

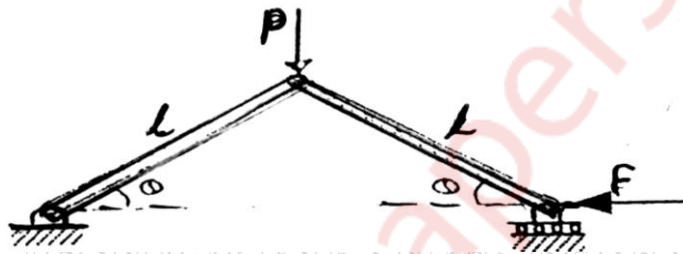
(3 Hours)

Marks :80

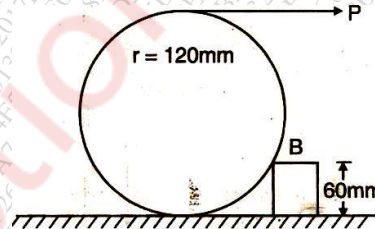
- N.B.
1. Question No.1 is compulsory.
  2. Answer any three questions from remaining questions.
  3. Assume suitable data if required.
  4. Figure to the right indicates full marks.
  5. Take  $g = 9.81 \text{ m/s}^2$ .

Q.1 Attempt any four.

- a) A force of  $100 \text{ N}$  act at a point  $P (-2, 3, 5)\text{m}$  has its line of action passing through  $Q (10, 3, 4)\text{m}$ . Calculate the moment of force about origin.
- b) A vertical lift of total mass  $750 \text{ kg}$  acquires an upward velocity of  $3 \text{ m/s}$  over a distance of  $4\text{m}$  moving with constant acceleration starting from rest. Calculate the tension in cable.
- c) For the mechanism shown express the relation between forces  $F$  and  $P$  in terms of  $\theta$ , by principle of virtual work.



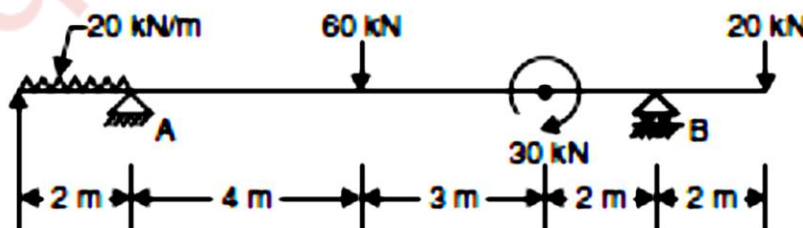
- d) A stone is released from top of the tower during the last second of its motion, it covers  $1/4^{\text{th}}$  of the height of the tower. Find the height of the tower.
- e) A roller of weight  $500 \text{ N}$  has a radius of  $120 \text{ mm}$  and is pulled over a step at height  $60 \text{ mm}$  by a horizontal force  $P$ . Find magnitude of  $P$  to just start the roller over the step.



- f) Classify types of motion for rigid body with suitable examples.

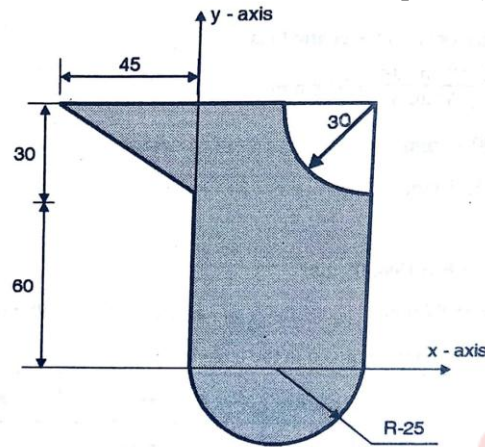
Q.2 a) State the laws of dry friction.

- b) Find support reaction of the beam as shown in fig.

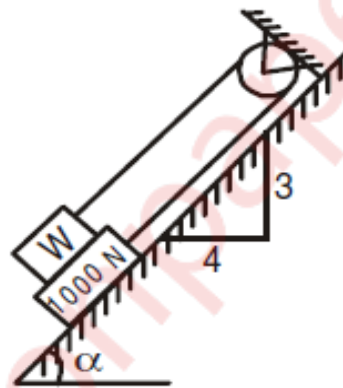


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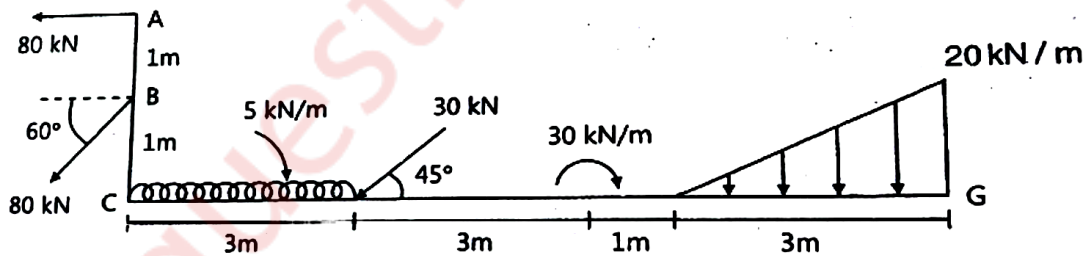
- c) Find the coordinates of the centroid of the shaded area with respect to the axes shown in Fig. 8



- Q.3 a) In Fig. The frictionless fixed drum, and coefficient of friction between other surfaces of contact is 0.3. Determine the minimum weight  $W$  to prevent downward motion of the 1000 N body. 8

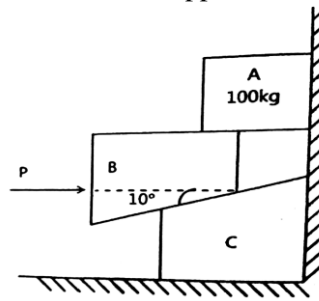


- b) Determine the resultant of the given force system as shown in fig. 6



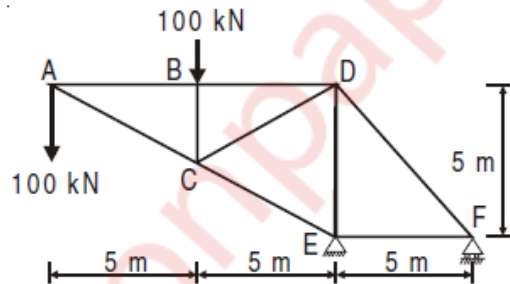
- c) An automobile starts from rest and travels on a straight path at  $2 \text{ m/s}^2$  for some time. After which it decelerates at  $1 \text{ m/s}^2$ , till its comes to halt. If the distance covered is 300 m, find the maximum velocity of the automobile and the total time of travel. 6

- Q.4 a) Two  $10^\circ$  wedges of negligible weight are used to just move the block of mass 100 kg. If  $\mu = 0.25$  at all surfaces of contact. Find the force P that should be applied on the wedge. **8**

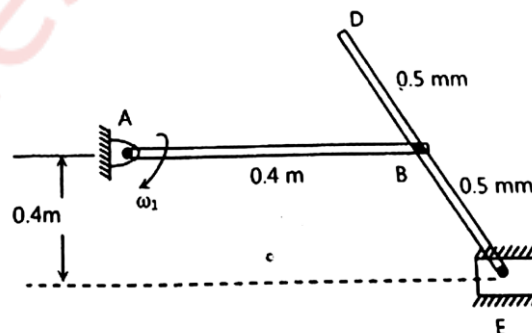


- b) State and derive Work Energy principle. **4**  
 c) Find the initial velocity and corresponding angle of projection of a projectile such that when projected from the ground it just clears a wall 4.5 m high at a horizontal distance of 6 m and finally lands on the ground at a distance of 35 m beyond the wall. **8**

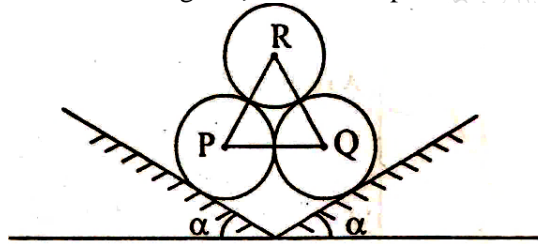
- Q.5 a) Referring to the truss shown in figure, find: **8**  
 (a) Support Reactions.  
 (c) Forces in members BD, CD and CE by method of sections.  
 (d) Forces in other members by method of joints.



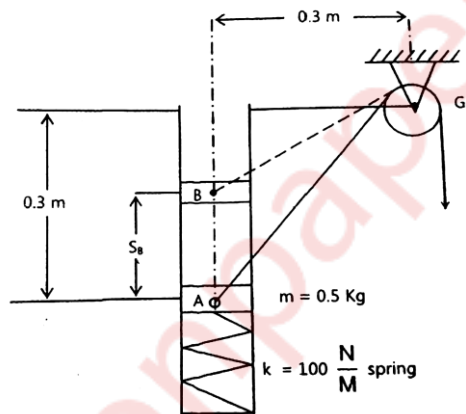
- b) Two balls of the masses 10 kg and 20 kg are moving along a straight line towards each other at velocities of 4 m/s and 1 m/s respectively. If  $e=0.6$ , determine the velocities of the balls just after collision. **6**  
 c) For the position shown, the angular velocity of bar AB is 2.8 r/s clockwise if AB is a horizontal. Determine the velocities of slider E and point D. **6**



- Q.6 a) Three identical spheres P, Q and R each of weight  $W$  are arranged on smooth inclined surface as shown in Fig. Determine the minimum angle  $\alpha$ , which will prevent the arrangement from collapsing. **8**



- b) The block of mass  $0.5 \text{ kg}$  moves within the smooth vertical slot. If it starts from rest, when the attached spring is in the upstretched position at A. determine constant vertical force  $F$  which must be applied to the cord, so that block attains a speed of  $2.5 \text{ m/s}$  when it reaches B. i.e.,  $S_B = 0.15 \text{ m}$ , neglect the mass of the cord, pulley and friction between cord and pulley. **6**



- c) A car is moving on a curve of radius  $300 \text{ m}$  at a speed of  $90 \text{ kmph}$ . The brakes are suddenly applied, causing speed to decrease at a constant rate of  $1.3 \text{ m/s}^2$ . Determine the total acceleration immediately after brakes have been applied. **6**