

Code No: 09A1BS05

R09**Set No. 2**

I B.Tech Examinations, December 2010

ENGINEERING MECHANICS

Common to CE, ME, CHEM, MECT, MEP, AE, AME, MMT

Time: 3 hours

Max Marks: 75

Answer any FIVE Questions

All Questions carry equal marks

- (a) Write the equations of equilibrium when the body is in space.
- (b) A vessel is pulled by two ropes as shown in figure 1. Obtain the resultant force applied on the vessel if the tension on each rope is 1000 N. [5+10]

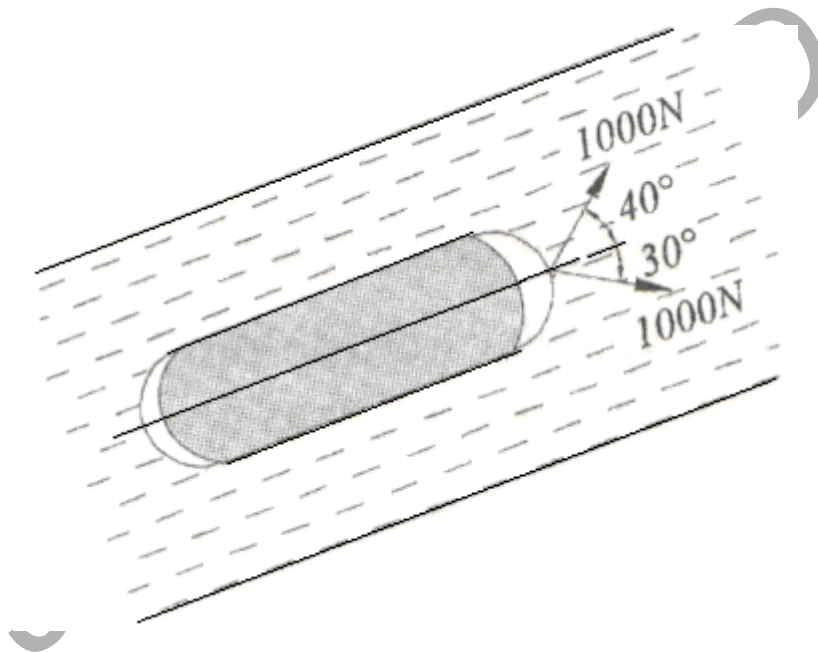


Figure 1:

- A beam is subjected to following systems of loads shown in the below figure 2. Find the resultant and mark its line of action with respect to A. [15]

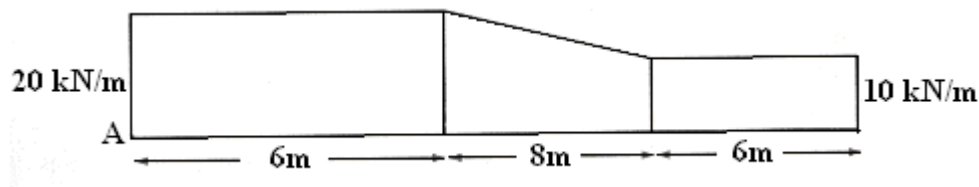


Figure 2:

- Two rods are connected to form a double pendulum as shown in the figure 3. If the weight of each rod is W and length L and if they are held in position by a horizontal force P , determine equilibrium position as defined by angle θ_1 and θ_2 . [15]

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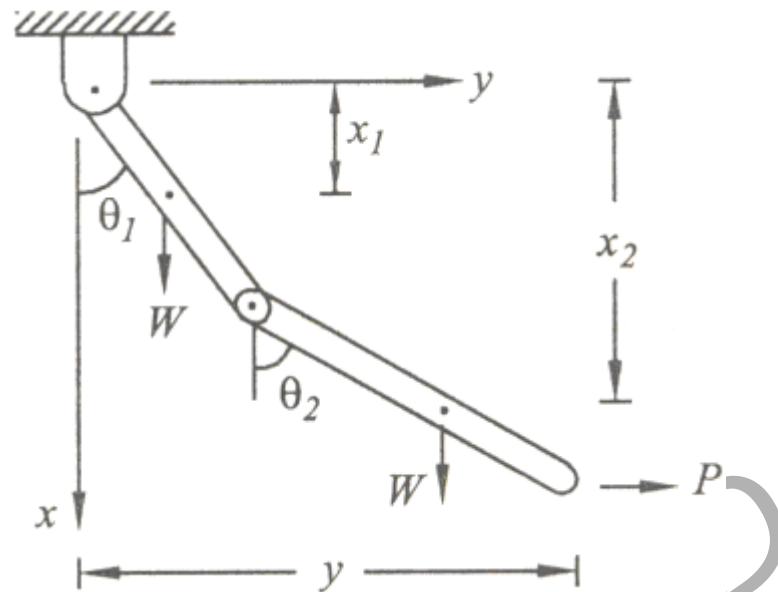
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Figure 3:

4. Find the forces in the BD, CE and FG members of the truss shown in figure 4 using method of sections. [15]

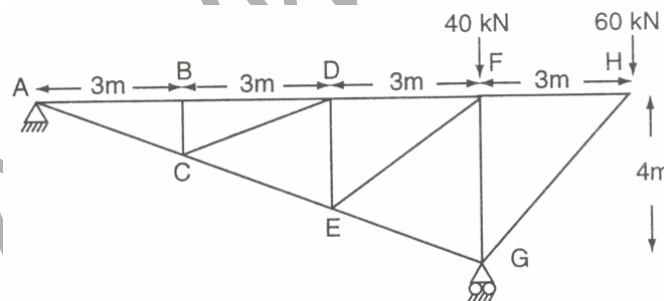


Figure 4:

5. Find the moment of inertia of thin plates about AA - axis shown in the figure 5. Assume $\rho = 7850 \text{ kg/m}^3$ and thickness 5 mm. All dimensions are in cm. [15]
6. A gear is accelerated from rest to a speed of 1800 rpm and then immediately decelerated to a stop. If the total elapsed time is 12 seconds, then determine total no. of revolutions of the gear. Assume both acceleration and decelerations are constant but not necessarily of the same magnitude. [15]
7. Three bars lying in one plane hinged at their ends are shown in figure 6. They are subjected to force P and Q applied at B and C. If $P = 100 \text{ N}$, determine the value of force a necessary to keep the system of bars in equilibrium. [15]

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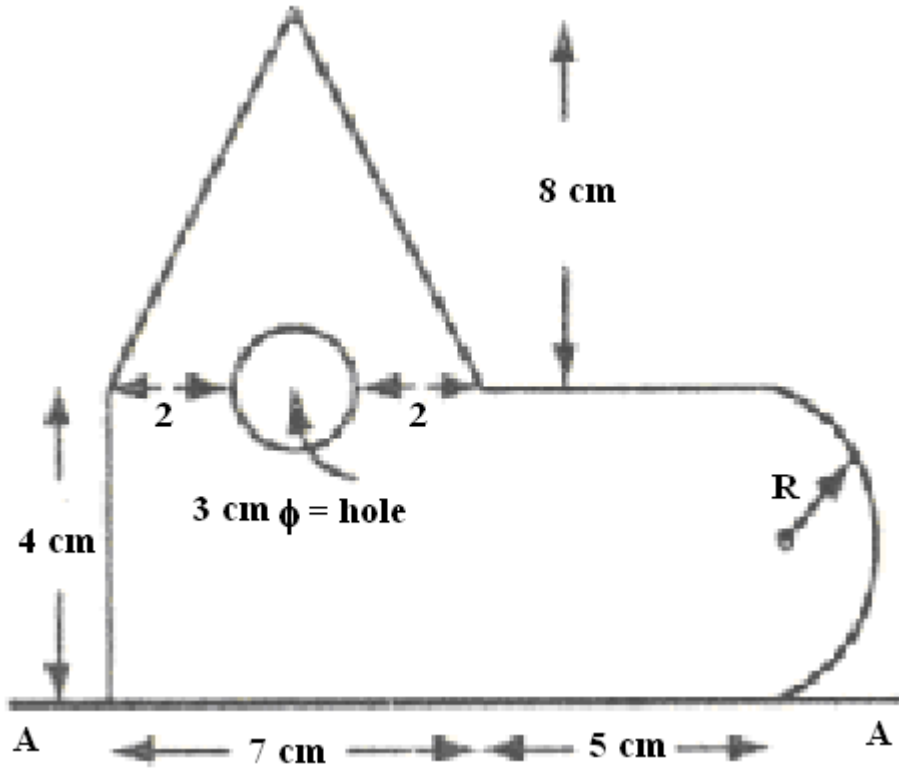


Figure 5:

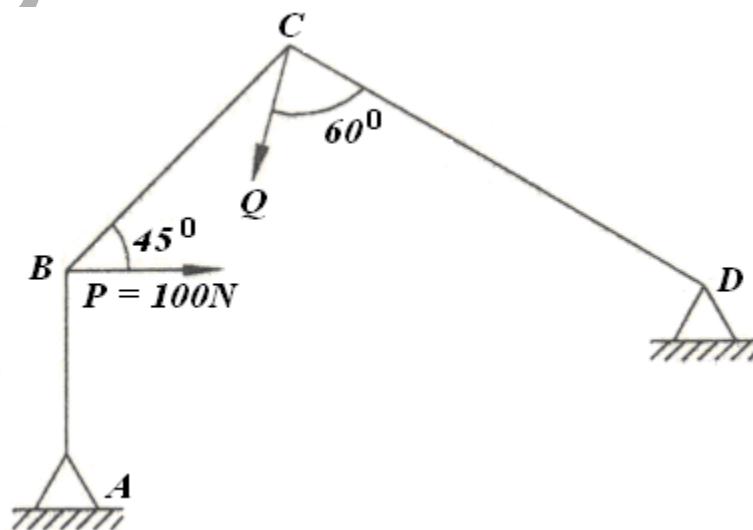


Figure 6:

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8. A horizontal force of 480N is used to push a 150 kg box by 4.00m on a rough horizontal surface. If the box moves at a constant speed, find:

- (a) Work done by 470 N force.
- (b) Energy lost due to friction and
- (c) Coefficient of kinetic friction.

[15]

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1. Determine the resultant of the three forces acting on the dam shown in the figure 1 and locate its intersection with the base AB. For good design, the intersection should occur within the middle third of the base. Does it. [15]

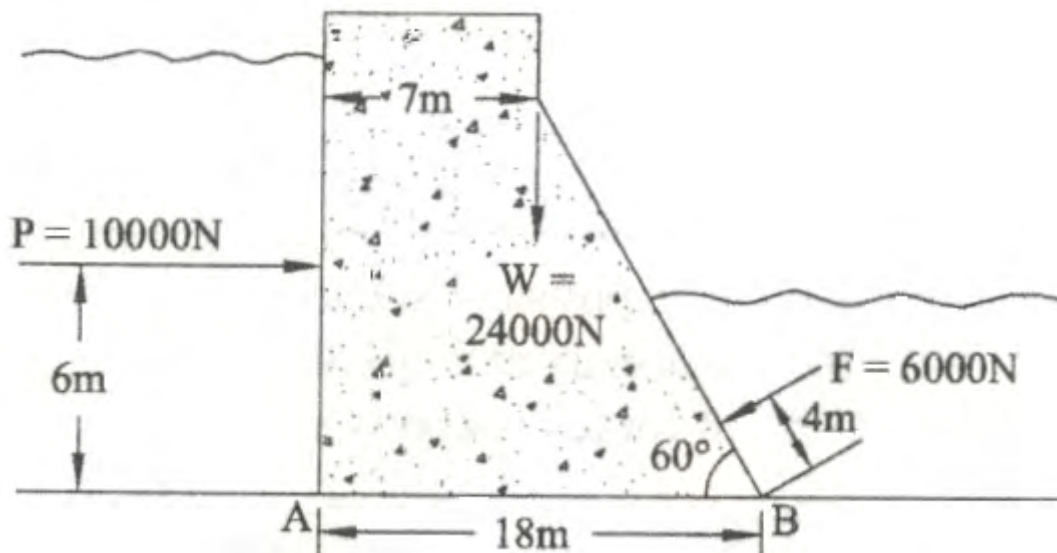


Figure 1:

2. Calculate the magnitude of the force supported by the pin at B for the bell crank loaded and supported as shown in figure 2. [15]
3. Referring to the figure 3, Determine equilibrium positions as defined by angles θ_1 and θ_2 . [15]
4. Locate the centroid of a shaded area as shown in the below figure 4. [15]
5. Find the moment of the inertia of the section shown in the figure 5 about horizontal and vertical centroidal axes. All dimension in cm $R = 8$. [15]
6. A 25 kg package slides at a speed of 12 m/s from point A on sloping board. Determine the speed at point B if the coefficient of kinetic friction is 0.3 as shown in the figure 6. [15]
7. Determine zero force member on the frame shown in fig 7. [15]

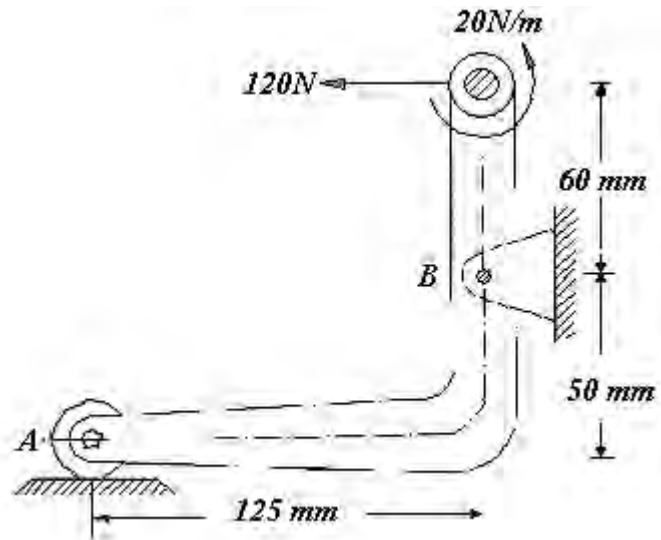


Figure 2:

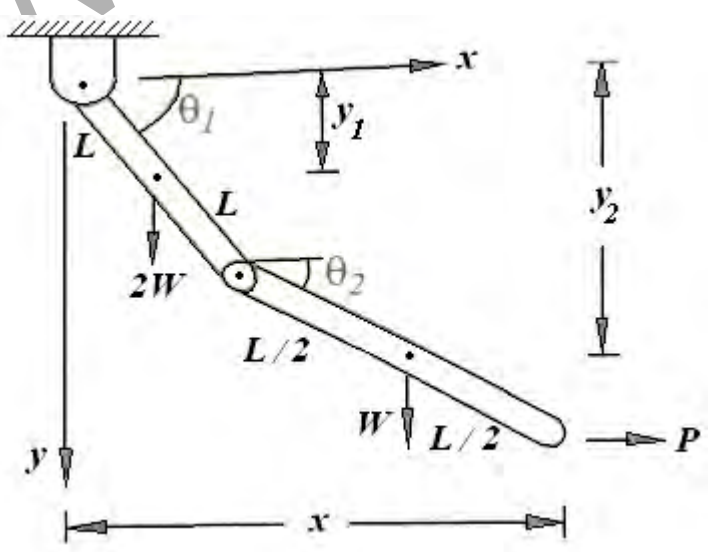


Figure 3:

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Set No. 4

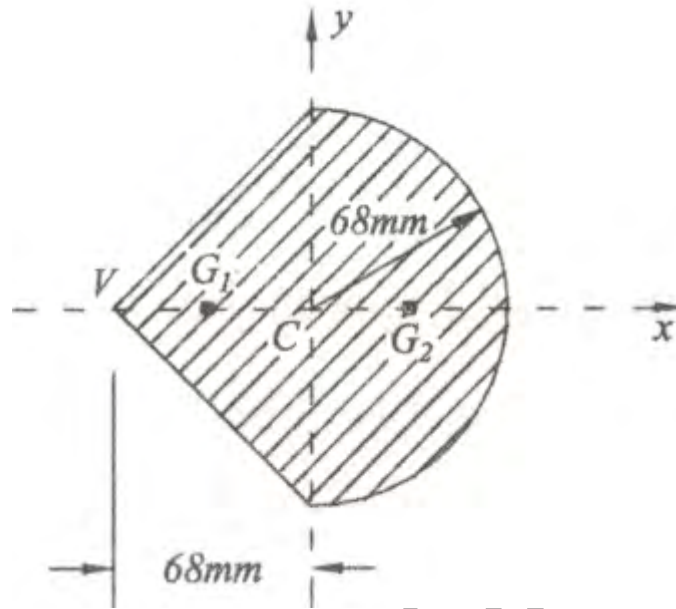


Figure 4:

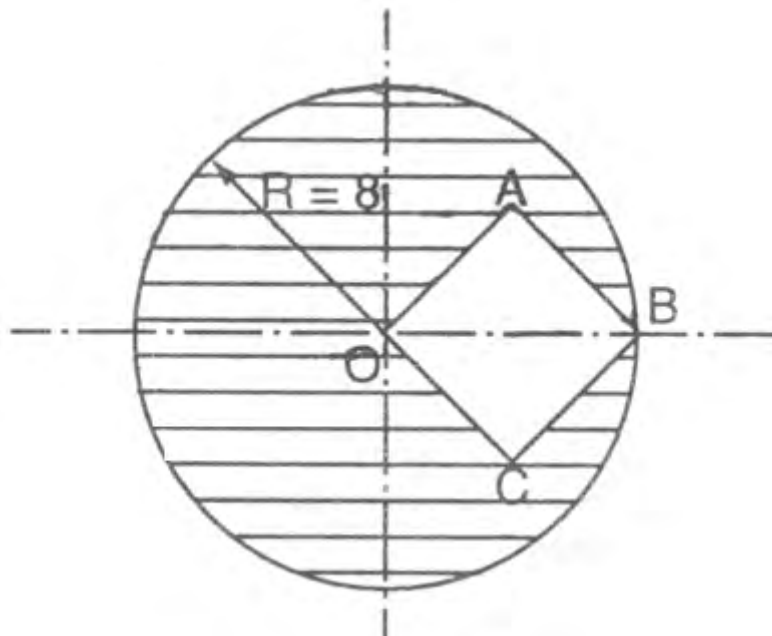


Figure 5:

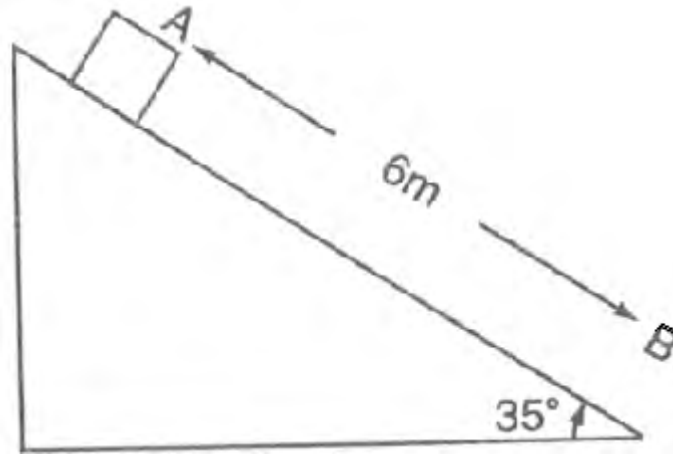


Figure 6:

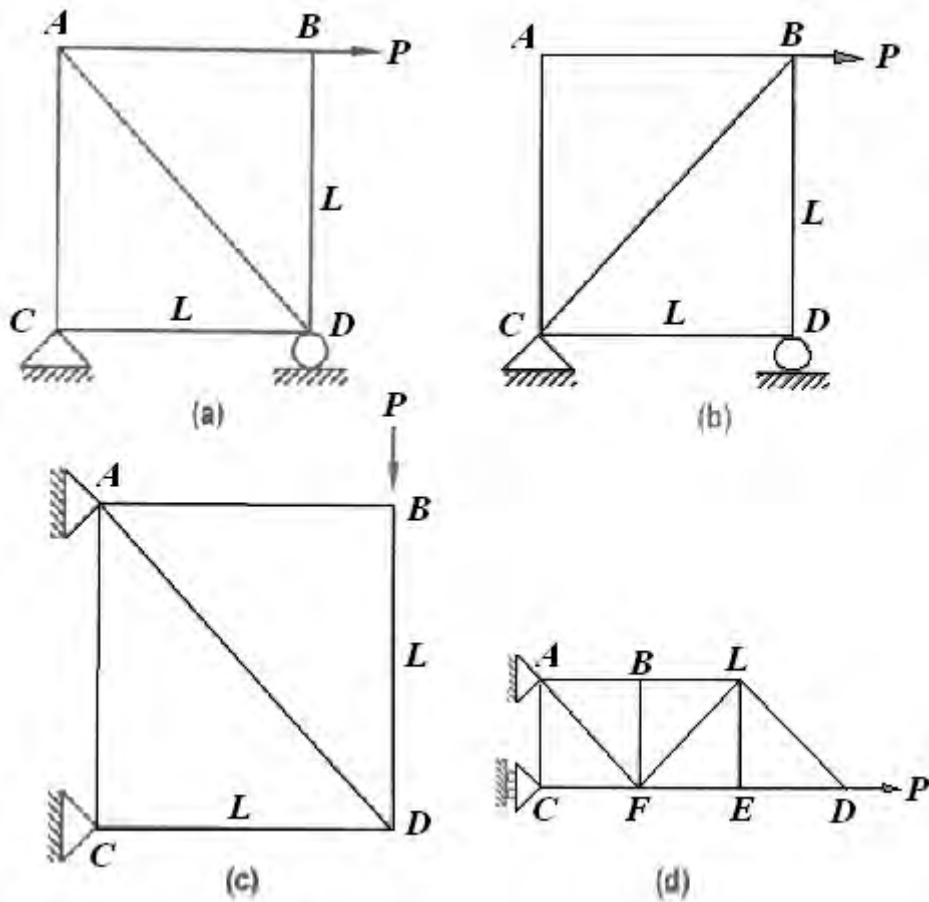


Figure 7:

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Set No. 4

8. The angle of rotation of a body is given as a function of time by the equation $\theta = \theta_0 + bt + ct^2$. Find the general expressions for the angular velocity and angular acceleration of the body. Determine also the values of the constants b and c if the initial angular velocity is 2π rad per sec. and sec later it is 4π rad per sec. [15]

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R09**Set No. 1**

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1. Find the moment of inertia about 'AA' and 'BB' axis for the areas shown in figure 1. [15]

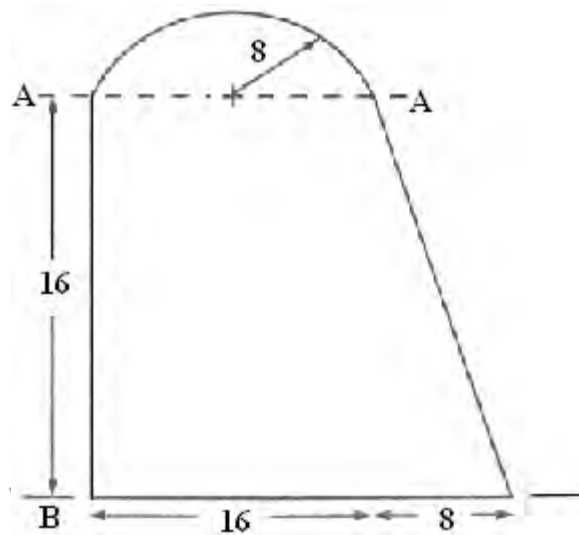


Figure 1:

2. Two blocks A and B of masses $m_A = 280\text{kg}$ and $m_B = 420\text{kg}$ are joined by an inextensible cable as shown in figure 2. Assume that the pulley is frictionless and $\mu = 0.30$ between block 'A' and the surface. The system is initially at rest. Determine the velocity of block after it has moved 3.5m. [15]
3. Calculate the magnitude of the clockwise couple M required to turn the 50 kg cylinder in the supporting block shown in figure 3. The coefficient of kinetic friction is 0.30. [15]
4. Find the supporting force at A in the figure 4 by the method of virtual work. [15]
5. Determine the volume and surface area of the solid shown in the below figure 5. [15]
6. (a) P is a force directed from A(2, 1, -4) to B(4, 4, 1). Find moment of P about origin and magnitude of this moment.
- (b) A force $F = 4i+3j+2k$ is applied at a point whose position vector from O is given by $r = i+2j+3k$. What is the resulting moment about O. [7+8]

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Set No. 1

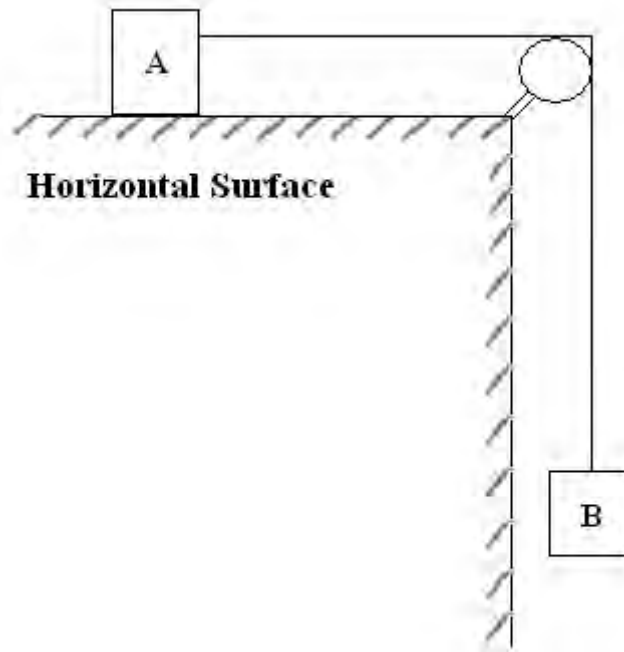


Figure 2:

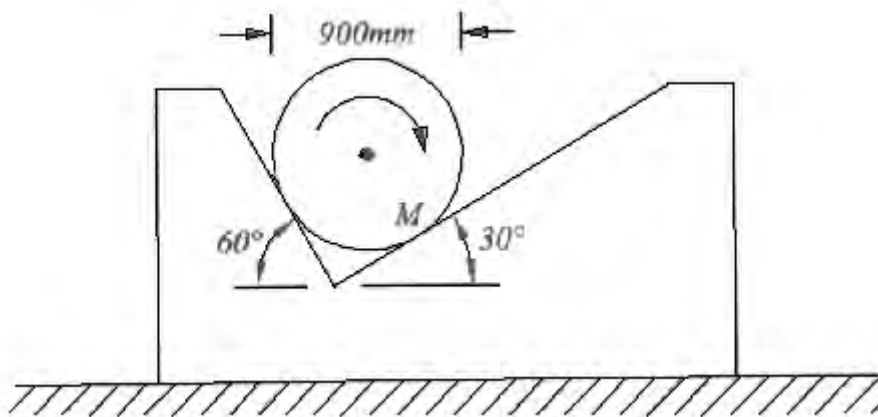


Figure 3:

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Set No. 1

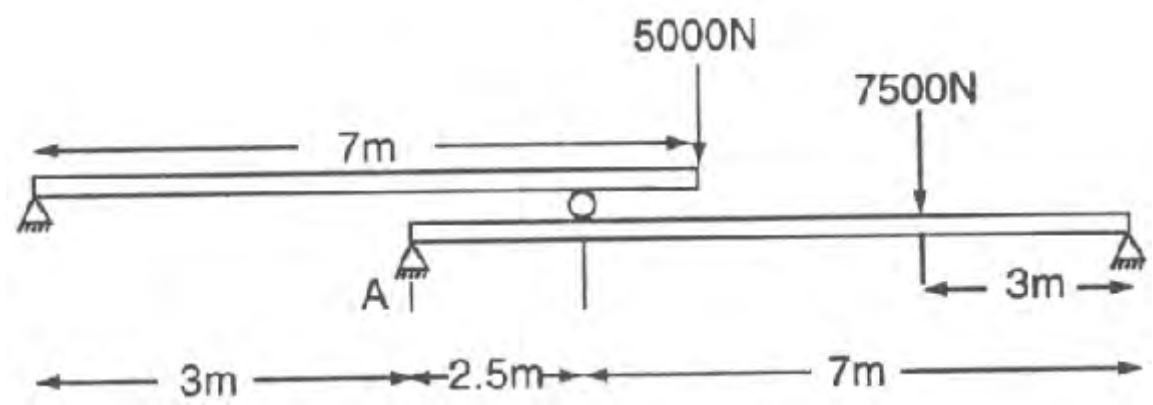


Figure 4:

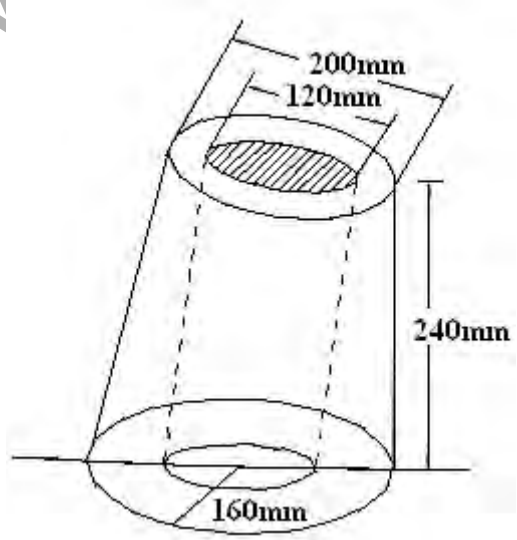


Figure 5:

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Set No. 1

7. (a) Prove that the path of a projectile is a parabola.
(b) Distinguish between normal and tangential components of acceleration. [7+8]
8. Determine zero force member as shown in figure 6. [15]

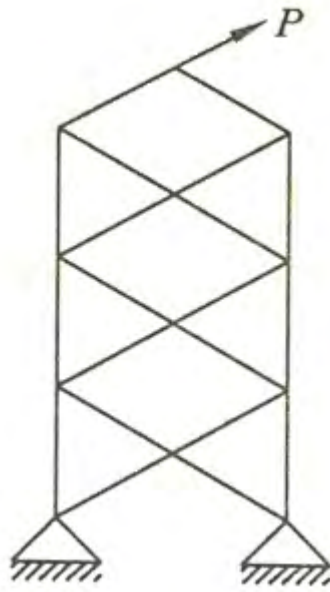


Figure 6:

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1. Find the moment of inertia about 'AA' and 'BB' axis for the areas shown in figure 1. [15]

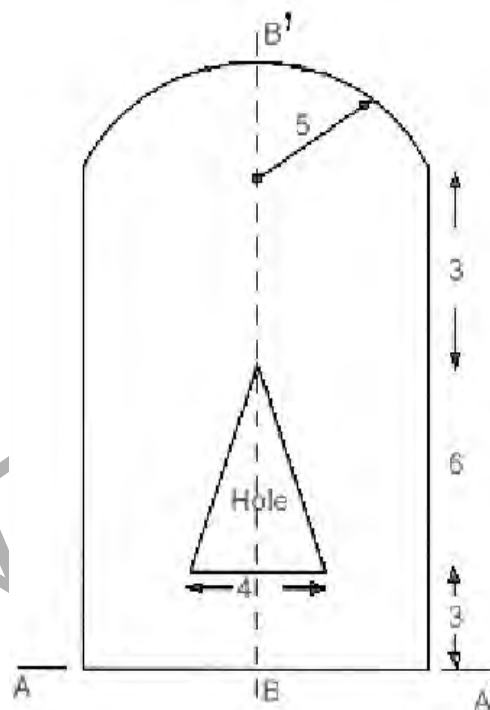


Figure 1:

2. A Block of weight 12 N falls at a distance of 0.75 m on top of the spring. Determine the spring constant if it is compressed by 150mm to bring the weight momentarily to rest. [15]
3. A fighter plane is directly over an anti-aircraft gun at time $t=0$ and at an altitude of 1800m. The plane is moving with a speed of 600 km/hour. A shell is fired at time $t=0$ in an attempt to hit the plane. If the muzzle velocity is 1000 m/sec, find out the angle at which the gun should be held. [15]
4. What is the moment of force P and F about points A, B, C as shown in figure 2? [15]

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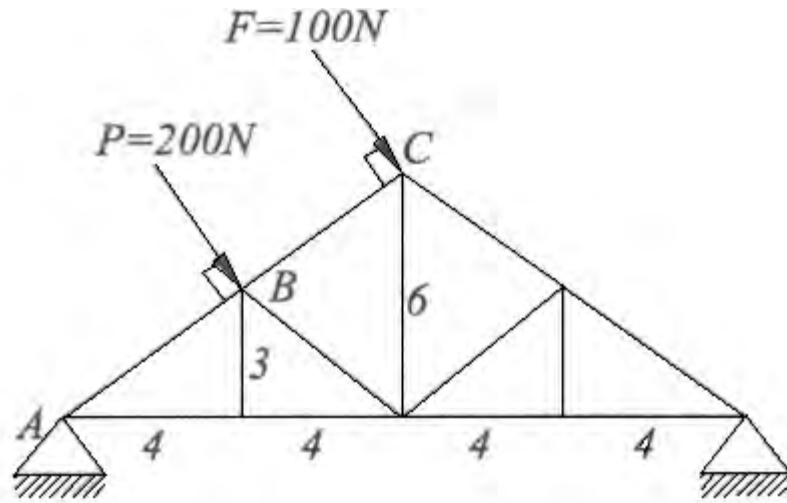
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Figure 2:

5. Two beams AC and CD of length 9m and 10m respectively are hinged at C. These are supported on rollers at the left and right ends (A and D). A hinged support is provided at B, 6m from A. Using the principle of virtual work, determine the reactions at the hinge C and at support B when a load of 600 N acts at a point 5 m from D. [15]
6. (a) Find the centroid of the plane lamina shown in figure 3a.

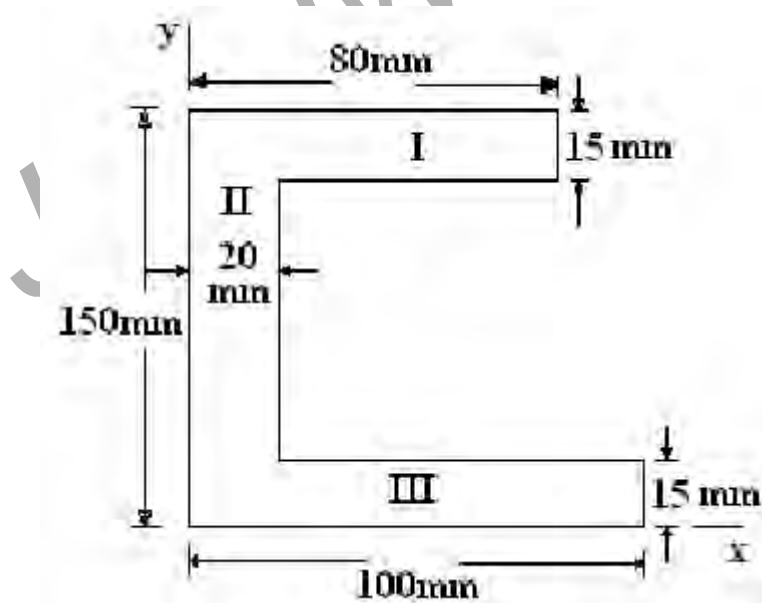


Figure 3a:

- (b) Find the centroid of the plane lamina shown in figure 3b. [7+8]
7. Find the forces in the AB, CD & CE members of the truss shown in figure 4 using method of sections. [15]
8. A load of 60kN is to be resisted by means of a shear leg arrangement as shown in figure 5. Determine forces in legs AB, AC and rope AD. [15]

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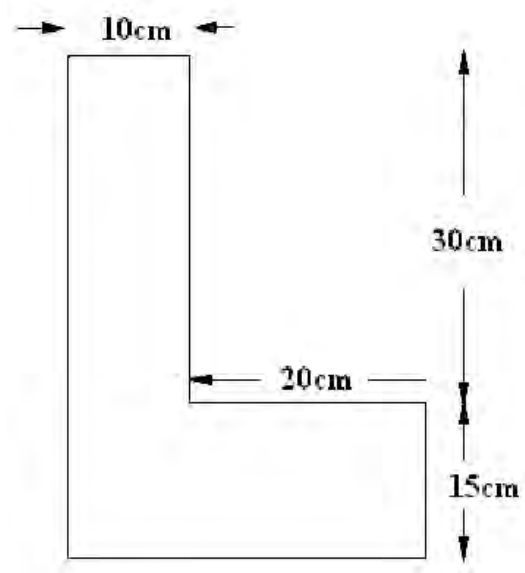


Figure 3b:

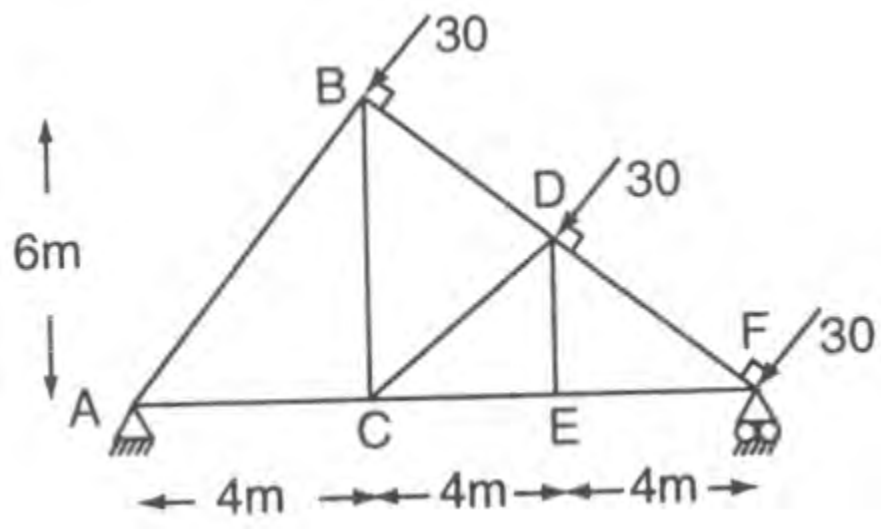


Figure 4:

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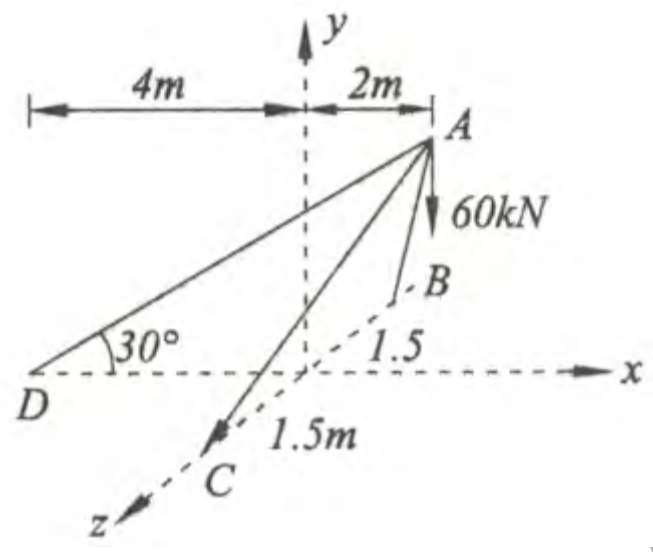


Figure 5:

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