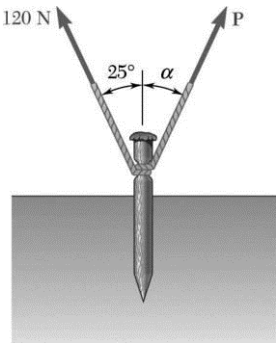
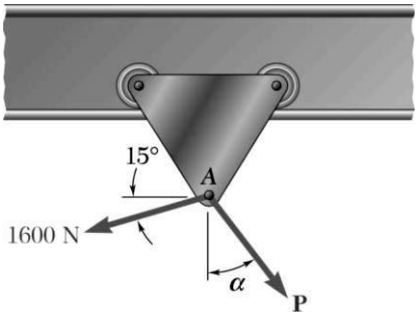
Module-I

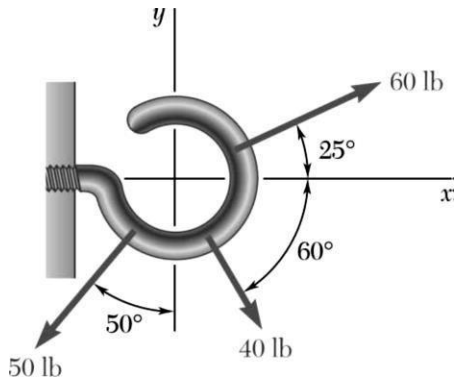
1. A stake is being pulled out of the ground by means of two ropes as shown. Knowing that $\alpha = 30°$, determine by trigonometry (*a*) the magnitude of the force **P** so that the resultant force exerted on the stake is vertical, (*b*) the corresponding magnitude of the resultant.

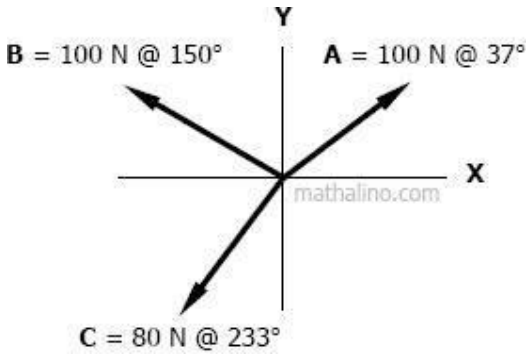


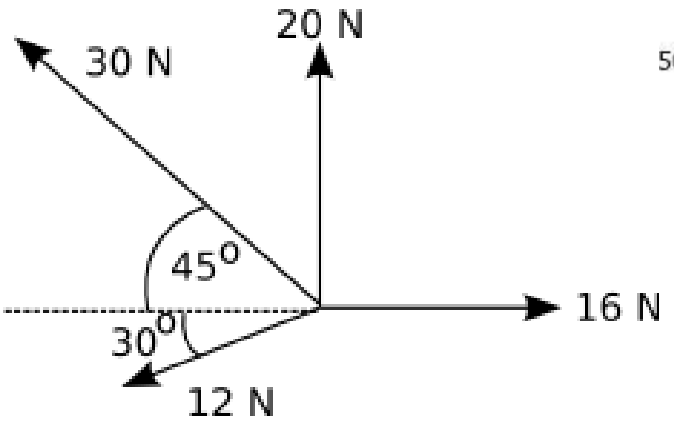
2. A trolley that moves along a horizontal beam is acted upon by two forces as shown. (*a*) Knowing that $\alpha = 25°$, determine by trigonometry the magnitude of the force **P** so that the resultant force exerted on the trolley is vertical. (*b*) What is the corresponding magnitude of the resultant?

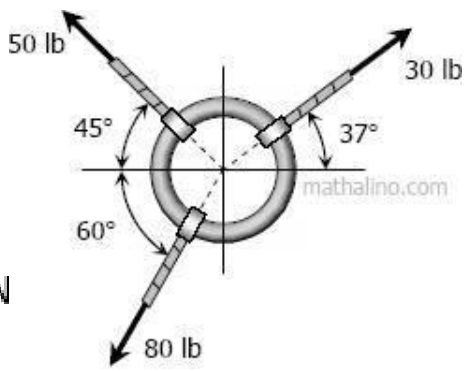


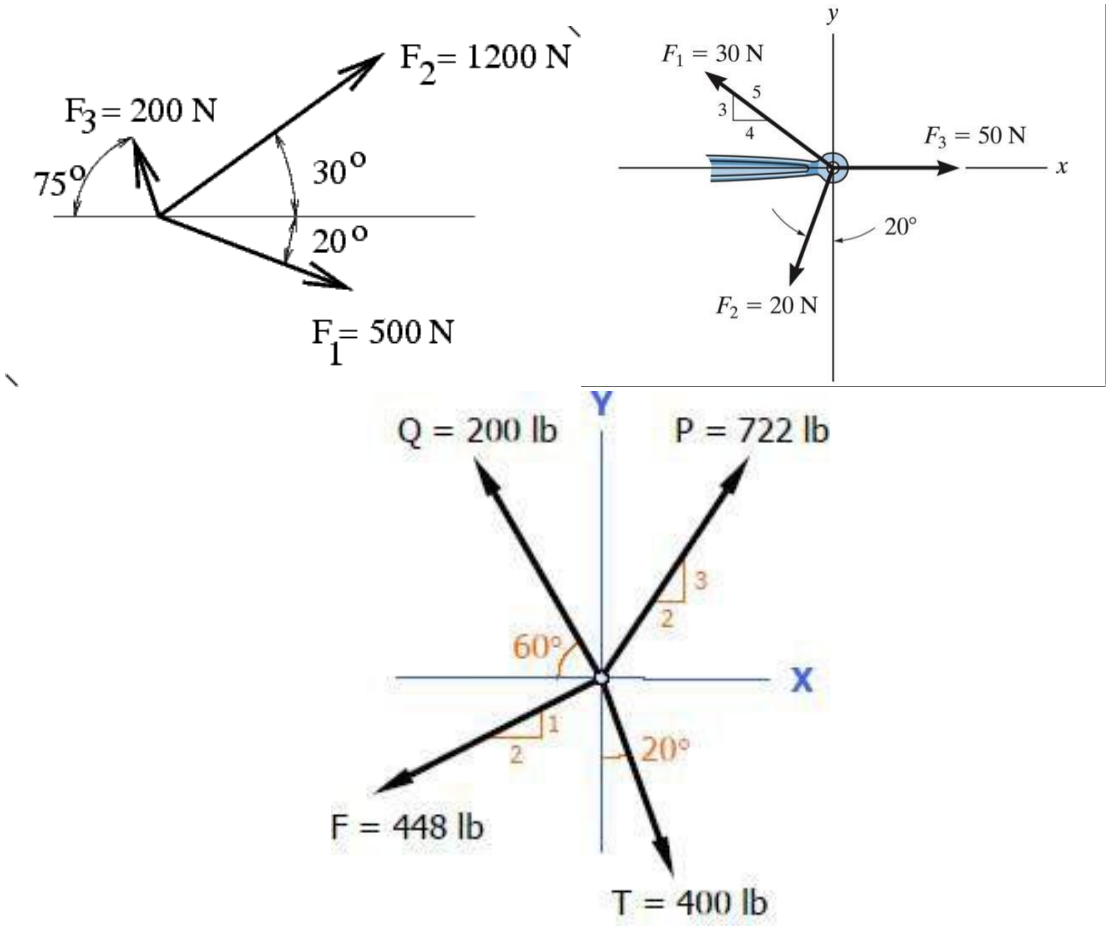
3. Determine the *x* and *y* components and the resultant of each of the forces shown in the following figures.











4. The magnitude of resultant force is 400 lb. Find the magnitude of F2 and its angle for figure 1.

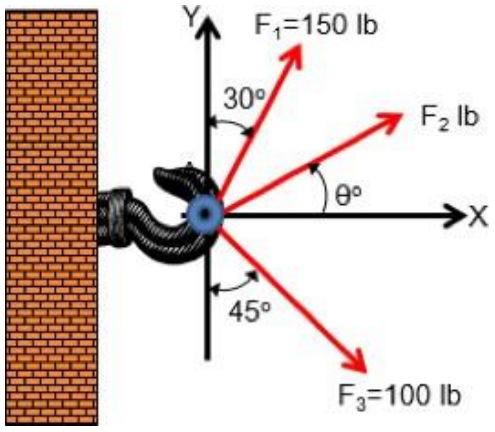


Figure 1

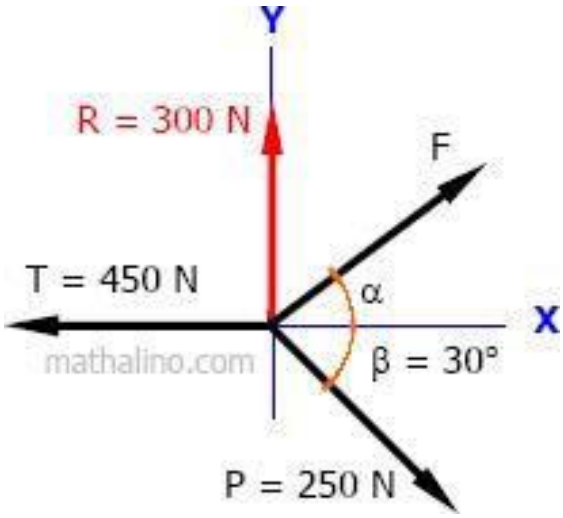
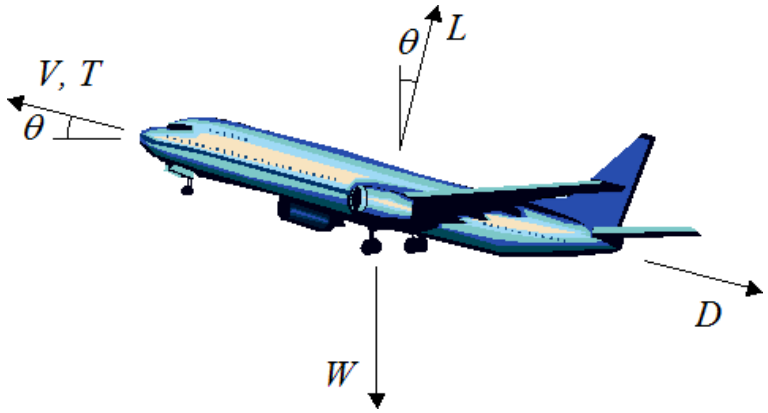


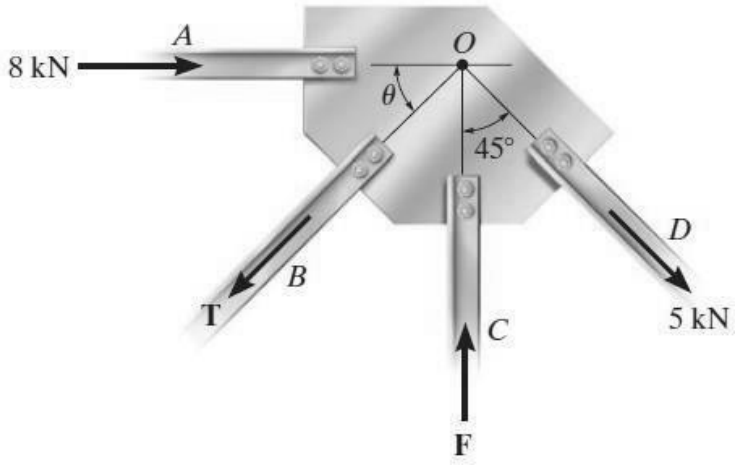
Figure 2

5. The magnitude of resultant force is 400 N. Find the magnitude of F and its angle for above figure 2.

6. The weight of the aircr.aft (W) is 500 kN, Drag force (D) is 200 kN, lifting force (L) is 150 kN and thrust force by the engine (T) is 300 kN. Find the resultant force magnitude and direction if the angle ɵ is 10˚.

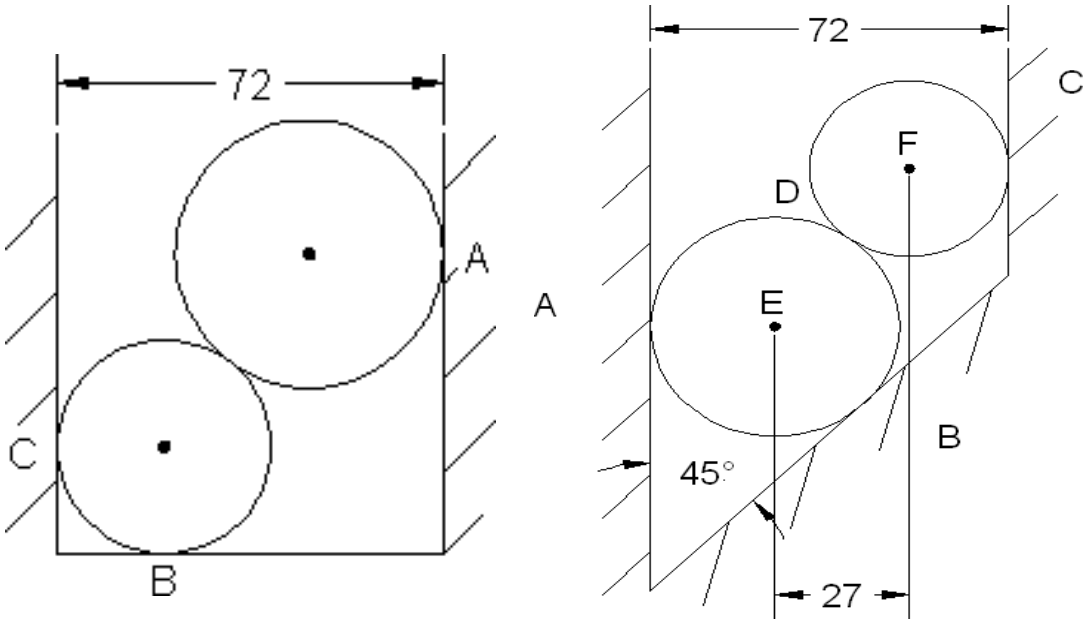


7. The gusset plate is subjected to the forces of four members. Determine the force in member *B* and its proper orientation u for equilibrium. The forces are concurrent at point *O*. Take $F = 12$ kN.

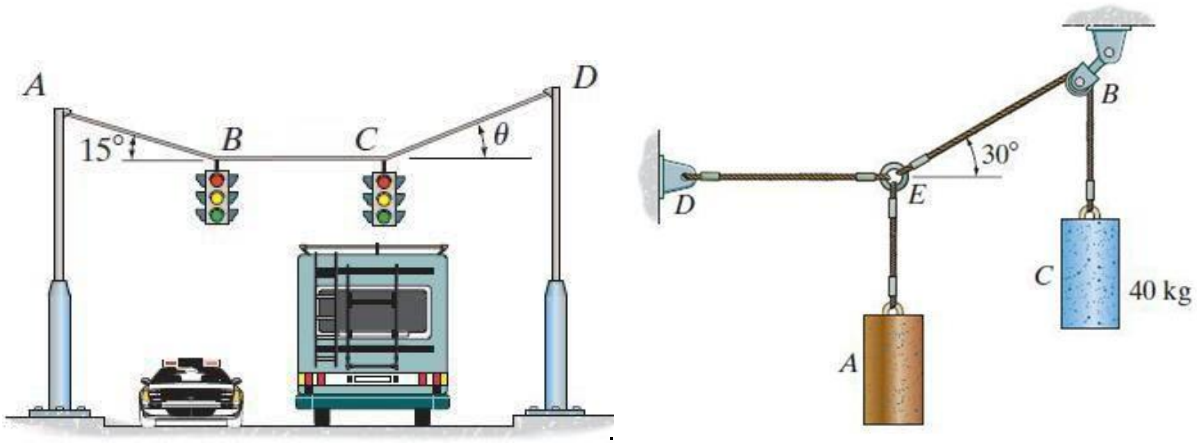


8. Two homogeneous spherical balls rest between two vertical walls as shown in figure 3. The radius of the smaller ball is 16 cm and weight 1.15 kN. The radius of the larger ball is 24 cm and weight 3.45 kN. The distance between the walls is 72 cm. Assuming the contact surfaces are smooth, determine the reactions at A, B and C of figure 1. All Dimensions in mm.

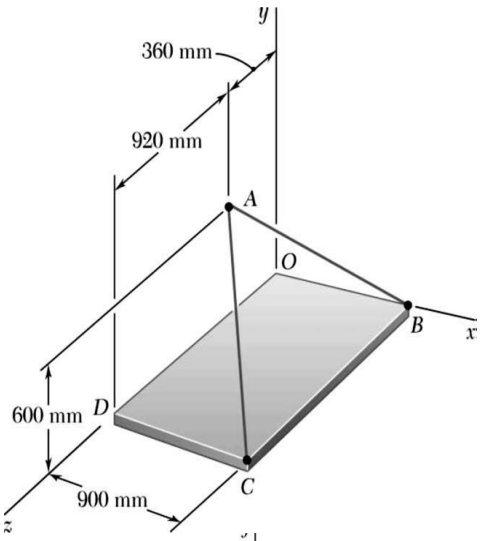
9. Two cylinders of diameters 60 mm and 30 mm weighing 160 N and 40 N respectively are placed as shown in figure. Assuming all the contact surfaces to be smooth, find the reactions at A, B and C of figure 2. All Dimensions in mm.



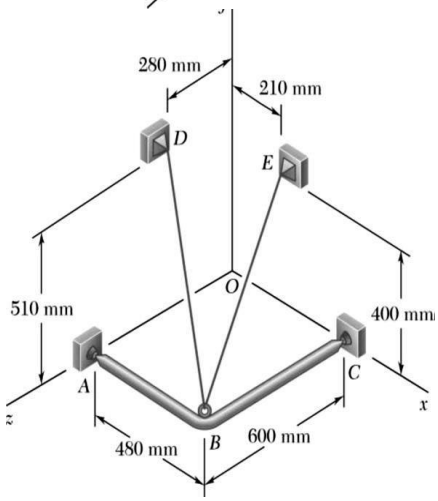
10. Determine the tension in cables *AB* , *BC* , and *CD* , necessary to support the 10-kg and 15-kg traffic lights at *B* and *C* , respectively. Also, find the angle u.
11. If the mass of cylinder *C* is 40 kg, determine the mass of cylinder *A* in order to hold the assembly in the position shown.



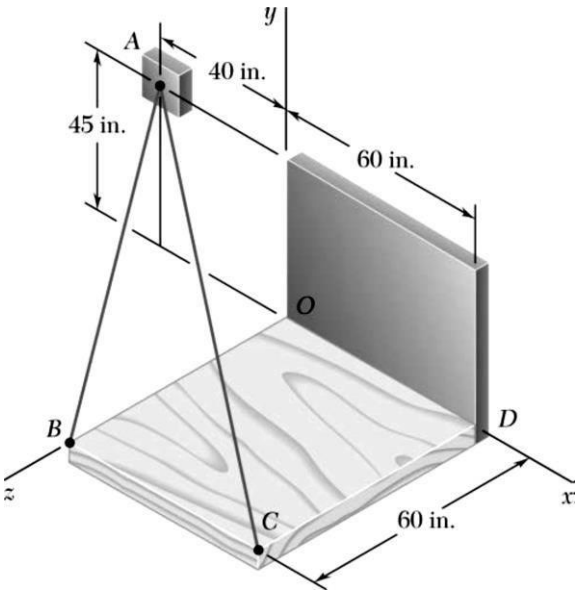
1. Knowing that the tension in cable *AB* is 1425 N, determine the components of the force exerted on the plate at *B*.



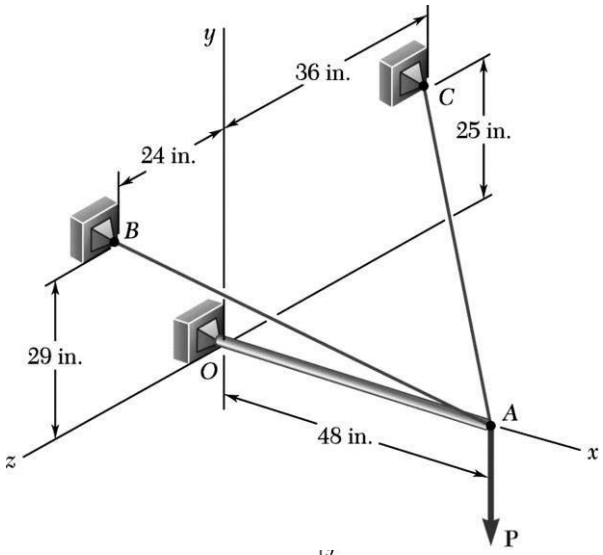
2. A frame *ABC* is supported in part by cable *DBE* that passes through a frictionless ring at *B*. Knowing that the tension in the cable is 385 N, determine the components of the force exerted by the cable on the support at *D and E*. determine the magnitude and direction of the resultant of the forces exerted by the cable at *B* knowing that the tension in the cable is 385N.



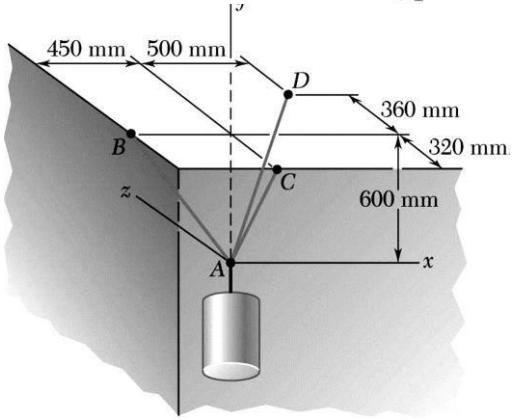
3. Knowing that the tension is 510 lb in cable *AB* and 425 lb in cable *AC*, determine the magnitude and direction of the resultant of the forces exerted at *A* by the two cables.



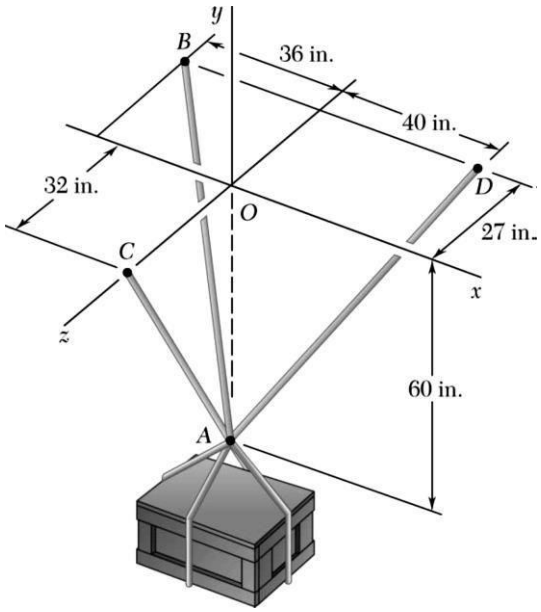
4. The boom *OA* carries a load **P** and is supported by two cables as shown. Knowing that the tension in cable *AB* is 183 lb and that the resultant of the load **P** and of the forces exerted at *A* by the two cables must be directed along *OA*, determine the tension in cable *AC*. determine the magnitude of the load **P**.



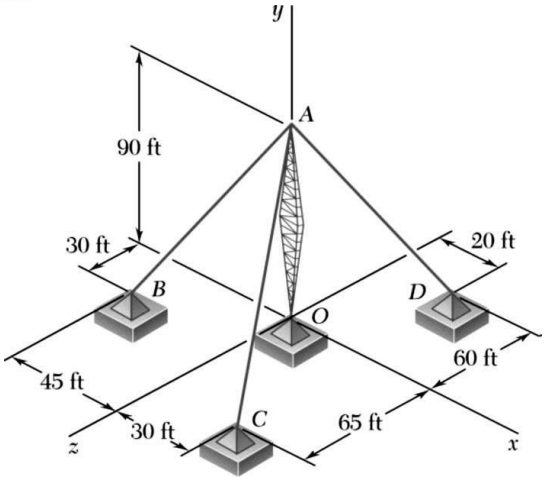
5. A container is supported by three cables that are attached to a ceiling as shown. Determine the weight *W* of the container, knowing that the tension in cable *AB* is 6 kN.



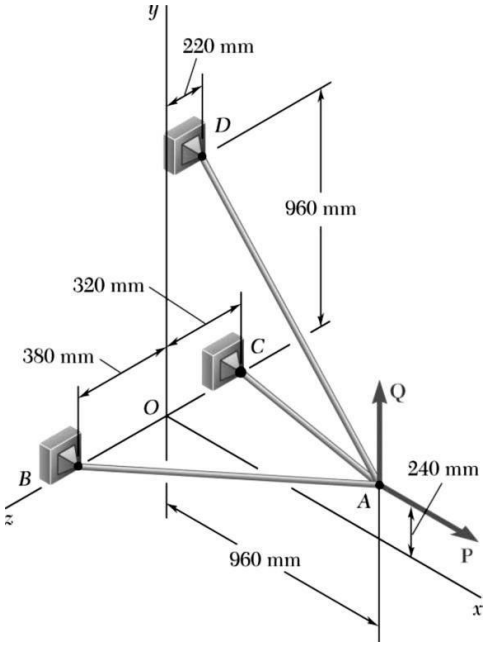
6. A crate is supported by three cables as shown. Determine the weight of the crate knowing that the tension in cable *AB* is 750 lb.



7. A transmission tower is held by three guy wires attached to a pin at A and anchored by bolts at B, C, and D. If the tension in wire AB is 630 lb, determine the vertical force **P** exerted by the tower on the pin at A.



8. Three cables are connected at A, where the forces **P** and **Q** are applied as shown. Knowing that P =1200 N, determine the values of Q for which cable AD is taut.



9. If the balloon is subjected to a net uplift force F of 800 N, then determine the tension developed in ropes AB, AC, AD. (Figure 1)

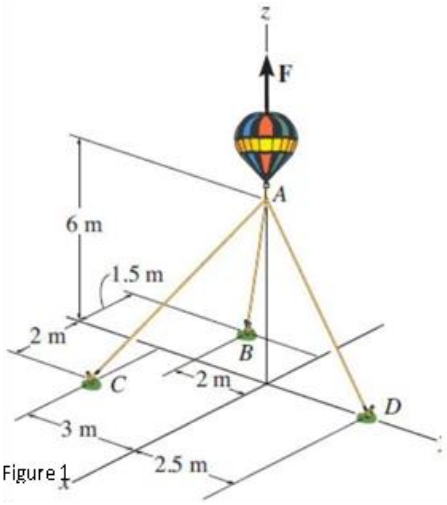


Figure 1

10. The tower is held in place by three cables. If the force of each cable acting on the tower is shown, determine the magnitude and coordinate direction angles of the resultant force. Take x = 20 m, y = 15 m. (Figure 2)

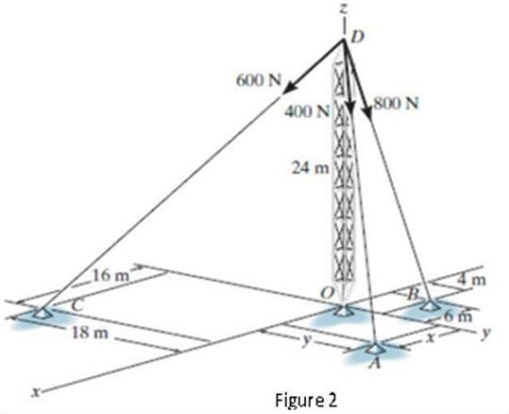


Figure 2

11. If FB = 560 N and FC = 700, determine the magnitude and coordinate direction angles of the resultant force acting on the flagpole. (Figure 3)

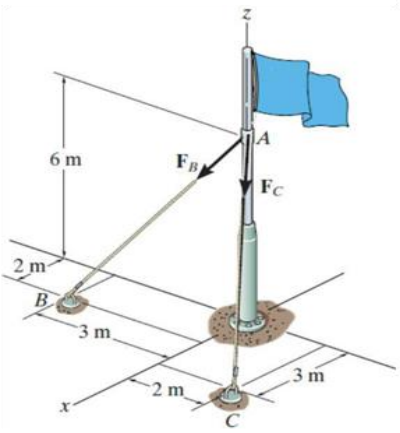


Figure 3.

12. Determine the vertical force P exerted by the balloon at A knowing that the tension in cable AC is 444 N. (Figure 4)

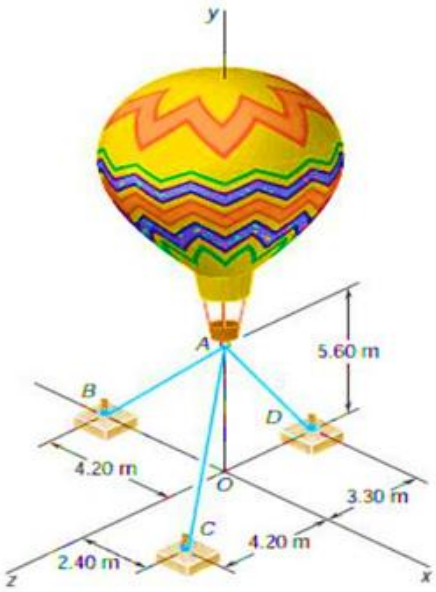
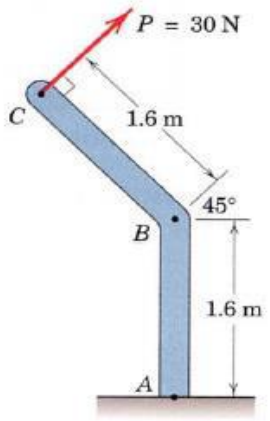


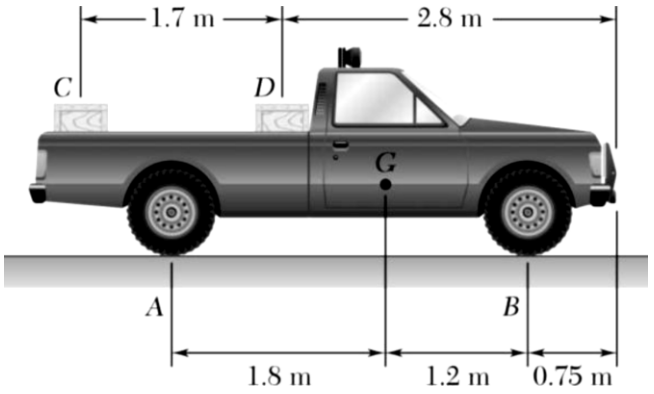
Figure 4.

Module II

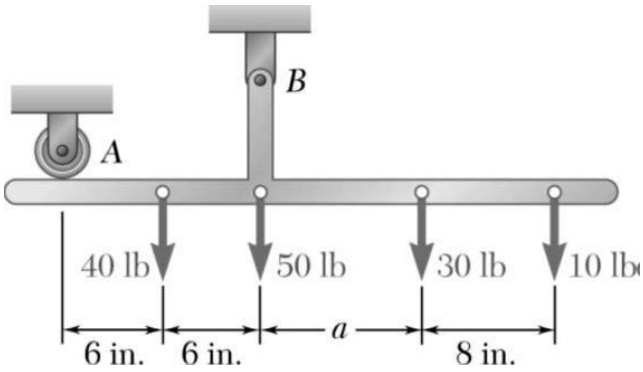
1. The 30 N force P is applied perpendicular to the portion BC of the bent bar as shown in figure 3. Determine the moment of P about point B and about point A.



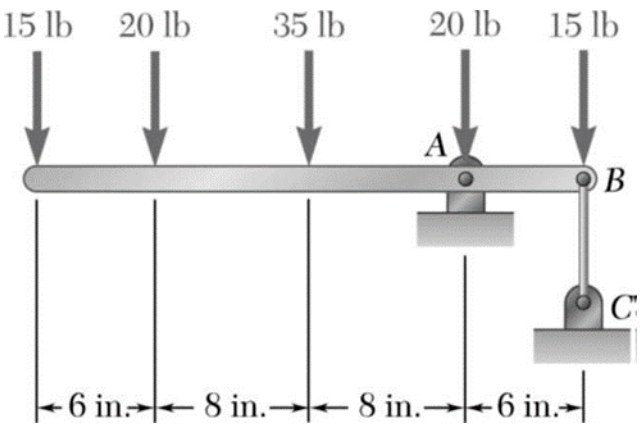
2. Two crates, each of mass 350 kg, are placed as shown in the bed of a 1400-kg pickup truck. Determine the reactions at each of the two (a) rear wheels A, (b) front wheels B.



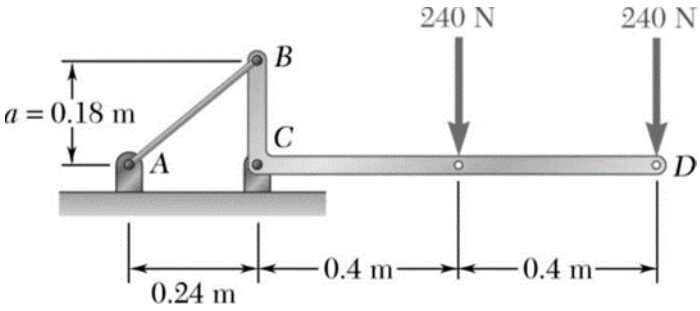
3. A T-shaped bracket supports the four loads shown. Determine the reactions at A and B (a) if a=10 in., (b) if a = 7 in.



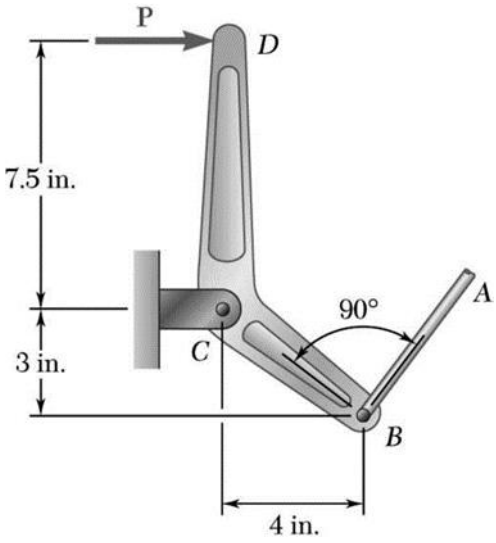
4. For the beam and loading shown, determine (a) the reaction at A, (b) the tension in cable BC.



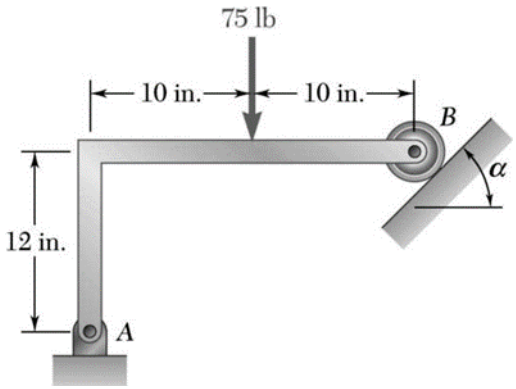
5. The bracket BCD is hinged at C and attached to a control cable at B. For the loading shown, determine (a) the tension in the cable, (b) the reaction at C.



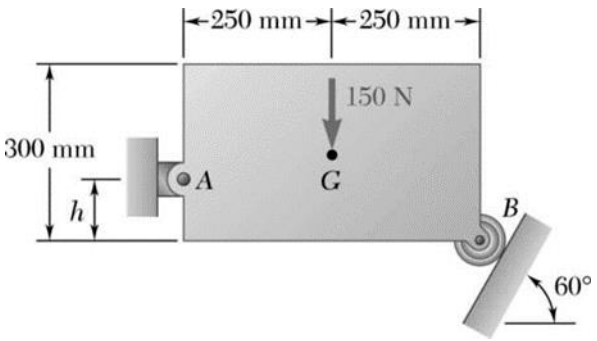
6. The lever BCD is hinged at C and attached to a control rod at B. If P = 100 lb, determine (a) the tension in rod AB, (b) the reaction at C.



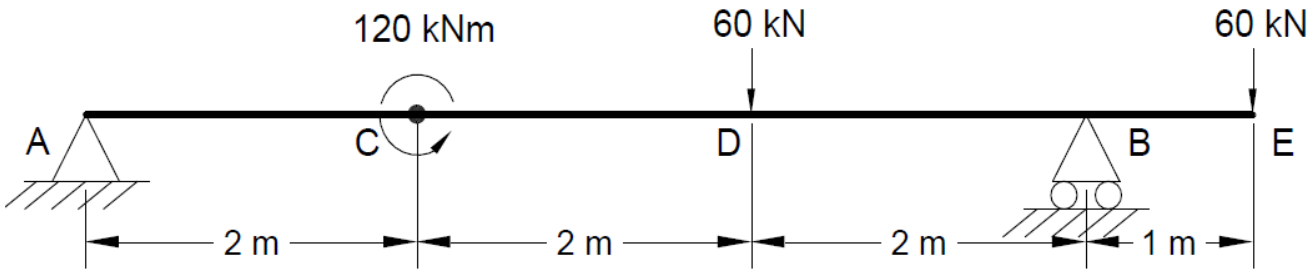
7. Determine the reactions at A and B when (a) α = 0, (b) α = 90°, (c) α = 30°.



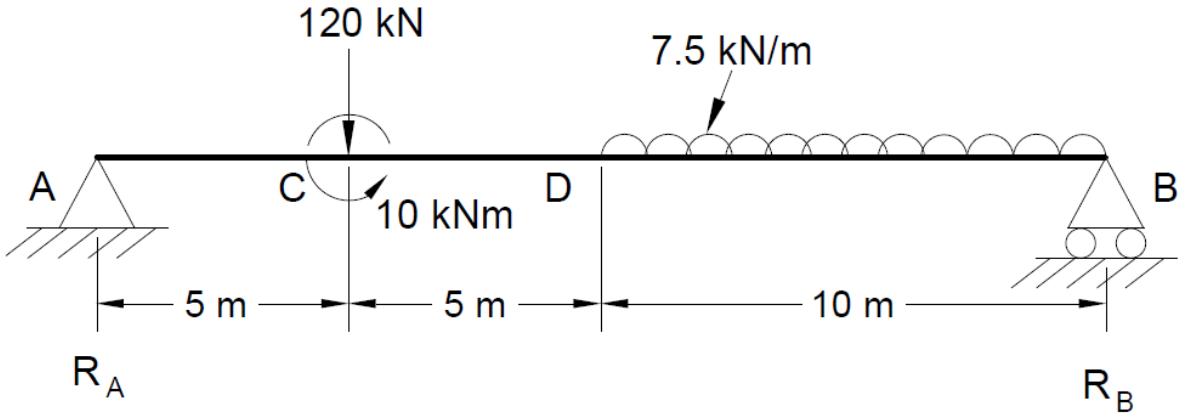
8. Determine the reactions at A and B when (a) h = 0, (b) h = 200 mm.



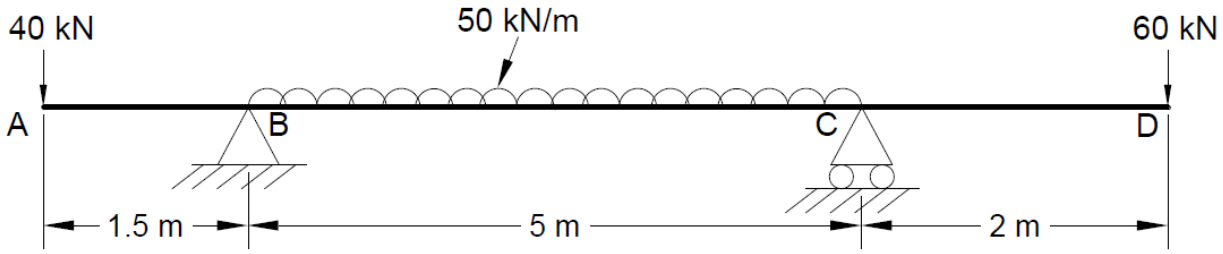
9. Find the reactions at the supports.



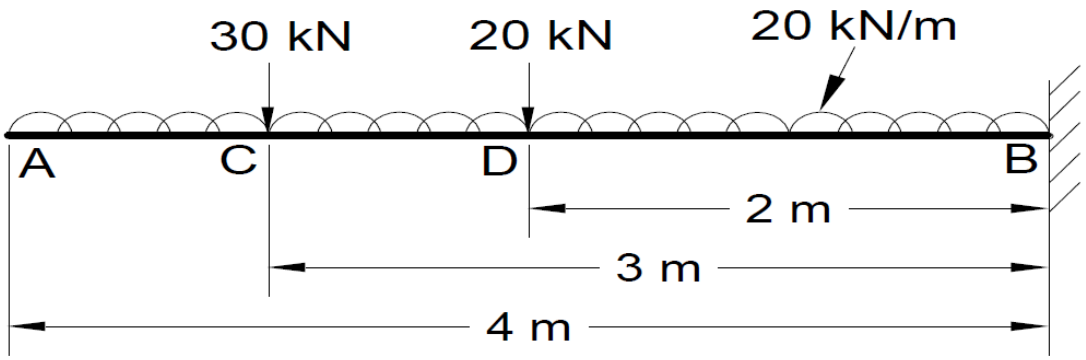
10. Find the reactions at the supports.



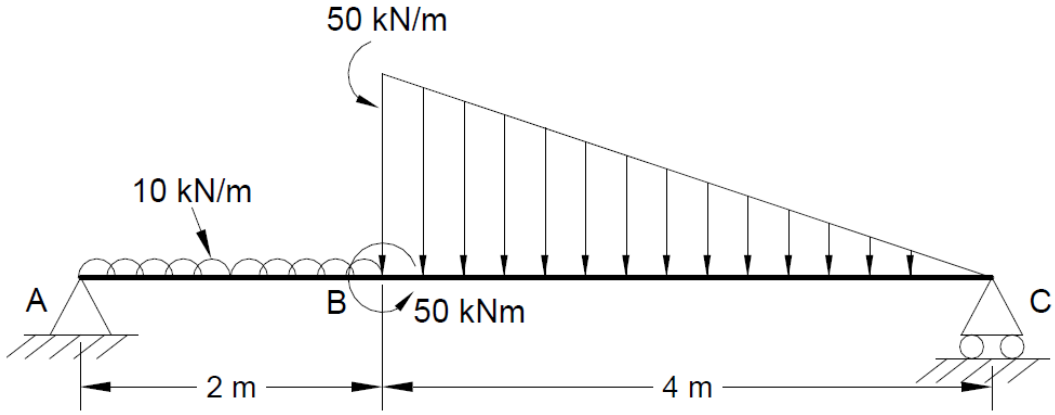
11. Find the reactions at the supports.



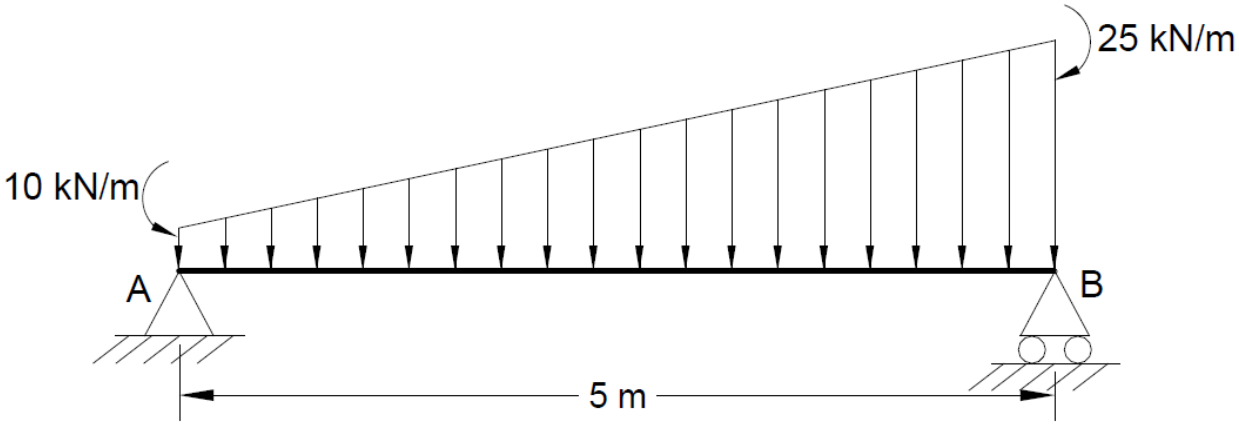
12. Find the reactions at the supports.



13. Find the reactions at the supports.

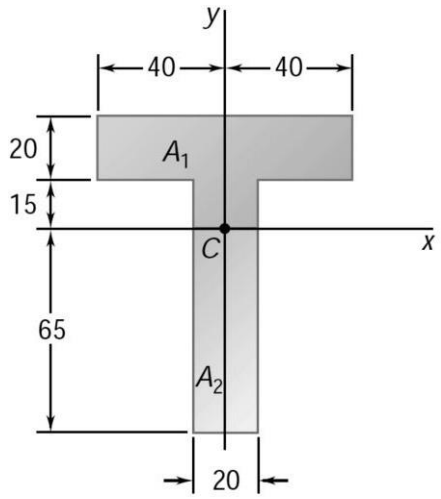


14. Find the reactions at the supports.

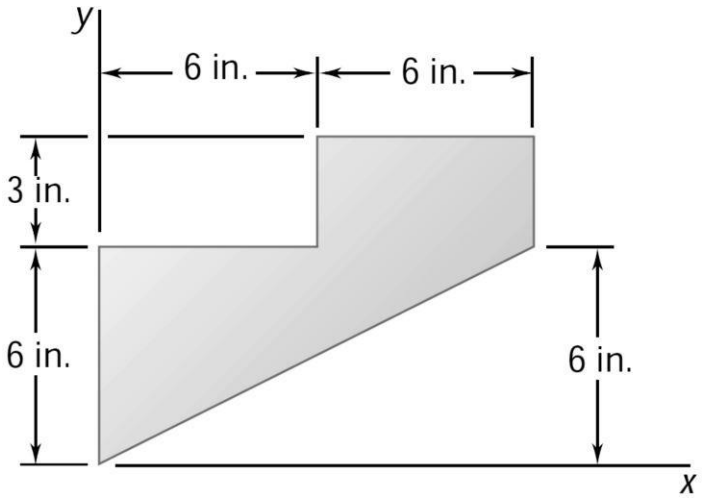


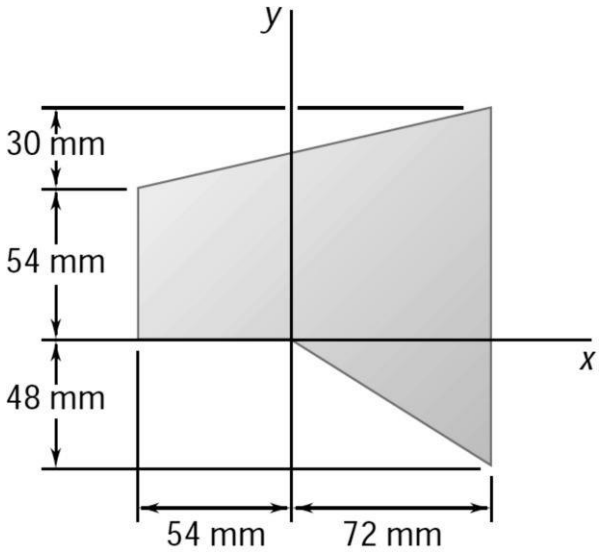
Module III

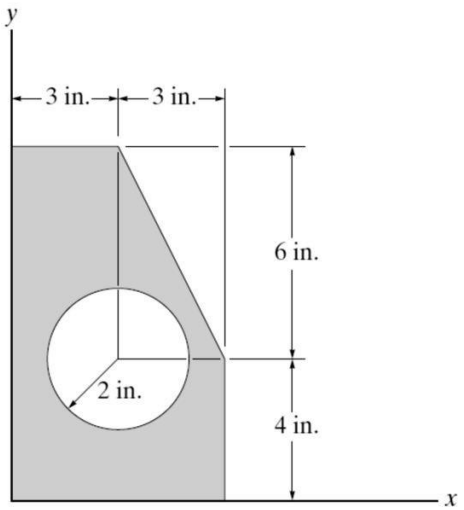
1. Determine the Centroid for the given sections

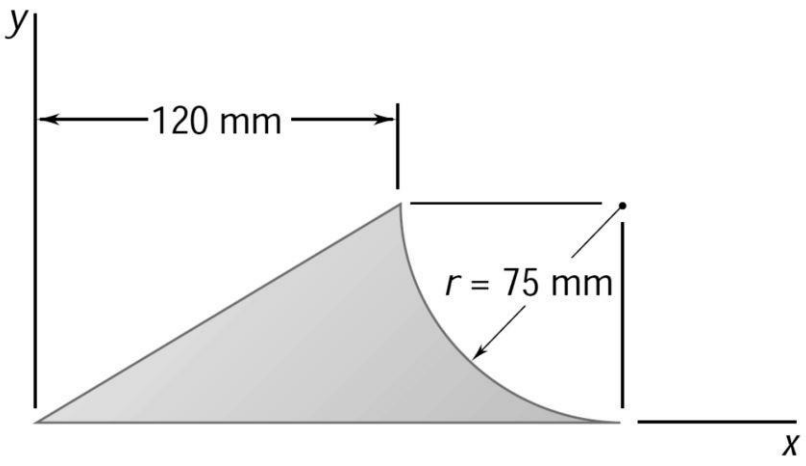


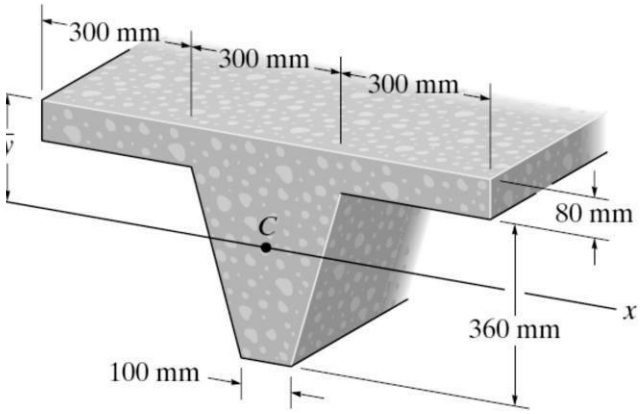
Dimensions in mm





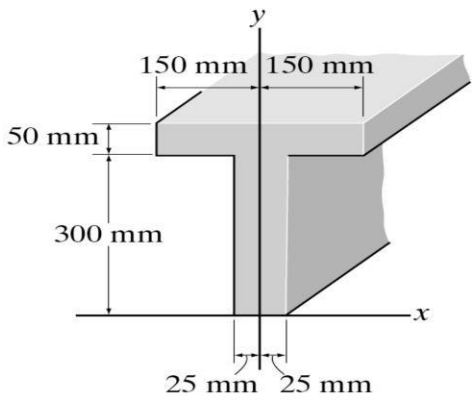


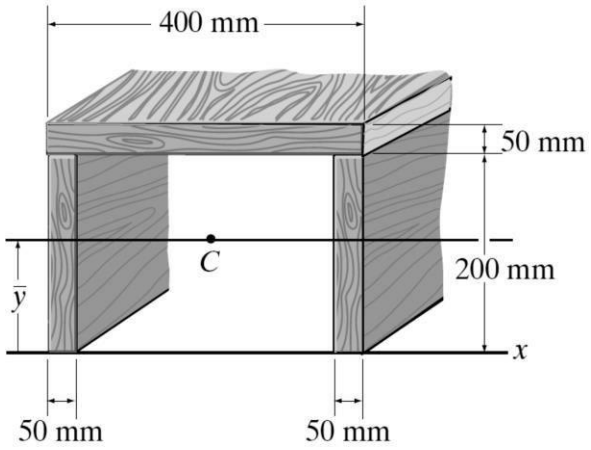


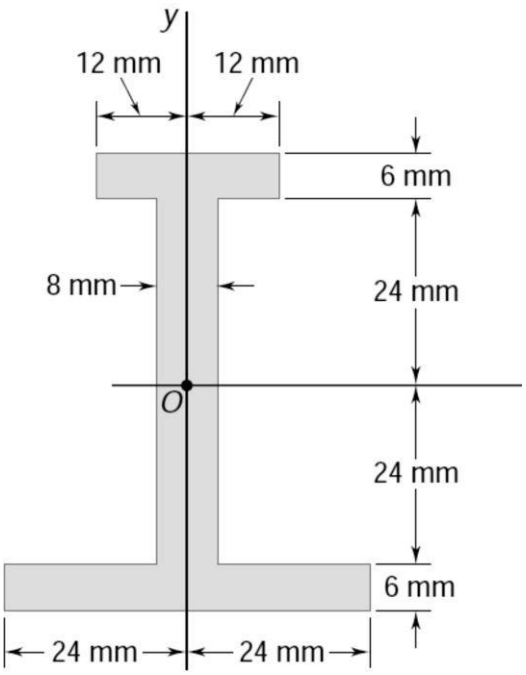


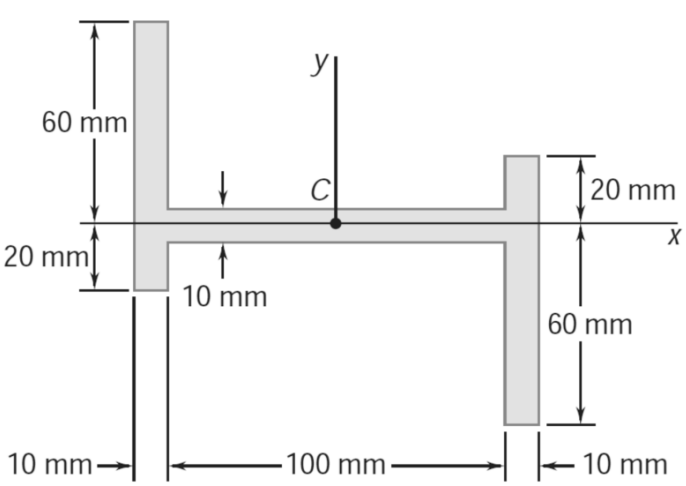
15.

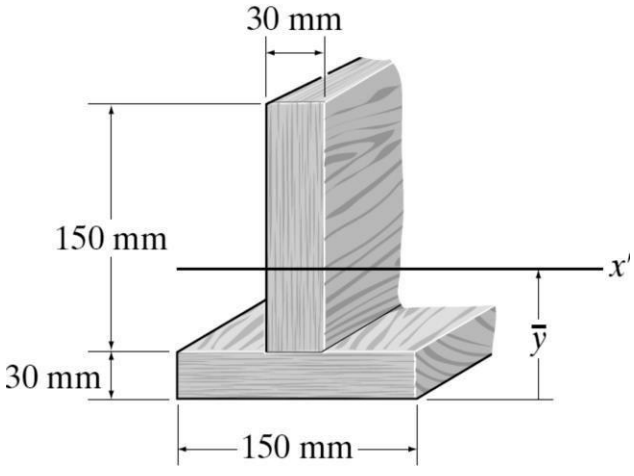
2. 2. Determine the Moment of Inertia about the centroidal axes for the given sections.

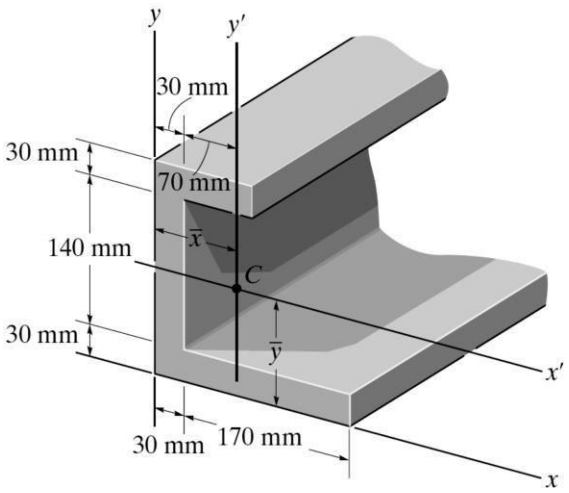




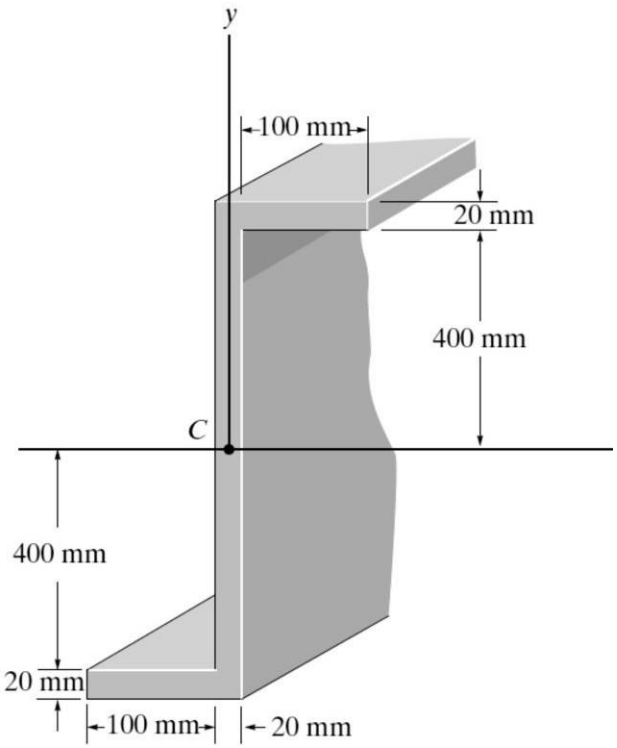


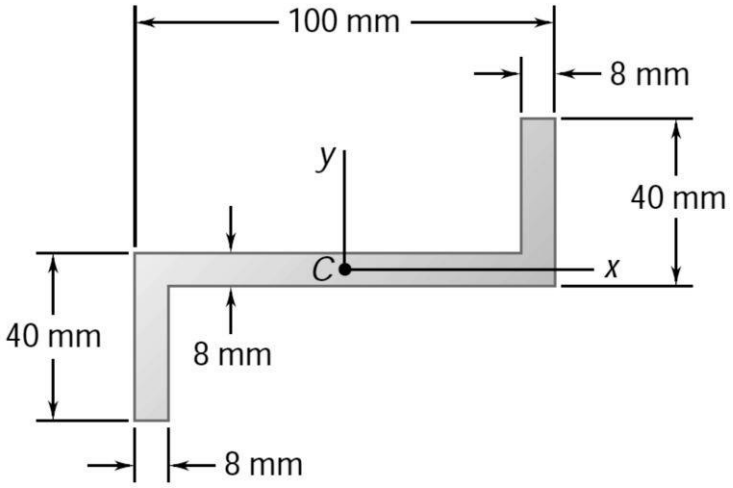


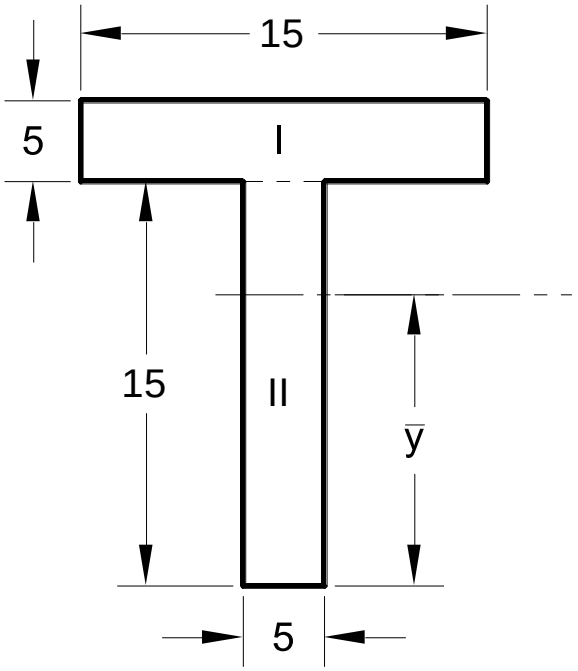




3. Determine the Product Moment for the given section about its centroidal axes.







All Dimensions in mm.

Module IV

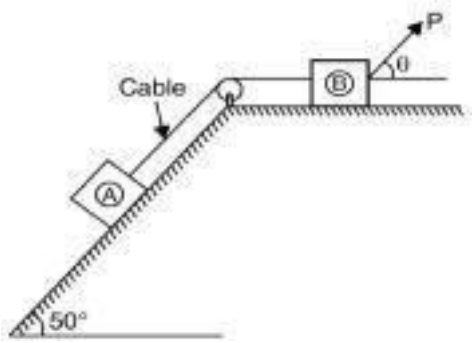
1. A body which weights 1000 N rests on a horizontal plane, the co-efficient of friction between the body and the plane being 0.1. Find the force, which acting at 30° to the horizontal will just move the body.[Ans. 109.2 N]

2. A body resting on a rough horizontal plane required a pull of 82 N inclined at 30° to the plane just to move it. It was found that a push of 100 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the co- efficient of friction. [Ans. 455 N, $\mu = 0.1714$]

3. A 100 N mass is dragged by a rope up 10° slope, the rope being paralleled to the line of the steepest slope. The co-efficient of friction is 0.5. Calculate the tension in the rope. [Ans. 66.9 N]

4. A body is in equilibrium on an inclined plane. Show clearly by means of a diagram, the forces acting on the body, describing the forces e.g., weight etc. The inclination of the plane is increased and it is found that uniform motion, once started, continues when the plane is inclined at 15° to the horizontal. What is the co-efficient of friction between the body and the plane? What force parallel to the plane, will be required to keep the body, whose weight is 100 N at rest when the plane is inclined at 30° to the horizontal?[Ans. 0.268, 26.8 N]

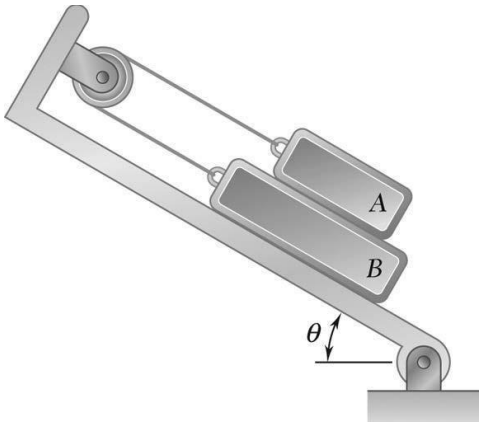
5. A system consisting of two blocks connected by a cable is as shown in figure. The masses of the block A and block B are 7.5 kg and 25 kg respectively. Determine the magnitude of minimum force and its inclination with reference to the horizontal, to be applied on block B. The block have impending motion towards the right. Take the coefficient of friction at all contact surfaces to be 0.28.



6. A ladder 5 m long and of 250 N weight is placed against a vertical wall in a position where its inclination to the vertical is 30°. A man weighing 800 N climbs the ladder. At what position will be induce slipping, the co-efficient of friction for both the contact surfaces of the ladder with the wall and floor is 0.2.[Ans. 1.79 m]

7. A uniform ladder 3 m long weighs 200 N. It is placed against a wall making an angle of 60° with the floor. The co-efficient of friction between the wall and the ladder is 0.25 and that between the floor and ladder is 0.5. The ladder in addition to its own weight has to support a man weighing 1 kN its top. Calculate.
   i. The horizontal force P to be applied to the ladder at the floor level to prevent slipping.
   ii. If the force P is not applied, what should be the maximum inclination of the ladder with the horizontal so that there is no slipping of it with the man at top. [Ans. 183.6 N, 68° 57′]

8. The 20-lb block *A* and the 30-lb block *B* are supported by an incline that is held in the position shown. Knowing that the coefficient of static friction is 0.15 between the two blocks and zero between block *B* and the incline, determine the value of μ for which motion is impending.



9. Block 5 kg rests on block 10kg and is attached by a horizontal rope to the wall as shown in figure 1**.** What force 'F' is necessary to cause motion of 'A' to impend? The co-efficient of friction between two blocks is 0.2 and between block and the floor is 0.3.

10. Block B rests on block A and is attached by a horizontal rope BC to the wall as shown in figure 2**.** What force 'P' is necessary to cause motion of 'A' to impend? The co-efficient of friction between 'A' and 'B' is 0.25 and between 'A' and the floor is 0.3. 'A' has a mass of 16 kg and 'B' has a mass of 10 kg.

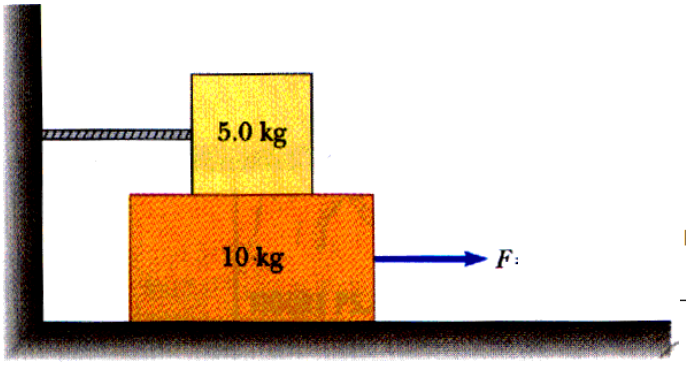


Figure 1.

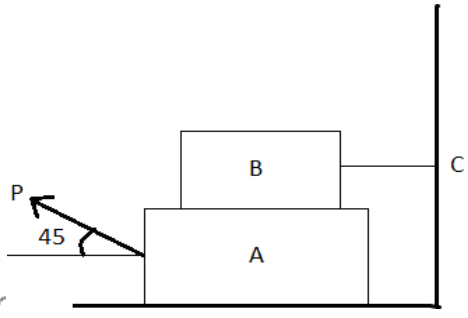


Figure 2.

Module V

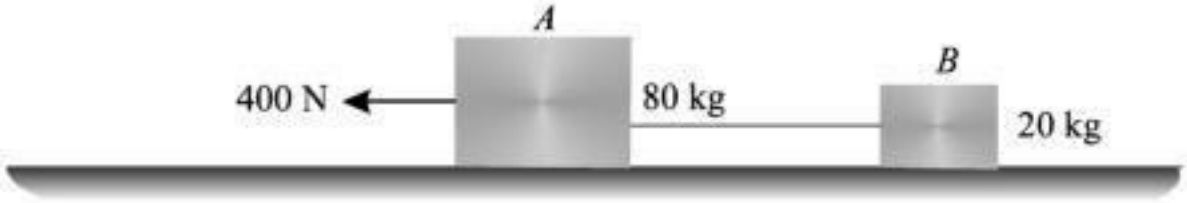
1. The motion of a particle is defined by the relation $x = t^4 - 10t^2 + 8t + 12$, where x and t are expressed in meters and seconds, respectively. Determine the position, the velocity, and the acceleration of the particle when t = 1 s.

2. The motion of a particle is defined by the relation $x = 2t^3 - 15t^2 + 24t + 4$, where x is expressed in meters and t in seconds. Determine (a) when the velocity is zero, (b) the position and the total distance traveled when the acceleration is zero.

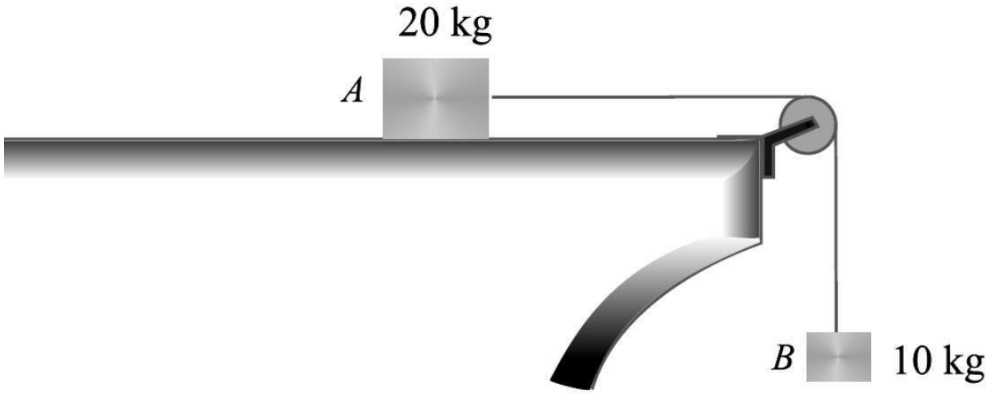
3. A ball is thrown upwards from the top of a tower, 29.4 m high, with a velocity of 19.6 m/sec. determine the time taken by the ball to reach the ground and the velocity with which it strikes the ground. (Ans: 5.158 sec and final velocity is 30.99 m/s downwards)

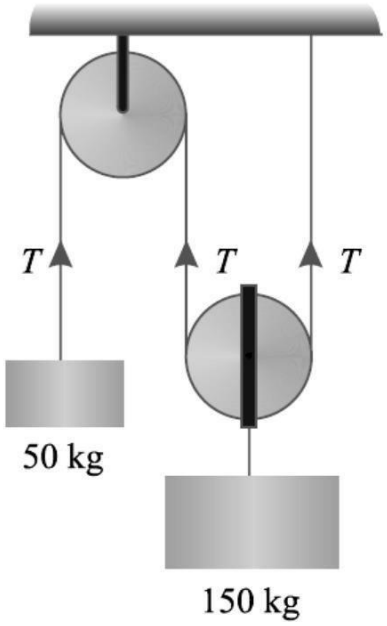
4. A stone is thrown upwards from the top of a tower 70 m high with a velocity of 19.2 m/sec. determine its position and velocity when t = 6 sec. (Ans: 39.66 m/sec downwards and 8.62 m from the ground)

5. Two bodies A and B of mass 80 kg and 20 kg are connected by a thread and move along a rough horizontal plane under the action of a force 400 N applied to the first body of mass 80 kg as shown in Fig. The coefficient of friction between the sliding surfaces of the bodies and the plane is 0.3.Determine the acceleration of the two bodies and the tension in the thread.



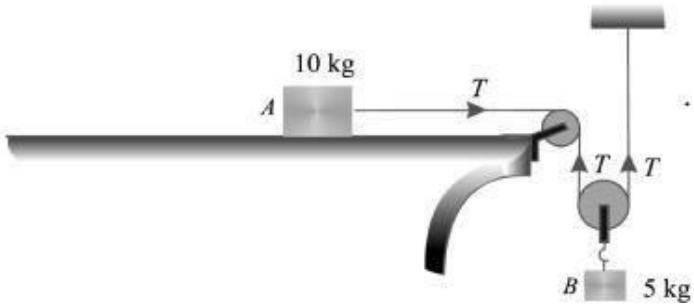
6. Determine the tension in the strings and accelerations of two blocks of mass150 kg and 50 kg connected by a string and a frictionless and weightless pulley as shown in Fig.



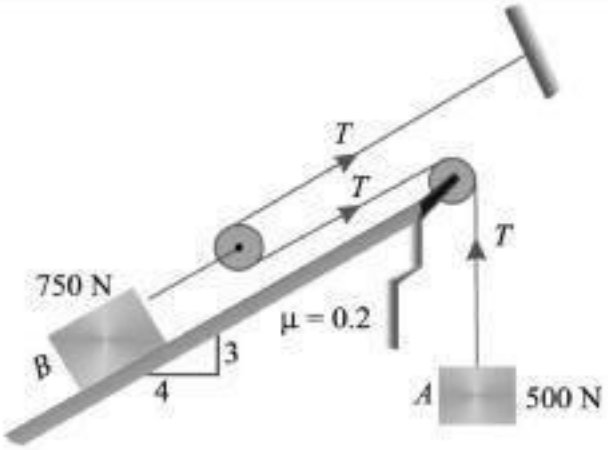


7. Two blocks shown in the above Fig, have masses A = 20 kg and B = 10 kg and the coefficient of friction between the block A and the horizontal plane, μ = 0.25.If the system is released, from rest, and the block B falls through a vertical distance of 1m,what is the velocity acquired by it? Neglect the friction in the pulley and the extension of the string.

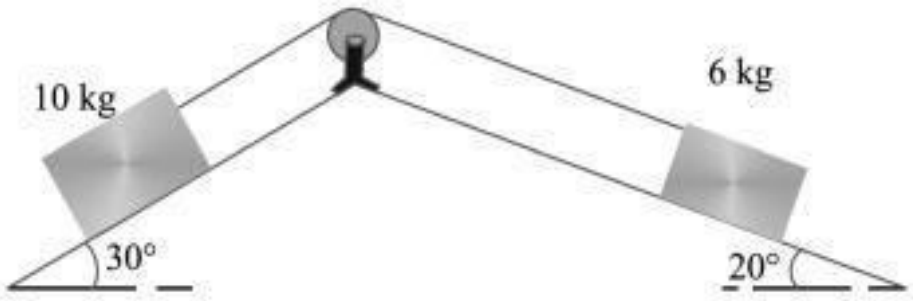
8. A block of wood A of mass 10 kg is held on a rough horizontal table. An elastic string connected to the block passes over a smooth pulley at the end of the table and then under a second smooth pulley carrying a body B of mass 5 kg as shown in Fig. The other end of the string is fixed to a point above the second pulley. When the 10 kg block is released, it moves with an acceleration of g=9.81m/s^2. Determine the value of coefficient of friction between the block and the table.



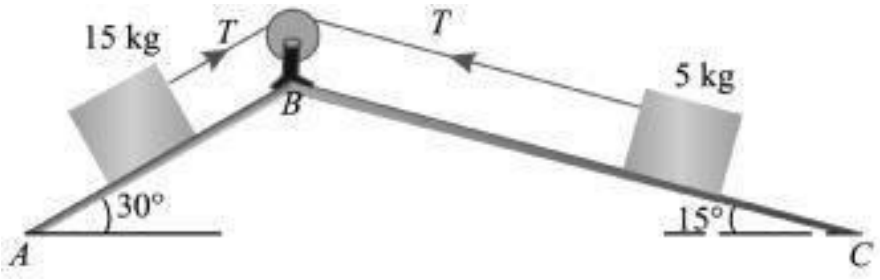
9. The system of bodies shown in Fig. starts from rest. Determine the acceleration of body B and the tension in the string supporting body A.



10. Two smooth inclined planes whose inclinations with the horizontal are 30° and 20° are placed back to back. Two bodies of mass 10 kg and 6 kg are placed on them and are connected by a light inextensible string passing over a smooth pulley as shown in Fig. Find the tension in the string. Take $g = 9.81\ m/s^2$.



11. Two rough planes inclined at 30° and 15° to the horizontal and of the same height are placed back to back. Two bodies of masses of 15 kg and 5 kg are placed on the faces and connected by a string over the top of the planes If the coefficient of friction be 0.3 find from fundamentals the resulting acceleration.



12. A body weighing 20kg slides up a 30° inclined plane under the action of an applied force of 300N acting parallel to the plane. The co-efficient of friction is 0.2. If the body moves from rest. Determine Acceleration of the body, Distance travelled in 4 s, Velocity of body after 4 s, Kinetic energy of the body after 4 s, Work done on the body after 4 s, Momentum of the body after 4 s and Impulse applied in 4 s.

13. Three balls A,B and C masses 12.5 kg, 25 kg and 50 kg respectively move along the same straight line and in the same directions with velocities of 16 m/s, 4 m/s and 3 m/s. If 'A' collides with 'B' and subsequently 'B' collides with C, find the final velocities. Assume perfectly elastic impacts. (Ans: 0,0,9 m/s)

14. The magnitude and directions of the velocities of two identical smooth balls before they strike each other are as shown in figure. Assuming e = 0.6, determine the magnitude and direction of velocity of each ball after impact.