Code No: R21031 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, June - 2015
ENGINEERING MECHANICS
(Com to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) State and prove Varignon's theorem (or) principle of moments.
   b) Two forces of magnitude 240 N and 200 N are acting at a point O as shown in Figure 1. If the angle between the forces is 60°,determine the magnitude of the resultant force and also determine the angle β and ϒ as shown in the Figure 1. (7M+8M)

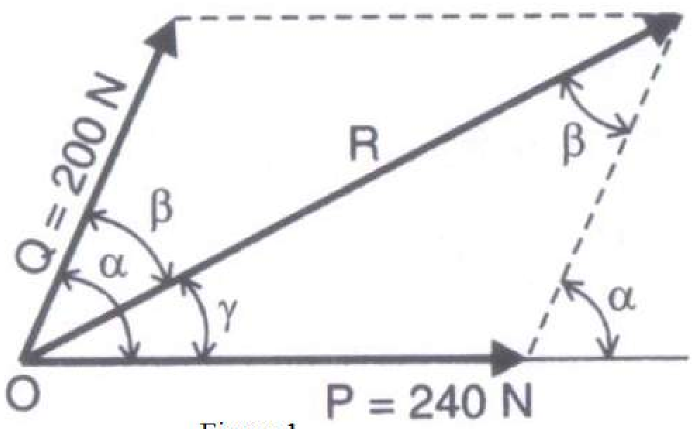

Figure 1

2. Two smooth circular cylinders, each of weight W=1000 N and radius 15 cm are connected at their centre's by a string AB of length 40 cm and rest upon a horizontal plane, supporting above them a third cylinder of weight 2000 N and radius 15 cm as shown in Figure 2. Find the force S in the string AB and the pressure produced on the floor at the points of contact D and E. (15M)

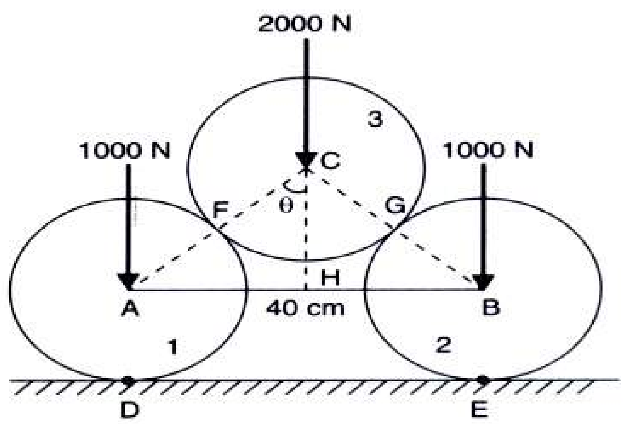

Figure 2
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3. a) Find the center of gravity of the I section shown in Figure 3.

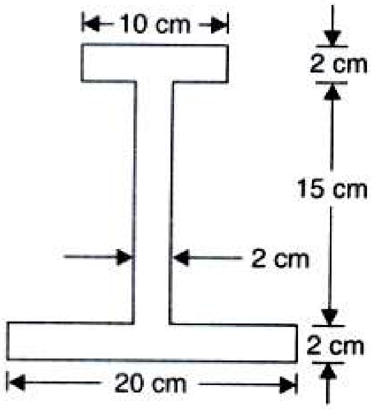
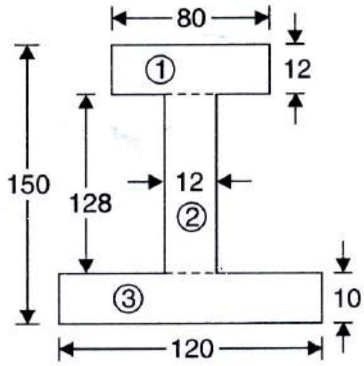


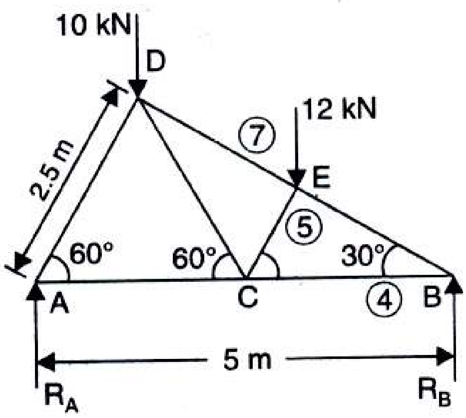
Figure 3

b) Determine the centroid of the parabolic spandrel. (8M+7M)

4. Determine the Polar moment of inertia of the I-Section shown in Figure, All Dimensions are in mm. (15M)



5. A truss of span 5 m is loaded as shown in Figure. Find the reactions and forces in the members marked 4, 5 and 7 using method of sections. (15M)



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6. The initial angular velocity of a rotating body is 2 rad/s and initial angular acceleration is zero. The rotation of the body is according to the relation $\alpha = 3t^2 - 3$. Find (i) angular velocity (ii) Angular displacement when t= 5 seconds. Consider the angular displacement in radians and time in seconds. (15M)

7. A tram car weighs 120 kN, the tractive resistance being 5 N / kN. What power will be required to propel the car at a uniform speed of 20 kmph?
i) On level surface ii) p an incline of 1 in 300 and iii) Down an inclination of 1 in 300? Take efficiency of motor **as 80%.** (15M)

8. a) What is solid friction? If a body of weight 70 N is placed on a rough horizontal plane. To just move the body on the horizontal plane, a push of 20N incline at 20° to the horizontal plane is required. Find the co-efficient of friction.
b) 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 the co-efficient of friction between the ladder and the floor and Frictional force acting on the ladder at the point of contact between ladder and **floor.** (8M+7M)

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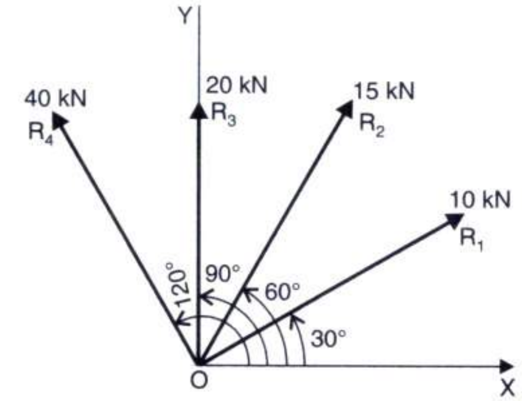
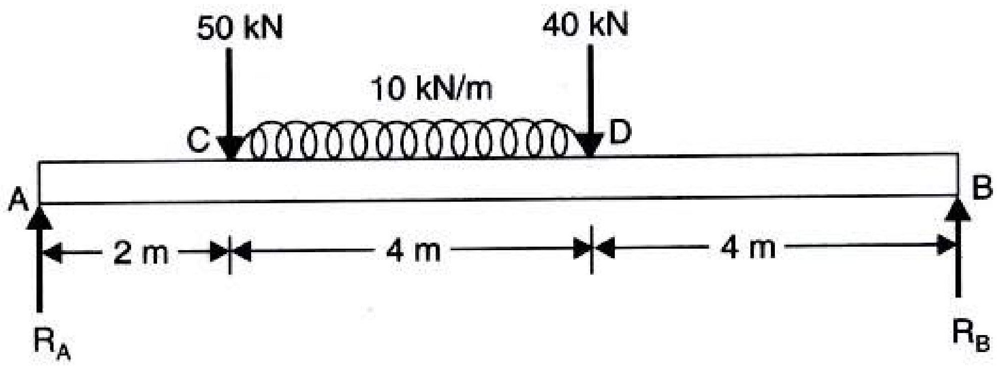
1. a) State and Prove Law of parallelogram of forces.
   b) Four forces of magnitude 10kN, 15kN, 20kN and 40 kN are acting at a point O as shown in Figure The angles made by 10 kN, 15 kN, 20 kN, and 40 kN with X-axis are 30°, 60°, 90° and 120° respectively. Find the magnitude and direction of the resultant force. (8M+7M)



2. a) A simply supported beam of length 10 m, carries the uniformly distributed load and two point loads as shown in Figure. Calculate the reactions R_A and R_B.



   b) A simply supported beam of span 9 m carries a uniformly varying load from zero at end A to 900 N/m at end B. Calculate the reactions at the two ends of the support. (7M+8M)
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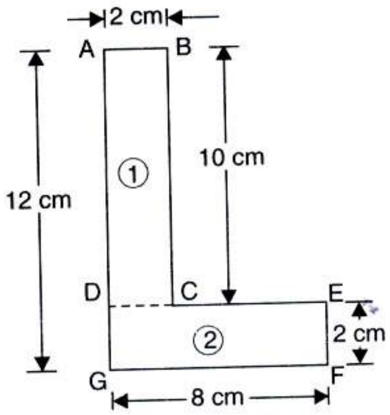
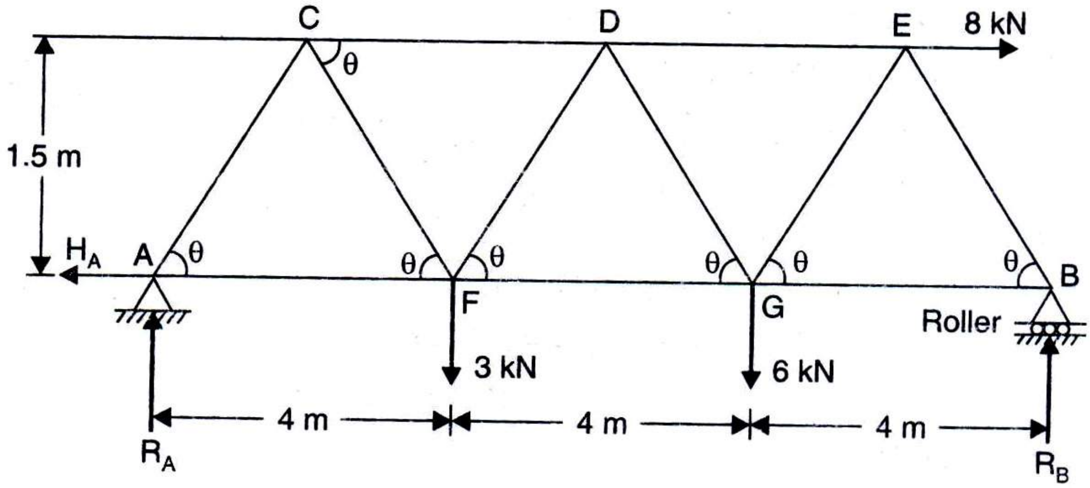
3. a) Find the center of gravity of the L-section shown in Figure.



b) Determine the centroid of the triangle of width b and height h. (7M+8M)

4. a) Determine the mass moment of inertia of the rectangular section About the X-X axis passing through the C.G. of the section.
b) Determine the mass moment of inertia of a hollow circular cylinder. (8M+7M)

5. Determine the forces in the truss shown in Fig. Which is subjected to horizontal and vertical loads. Mention the nature of forces in each case. (15M)



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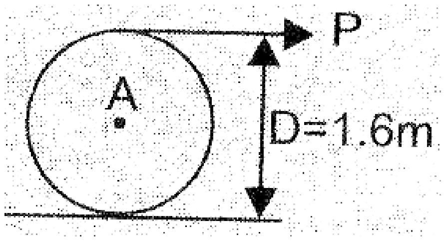
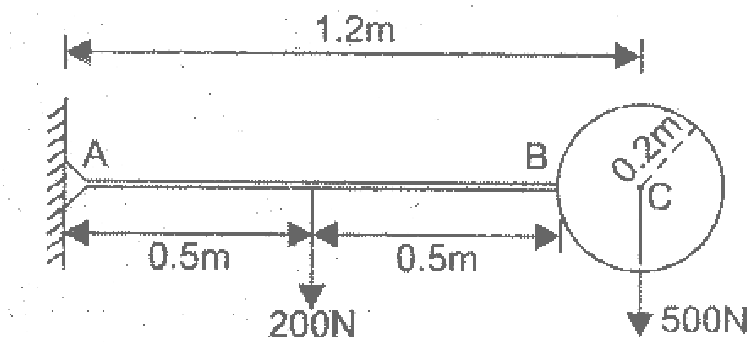
6. A solid cylinder weighing 1200 N is acted upon by a force P horizontally as shown in Fig. Determine the maximum value of P for which there will be rolling without slipping. If P= 1000 N, determine the acceleration of the mass centre and the angular acceleration, given that the co-efficient of static friction $\mu_s = 0.2$. and the co-efficient of kinetic friction $\mu_k = 0.15$. (15M)



7. A cylinder weighing 500 N is welded at a 1m long uniform bar which weighs 200 N as shown in Fig. Determine the angular velocity when the cylinder comes to lowest position. Determine the angular acceleration also. Use work energy method. Assume the system is released from horizontal rest position. (15M)



8. a) A pull of 20 N, inclined at 25° to the horizontal plane, is required just to move a body placed on a rough horizontal plane. But the required to move the body is 25 N. If the push is inclined at 25° to the horizontal, find the weight of the body and co-efficient of friction.
   b) A Uniform ladder of weight 850 N and of length 6 m rests on a horizontal ground and leans against a smooth vertical wall. The angle made by the ladder with the horizontal is 65°. When a man of weight 750N stands on the ladder at a distance of 4m from the top of the ladder, the ladder is at the point of sliding. Determine the co-efficient of friction between the ladder and the floor. (8M+7M)

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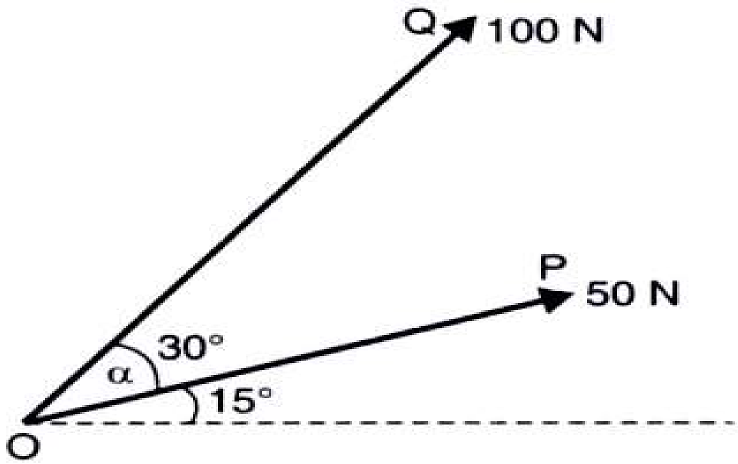
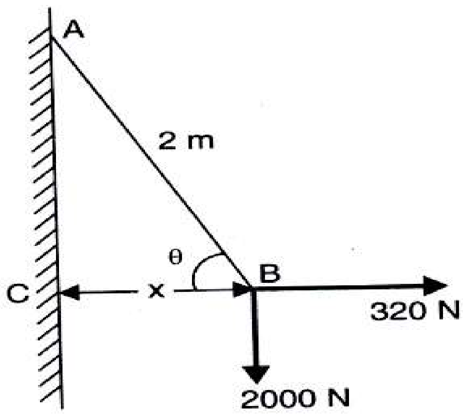
1. a) Two forces are acting at a point O as shown in Figure. Determine the resultant in magnitude and direction.



b) The resultant of two concurrent forces is 1500 N and the angle between the forces is 90°. The resultant makes an angle of 36° with one of the force. Find the magnitude of each force.
(7M+8M)

2. a) State and prove Lami's Theorem.
b) A body weighing 2000 N is suspended with a chain AB 2 m long. It is Pulled by a horizontal force of 320 N as shown in Figure. Find the force in the chain and the internal displacement (i.e., x) of the body. (6M+9M)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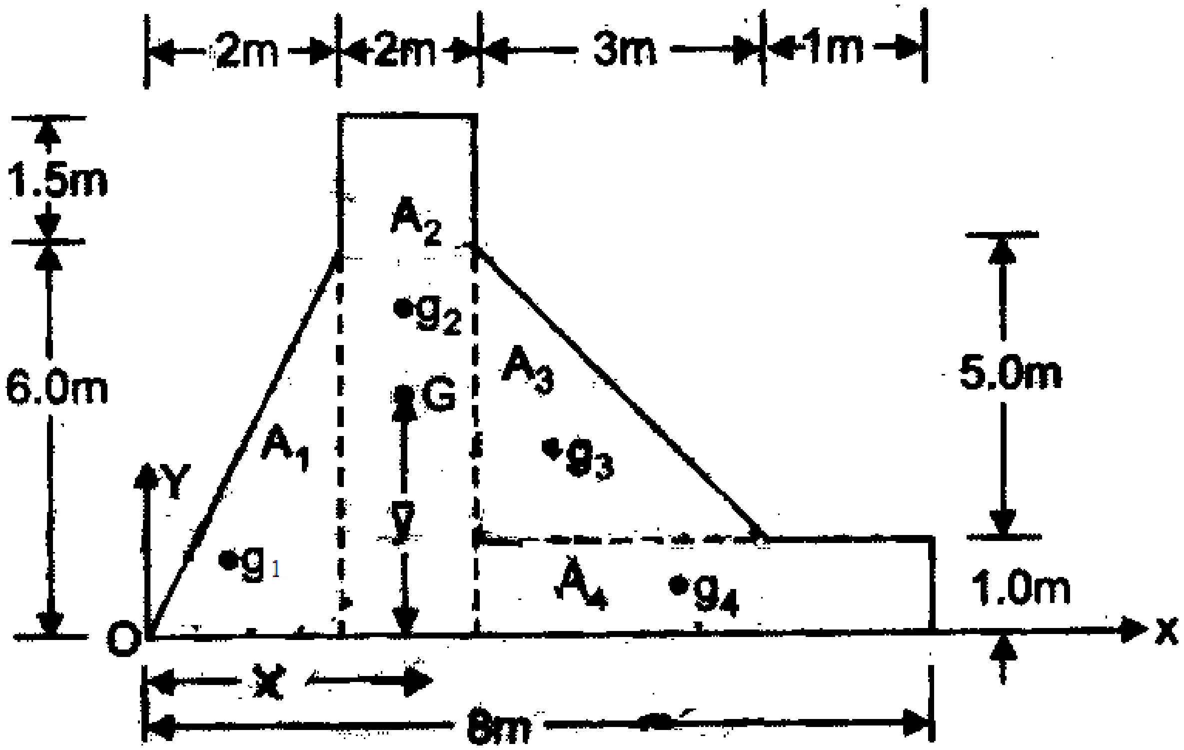
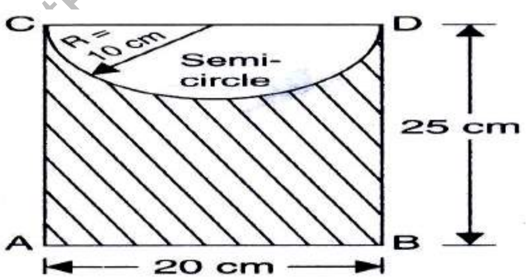
Code No: R21031 **R10** SET - 3

3. a) Locate the center of gravity of the right circular cone of base radius r and height h.
   b) Determine the centroid of the section of the concrete dam shown in Figure. (7M+8M)



4. a) State and Prove area moment of inertia perpendicular axis theorem.
   b) Determine the moment of inertia of the shaded area shown in Figure. About edge AB. (6M+9M)



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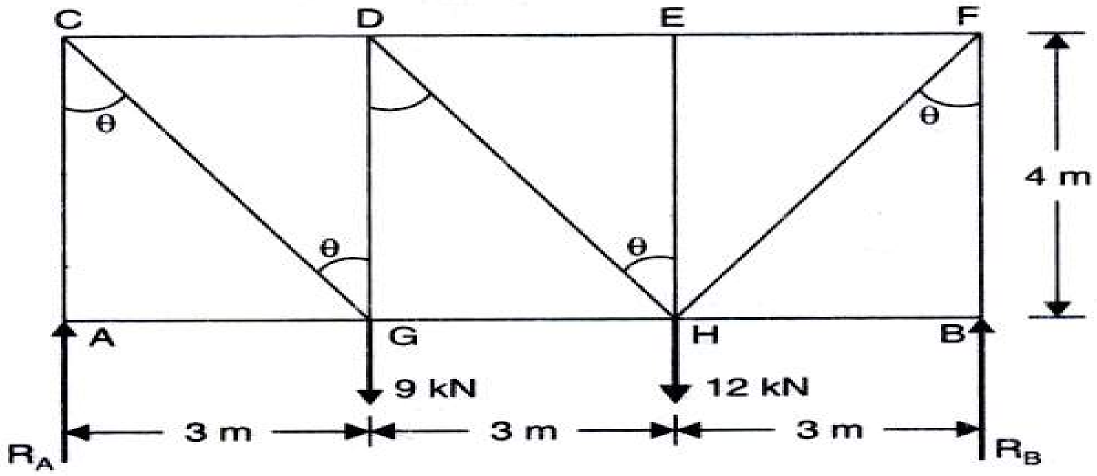
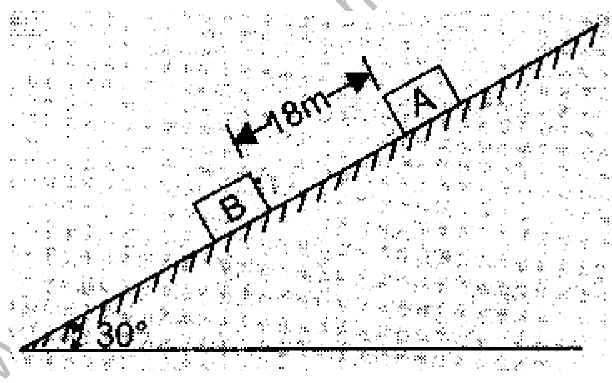
5. A truss of span 9 m is loaded as shown in Fig. Find the Reactions and the forces in the members of the truss. (15M)



6. Two blocks A and B are released from rest on a 30°, when they are 18m apart as shown in Fig. The co-efficient of friction under the upper block A is 0.2 and that under the lower block B is 0.4. In what time block A reaches block B? After they touch and move as a single unit, what will be the contact force between them? Weights of the blocks A and B are 100 N and 80 N respectively. (15M)



7. Determine the tension in the strings and the velocity of 1500 N block shown in Fig. 5 seconds after starting from (i) rest (ii) starting with a downward velocity of 3 m/s. Assume pulleys as weightless and frictionless pulleys. (15M)

8. a) A cord connects two bodies of weights 300 N and 800 N. The two bodies are placed on an inclined plane and cord is parallel to the inclined plane. The co-efficient of friction for the weight of 400 N is 0.15 and that for 800 N is 0.4. Determine the inclination of the plane to the horizontal and the tension in the cord when the motion is about to take place, down the inclined plane. The body weighing 400 N is below the body weighing 800 N.

   b) A screw-jack is used to lift a load of 3 kN. The screw of the screw-jack is square threaded with two threads to1.2cm. If the co-efficient of friction between the nut and the screw is 0.09 and the outer diameter of the screw is 6 cm, find the force required at the end of the handle of length 60 cm to lift the load. (8M+7M)

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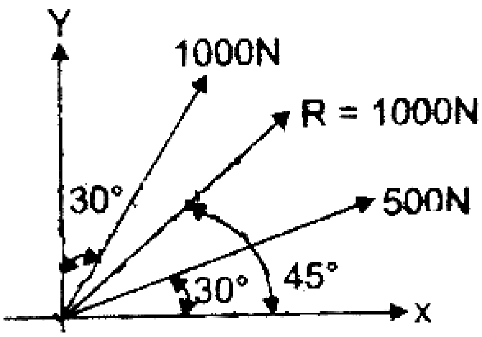
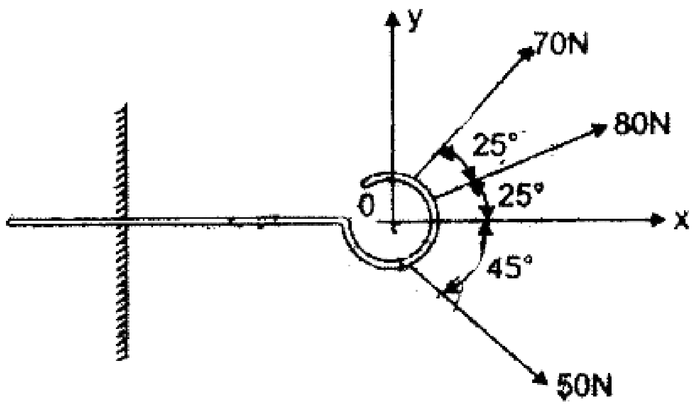
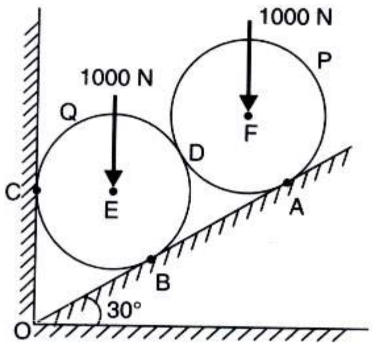
1. a) Two forces acting on a body are 500 N and 1000 N as shown in Fig. Determine the third force F such that the resultant of all the three forces is 1000 N directed at 45° to x-axis.



b) Determine the resultant of three forces acting on a hook as shown in Fig. (8M+7M)



2. Two identical rollers, each of weight W = 1000 N, are supported by an inclined plane and a vertical wall as shown in Fig. Find the reactions at the points of supports A, B and C. Assume all the surfaces to be smooth. (15M)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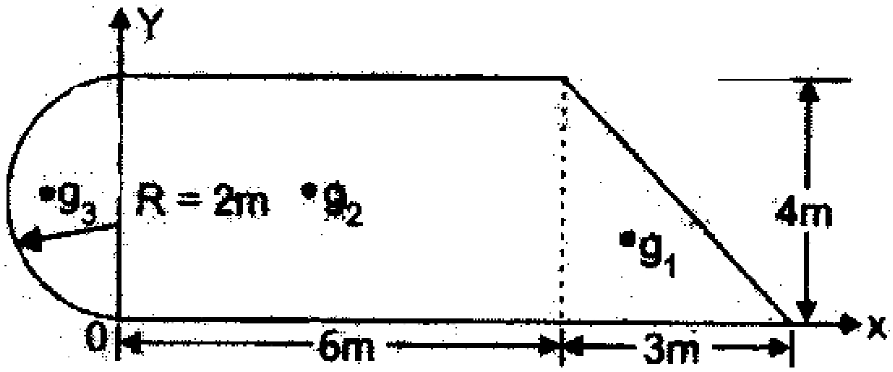
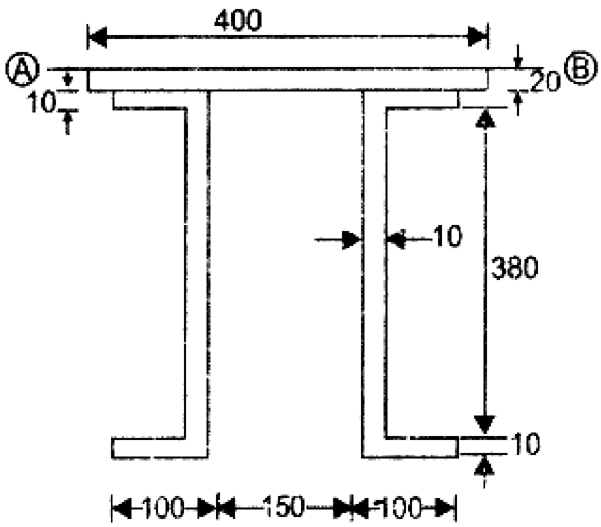
Code No: R21031 **R10** SET - 4

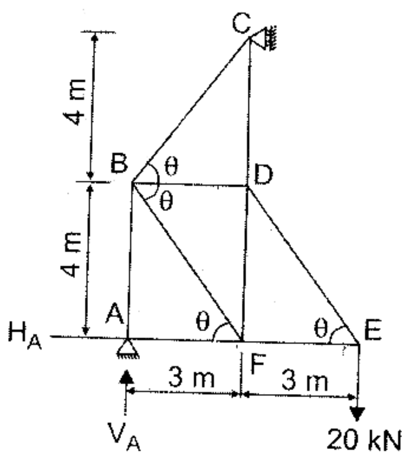
3. a) Determine the center of gravity of a solid hemisphere of radius r from its diametral axis.
   b) Determine the centroid of the area shown in Fig. With respect to the axis shown. (7M+8M)



4. a) Find the mass moment of inertia of the solid cone of height h and base radius R about its axis of rotation.
   b) Determine the moment of inertia of the built up section shown in the Fig. About an axis AB passing through the top most fiber of the section as shown. (9M+6M)

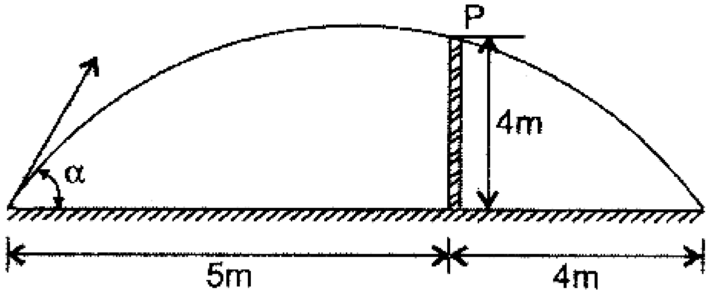


5. Analyse the truss shown in Figure. (15M)



Code No: R21031 **R10** SET - 4

6. a) What is instantaneous axis of rotation. And find the angle of projection, when a body is projected at an angle such that its horizontal range is 3 times the maximum height.
   b) Find the least initial velocity with which a projectile is to be projected so that it clears a wall of 4 m height located at a distance of 5 m, and strike the ground at a distance 4 m beyond the wall as shown in Fig. The point of projection is at the same level as the foot of the wall. (7M+8M)



7. A flywheel weighing 50 kN and having radius of gyration 1m loses its speed from 400 rpm to 280 rpm in 2 minutes. Calculate (15M)
   i) The retarding torque acting on it.
   ii) Change in its kinetic energy during the above period.

8. a) What about be the value of the angle θ in Fig. So that the motion of the 90 N block impends down the plane? The co-efficient of friction μ for all the surfaces is 1/3.
   b) A body of weight 450 N is pulled up along an inclined plane having inclination 30° to the horizontal at a steady speed. Find the force required if the co-efficient of the friction between the body and the plane is 0.25 and force is applied parallel to the inclined plane. If the distance travelled by the body is 10 m along the plane, find the work done on the body. (8M+7M)