on the ladder?

2011–2012 (Sem. II) (EME202)

1. Fig. shows a wedge *B* held between the block *A* and the surface *C*. A horizontal push of 10 kN is acting on the block '*A*'. Find the vertical force '*P*' on the wedge *B* so as to just move it downward. Assume coefficient of friction as 0.3 for all the surfaces of contact.



2. A 4 kN block is placed on an inclined plane as shown in Fig. 6. Find maximum value of *W* equilibrium if tipping does not occur. Take $\mu = 0{\cdot}25$.



2011–2012 (Sem. II) (EME202) (MTU)

1. A torque of 300 Nm acts on the brake drum as shown in Fig. 4. If the brake bond is in contact with the brake drum through 250° and the coefficient of friction is 0.3. Determine the force *P* applied at the end of the brake lever for the position shown in Fig. 4.

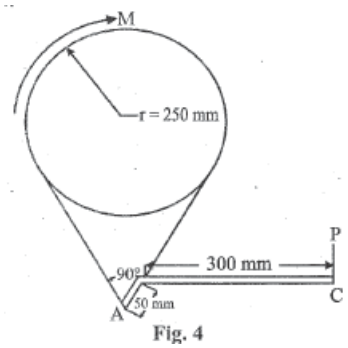
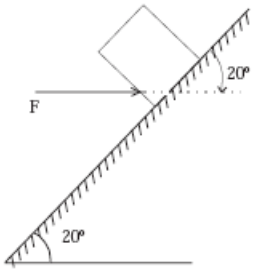


Fig. 4

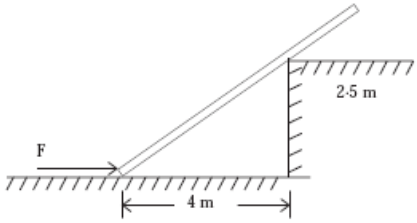
2012–2013 (Sem. I) (EME102)

1. A body *A* is about to slip over body *B*. Normal reaction at the contact surface is 70 N and the angle of friction is 25°. Determine the total reaction of the surface.

2. Determine the value of the force *F* needed to get the block just started up the incline as shown in Fig. 7. The coefficient of friction is 0.3. The weight of the block is 500 N.



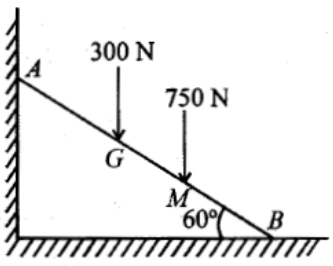
3. A 7 m long ladder is pushed by a horizontal force *F* as shown in Fig. 8. Determine the minimum value of *F* necessary to move the ladder forward. The static coefficient of friction is 0.4 for all contact surfaces.



2012–2013 (Sem. I) (ME101) (MTU)

1. List out the different types of friction. What is coefficient of static friction?

2. A ladder 6 m long weighing 300 N is resting against a wall at an angle of 60° to the horizontal plane as shown in Fig. 3. A man weighing 750 N climbs the ladder from position *B* towards *A*. At what position along the ladder from the bottom of the ladder does he induce slipping? The coefficient of friction for both the wall and the ground with the ladder is 0.2.



3. Explain: (i) Coefficient of friction, (ii) Angle of friction, (iii) Angle of repose.

2012–2013 (Sem. I) (EME102) (MTU) [COP]

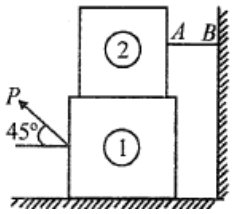
1. A man climbs on a 5 m long ladder. The ladder makes an angle of 60° from the horizontal. The other end of the ladder is supported on a vertical wall. The coefficient of friction between the ladder and wall is 0.2 and between the ladder and floor is 0.3. The weight of ladder and man are 150 N and 800 N. How far can the man climb on the ladder?
2. Find the power transmitted by belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between belt and pulley is 0.25, angle of wrap is 160° and maximum tension in the belt is 2.5 kN.

2012–2013 (Sem. I) (TME101) [COP]

1. A ladder of length L rests against a wall, the angle of inclination being 45°. If coefficient of friction between the ladder and ground and that being ladder and wall be 0.5 each. What will be maximum distance on the ladder to which a man whose weight is 1.5 times the weight of the ladder may ascend before the ladder begins to slip.
2. Derive the relation $\frac{T_1}{T_2} = e^{\mu\theta}$ for a flat belt drive.

2012–2013 (Sem. II) (ME201) (MTU)

1. List any four engineering applications of friction.
2. Block 2 rests on block 1 and is attached by horizontal rope AB on the wall as shown in Fig. 7. What force P is necessary to cause motion of the block 1 to impend? The coefficient of friction between the blocks is 1/4 and between the floor and block 1 is 1/3. Mass of the blocks 1 and 2 are 14 kg and 9 kg respectively.

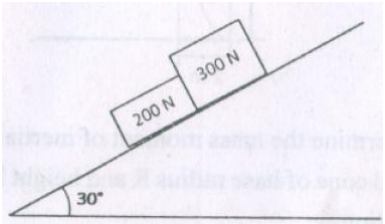


2012–2013 (Sem. II) (TME201) [COP]

1. Define the Angle of repose.
2. Derive the relation $\frac{T_2}{T_1} = e^{\mu\theta}$ for the tensions on the tight and slack sides of the belt passing over a pulley with friction.

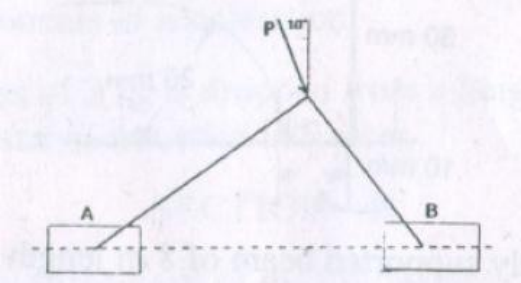
2013–14 (Sem. I) (NME102)

1. Explain the relationship between angle of friction and angle of repose.
2. Two blocks, as shown in figure slide down a 30° incline. If coefficient of friction at all contact surfaces is 0.2, determine the pressure between the blocks.



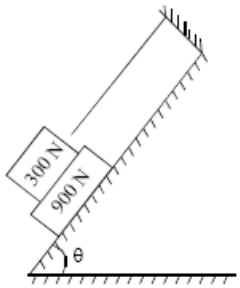
3. Two slender rods of negligible weight are pin connected at C and attached to two blocks A and B each of weight 100 N as shown in figure. If coefficient of friction is

0.3 at all surfaces of contact, find largest value of P for which equilibrium is maintained.



2013–14 (Sem. I) (EME102) [COP]

1. What should be the value of θ in Fig. (1) which will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is 0.3.



2. A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 70° with the horizontal. The weight of the ladder is 300 N. The ladder is on the verge of sliding when a man weighing 750 N stands on a rung 1.5 m high. Calculate the coefficient of friction between the ladder and the floor.

2013–14 (Sem. I) (ME101) [COP]

1. Friction is desirable and undesirable both. Explain.

2. A body of mass 100 kg is moving relative to a rough surface. Calculate the frictional resistance offered by the surface if $\mu_s = 0.3$ and $\mu_k = 0.2$.

3. For a ladder of length 4 m, rest against a vertical wall making an angle of 45°. Determine the minimum horizontal force applied at A to prevent slipping, $\mu = 0.2$ between the wall and ladder, and $\mu = 0.3$ for floor and the ladder. The ladder weight 200 N and a man weight 600 N is at 3 m from A. (Point A is on floor).

2013–14 (Sem. I) (TME101) [COP]

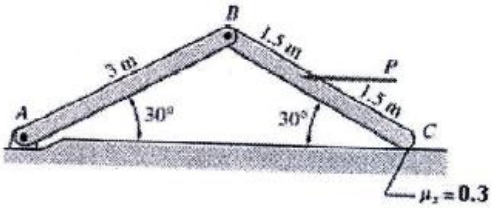
1. Derive an expression for Belt friction $T_1/T_2 = e^{\mu\theta}$.

2. A uniform ladder of 7 m rests against a vertical wall with which it makes an angle of 45°, the coefficient of friction between the ladder and the wall is 0.4 and that between ladder and the floor is 0.5. If a man, whose weight is one half of that of the ladder, ascends it, how high will it be when the ladder slips?

2013–14 (Sem. II) (NME202)

1. A block of mass m on an inclined plane is kept in equilibrium and prevented from sliding down by applying a force of 500 N. If the angle of the inclination is 30° and coefficient of friction for the contact surface is 0.35, determine the weight of the block.

2. Determine the largest and smallest values of the force *P* for which the system in figure will be in static equilibrium. The homogeneous bars *AB* and *BC* are identical, each having a mass of 50 kg. The coefficient of static friction between the bar at *C* and the horizontal plane is 0.3.



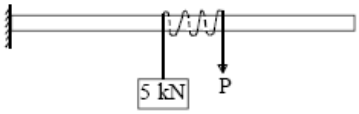
2013–14 (Sem. II) (EME202) [COP]

1. Define angle of repose.

2. A ladder is 6 m long and is supported by horizontal floor and vertical wall. The coefficient of friction between the floor and ladder is 0.3 and between wall and ladder is 0.15. Weight of ladder is 300 N. The ladder supports a vertical load of 800 N at a point which is at a distance of 1 m from top of ladder. Determine the least value of angle of inclination of ladder with floor at which ladder may be placed without slipping.

2013–14 (Sem. II) (ME201) [COP]

1. A weight of 5 kN is suspended by an inextensible string on a circular bar as shown in Figure-9. If co-efficient of friction between bar and string is 0.2, what will be the value of force '*P*' to hold the weight? String is wrapped three and half round on the bar.



2014–15 (Sem. I) (NME102)

1. State the concept of impending motion (columb's law of dry friction).

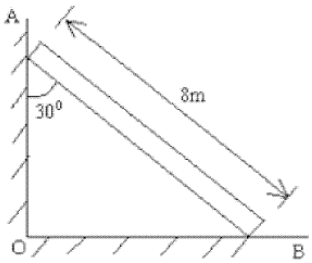
2. What do you mean by the angle of repose? Prove the angle of repose is equal to the angle of friction.

2014–15 (Sem. I) (EME102) [COP]

1. What is meant by coefficient of static friction?

2. What do you mean by angle of repose?

3. An 8 m long uniform ladder weighing 500 N is resting on a rough horizontal floor and inclined at an angle of 300 with a vertical wall. A man weighing 750 N climbs the ladder. At what position will be induce slipping? The coefficient of friction between the ladder and the wall is 0.3 and that between the ladder and the floor is 0.2.



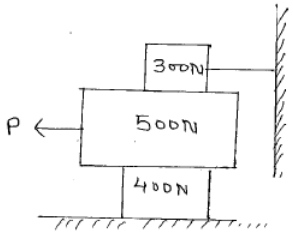
4. A body weighing 300 N is resting on a rough horizontal table. A pull of 100 N is applied at an angle of 15° with the horizontal to just cause the body to slide over the table. Find normal reaction and the coefficient of friction.

2014–15 (Sem. I) (ME101) [COP]

1. The force required to pull a body of weight 50 N on a rough horizontal plane is 15 N. Determine the co-efficient of friction if the force is applied at an angle of 15° with the horizontal.
2. Explain the terms: (i) Cone of friction, (ii) Angle of repose.
3. A uniform ladder of length 10 m and weighing 20 N is placed against a smooth vertical wall with its lower end 8 m from the wall. In this position the ladder is just to slip. Determine: (i) the coefficient of friction between the ladder and the floor, and (ii) frictional force acting on the ladder at the point of contact between ladder and floor.

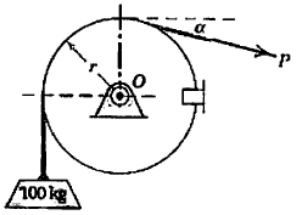
2014–15 (Sem. II) (NME202)

1. "Friction is both desirable and undesirable". Explain.
2. A uniform ladder, 5 m long weighs 180 N. It is placed against a wall making an angle of 60° with floor. The coefficient of friction between the wall and ladder is 0.25 and between the floor and the ladder is 0.35. The ladder has to support a mass 900 N at its top. Calculate the horizontal force P to be applied to the ladder at the floor level to prevent slipping.
3. Determine the force P required to impend the motion of the block B shown in Fig. 4 Take coefficient of friction = 0.3 for all contact surface.

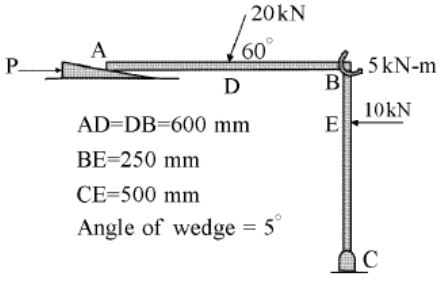


2014–15 (Sem. II) (EME202) [COP]

1. For the system given in the figure find the maximum and minimum value of P for not to raise or lower the mass of 100 kg. Take $\alpha = 20°$ and coefficient of friction between cable and the drum is 0.3.

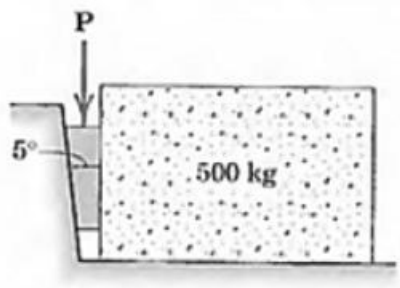


2. A wedge is used to level the member loaded as shown in figure. Determine the force P that must be applied to the wedge to the right. Assume coefficient of friction as 0.25. Neglect size and weight of the wedge.



2014–15 (Sem. II) (ME201) [COP]

1. The horizontal position of 5000 N rectangular block of concrete is adjusted by a 5° wedge under the action of force *P*. If the coefficient of static friction for both surfaces of wedge is 0.3 and for the block and the horizontal surface is 0.6. Determine the least force required to move the block.



2014–15 (Sem. I) (NME202/NME102/EME202/EME102) [SCOP]

1. Define coefficient of friction and angle of friction.

2. A ladder 7 m long rests against a vertical wall with which it makes an angle 45° & resting on a floor. If a man whose weight is one half of that the ladder climbs it, at what distance along the ladder will he be, when ladder is about to slip? Take coefficient of friction between all contact surfaces 0.3.

2015–16 (Sem. I) (NME102)

1. Write any four engineering applications of friction.

2015–16 (Sem. I) (EME102) [COP]

1. A ladder 7 m long rests against a vertical wall with which it makes an angle of 30° and resting on a floor. If a man whose weight is one half of that ladder, climbs it. At what distance along the ladder will he be when ladder is about to slip? μ = 0.33 at wall and 0.5 at floor.

2015–16 (Sem. I) (ME101) [COP]

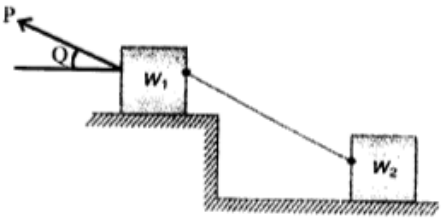
1. State the laws of dry friction.

2. Derive the expression for the relationship between tight side and slack side forces in a belt friction problem.

2015–16 (Sem. II) (NME202)

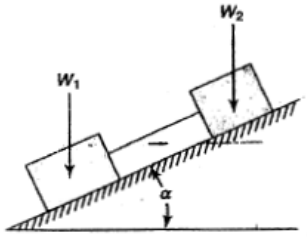
1. A body *P* is about to slip over body *Q*. Normal reaction at the contact surface is 120 N and the angle of friction is 14°. Determine the friction force.

2. Two blocks having weights W_1 and W_2 are connected by a string and rest on horizontal planes as shown in figure. If the angle of friction for each block is φ, find the magnitude and direction of the least force *P* applied to the upper block that will induce sliding.

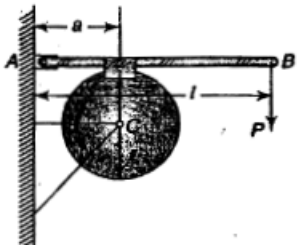


2015–16 (Sem. II) (EME202) [COP]

1. Explain the angle of friction & angle of repose.
2. Two blocks of weights W_1 and W_2 rest on rough inclined plane and connected by a short piece of string as shown in fig. If coefficient of friction are 0.2 for block 1 and 0.3 for block 2 respectively, find the angle of inclination of plane for which sliding will impend. Assume $W_1 = W_2 = 225$ N.

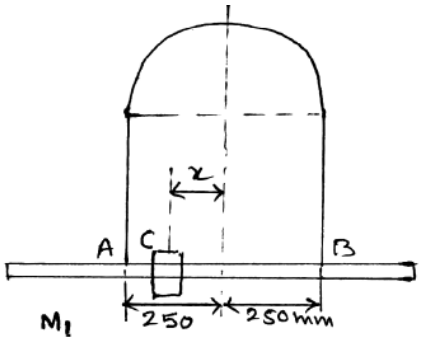


3. A heavy rotating drum of radius r is supported in bearing at C and is braked by the device as shown in fig Calculate the braking moment M with respect to point C if the coefficient of kinetic friction between drum and brake shoe is μ.



2015–16 (Sem. II) (ME201) [COP]

1. Rod AB weighing 200 N is supported by cable wrapped around a semi cylinder having coefficient of friction 0.2. A weight C having mass of 10 Kg can slide on rod AB. What is the max range x from the centre line that centre of C can be replaced with slippage as Shown in fig. 6.



2. Explain the terms: (i) Angle of friction, (ii) Angle of repose, (iii) Cone of friction.
3. A ladder of length L rests against a wall, the angle of inclination being 45 degree. If the coefficient of friction between the ladder and the ground and that between ground and the wall is 0.5 each, what will be the maximum distance on ladder to which a man whose weight is 1.5 times the weight of ladder may ascend before the ladder beings to slip?

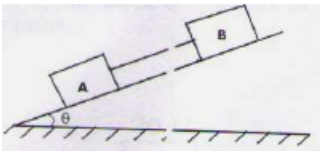
2016–17 (Sem. II) (NME202/EME202/ME201) [COP]

1. Explain coulomb's law of friction.
2. Define coefficient of friction.

3. Two blocks *A* & *B* weighing 250 N and 400 N respectively are resting on an inclined plane. They are connected by a string as shown in Fig. 1. The coefficient of friction under the blocks and plane are $\mu_A = 0.25$ and $\mu_B = 0.5$.

(i) What should be the angle of θ the plane at which the sliding of the blocks will impend?

(ii) hat will be the tension in the string?

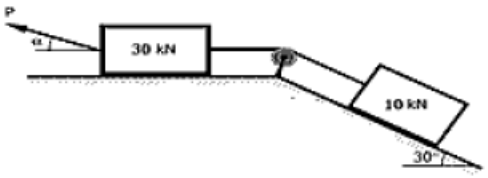


4. A ladder of length *L* rests against a wall, the angle of inclination being 45°. If the coefficient of friction between the ladder and the ground and that between ground and the wall is 0.5 each, what will be the maximum distance on ladder to which a man whose weight is 1.5 times the weight of ladder may ascend before the ladder begins to slip?

2017–18 (Sem. I) (NME102/EME102) [COP]

1. The 2225 N block shown in figure is in contact with 45° incline. The coefficient of static friction is 0.25. Compute the value of the horizontal force *P* necessary to just prevent motion down the incline.

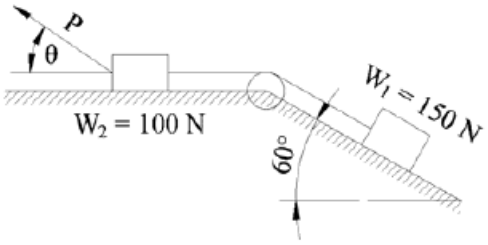
2. Find the least value of *P* required to cause the system of blocks shown in given figure to have impending motion to the left. The coefficient of friction under each block is 0.20.



2017–18 (Sem. II) (NME202) [COP]

1. Explain the term Angle of Repose and Angle of Friction with neat sketch.

2. Two blocks are connected by a string and rest on an inclined plane and on a horizontal surface as shown in figure 2. The coefficient of friction for all surfaces is 0.2. Find the magnitude and direction of the least force *P* at which the motion of the blocks will impend.

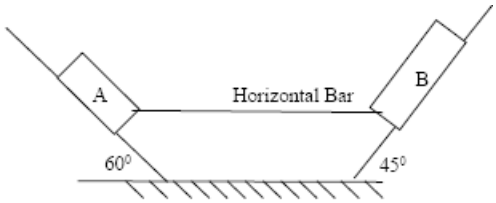


2017–18 (Sem. II) (EME202) [COP]

1. What is the condition of impending motion?
2. Explain angle of friction.
3. Explain the phenomenon of rolling friction mentioning the factors affecting it. Determine the minimum angle θ at which a uniform ladder can be placed against a wall without slipping under its own weight. The coefficient of friction for all surfaces is 0.2.

2018–19 (Sem. I) (NME102/EME102) [COP]

1. Define terms Angle of limiting friction, Angle of repose, Cone of friction, Laws of dry friction.
2. Block A & B connected by a rigid horizontal bar, pinned at either end are placed on inclined plane. The weight of block B is 300 N. Find the limiting weight of block A to just start motion of the system. $\mu_A = 0.25$, $\mu_B = 0.3$.



2018–19 (Sem. II) (NME202/EME202) [COP]

1. Define coefficient of friction and angle of friction.
2. A uniform ladder of weight 30 N and length 13 m is placed against a smooth vertical wall with its lower end 10 m from the wall. In this position the ladder is just to slip. Determine the coefficient of friction between the ladder and the floor and frictional force acting on the ladder at the point of contact between the ladder and floor.

2019–20 (Sem. I) (NME102/EME102) [COP]

1. Explain coulomb's law of friction.
2. Define coefficient of friction.
3. A uniform ladder of weight 30 N and length 13 m is placed against a smooth vertical wall with its lower end 10 m from the wall. In this position the ladder is just to slip. Determine the coefficient of friction between the ladder and the floor and frictional force acting on the ladder at the point of contact between the ladder and floor.
4. Define friction and its types also describe limiting friction, coefficient of friction and angle of repose.