

Time: 3 Hours

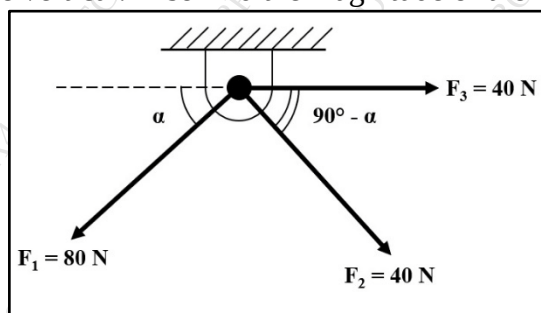
Max Marks: 80

1. Question No. 1 is compulsory.
2. Attempt **Any Three** questions from the remaining **Five** questions.
3. Assume suitable data wherever necessary and **clearly mention** the same.
4. Take $g = 9.81 \text{ m/s}^2$.

Q. 1 Answer any FIVE questions**20**

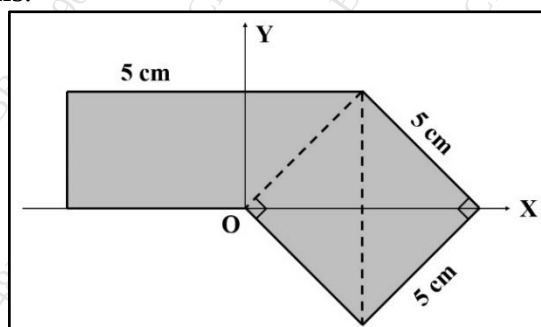
- A Three Coplanar Forces act at a point on a bracket as shown in figure. Determine the value of angle ' α ' such that the resultant of the given system will be vertical. Also find the magnitude of the resultant.

4



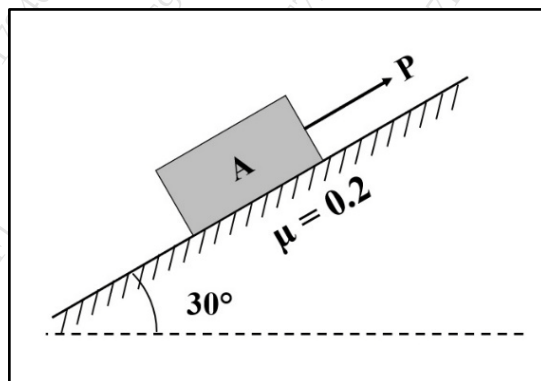
- B Locate the centroid of the shaded region with reference to the coordinate axis.

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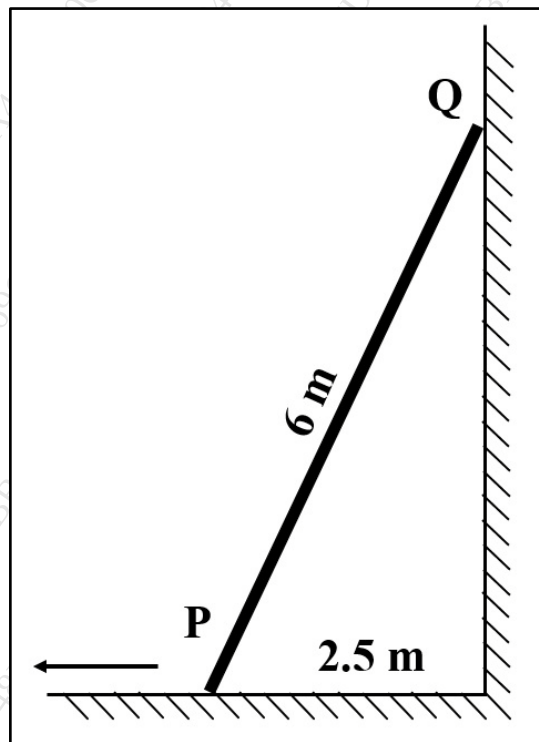


- C Block 'A' of weight 1000N is kept on a rough inclined surface of 30° . Find the upper limit of force 'P' that disturbs the equilibrium. Take $\mu = 0.2$.

4



- D A car starts from rest and moves in a straight line such that for a short time its velocity is defined by the equation $V = (9t^2 + 2t)$ m/s, where t = time in seconds. Determine the position and acceleration of the car at $t = 3$ seconds. 4
- E A block of 50 kg mass is pushed down a 15° sloping surface with an initial velocity of 25 m/s. Determine time and distance covered by the block before it comes to rest on the slope. Take $\mu_k = 0.4$. 4
- F A ladder PQ of length 6 m rests on a horizontal floor at P and leans against a vertical wall at Q. If the lower end P is pulled away from the wall with a constant velocity 5 m/s, what is the angular velocity of the ladder at the instant when P is 2.5 m from the wall. Also calculate the sliding velocity of Q against the wall. 4



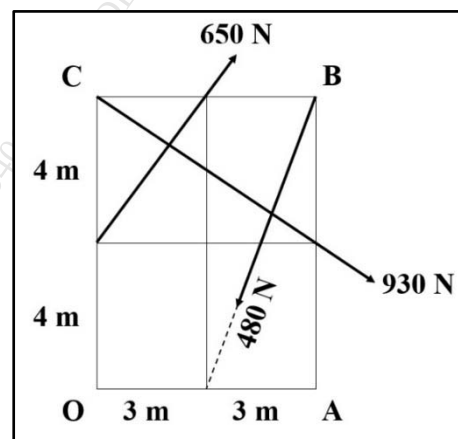
Q. 2

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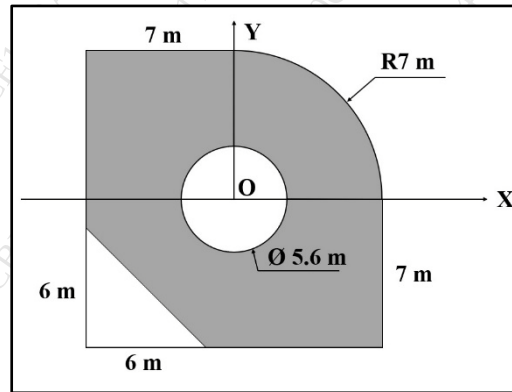
- A Determine the resultant of the force system acting on a rectangular plate as shown in the diagram. Locate its intercepts on OA and OC sides of the plate.

Take OA = 6 m and OC = 8 m.

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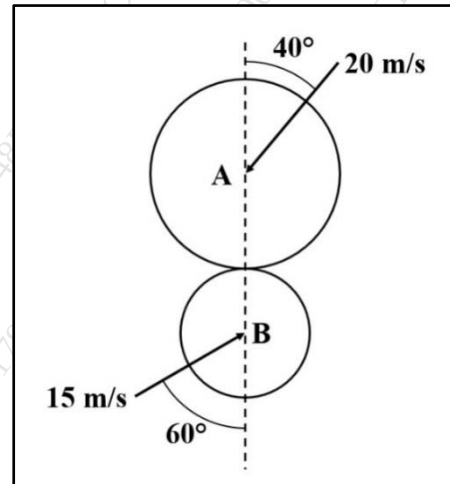


- B Locate the centroid of the shaded region with reference to the coordinate axis.



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- C Two smooth balls A (5kg) and B (3kg) strike each other with velocities at angles as shown in the figure on right. If $e = 0.7$, find the velocities of the balls after the impact.



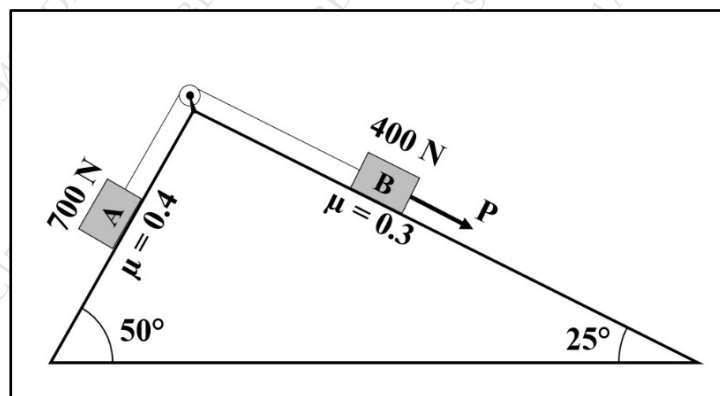
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Q. 3

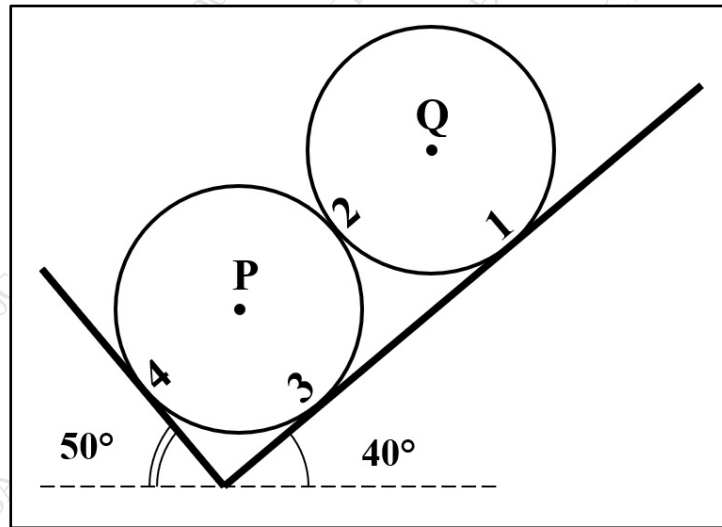
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- A Determine the magnitude of the force 'P', that will cause the motion of the system to impend.

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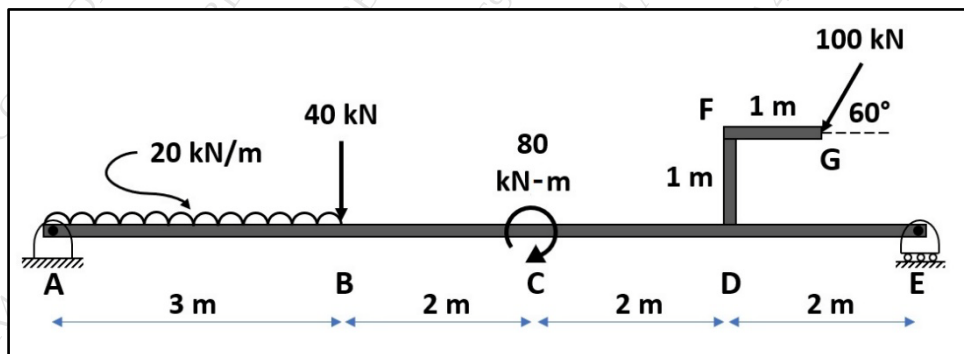
- B Two identical homogenous spheres P and Q of weight 3000 N and diameter 1m are resting against an inclined L-bracket as shown. Determine the contact point reactions at points 1, 2, 3, 4 assuming smooth surfaces. 6



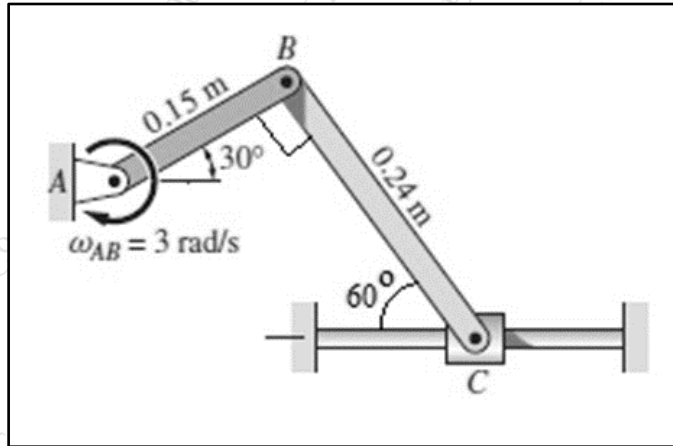
- C A point moves along a curved path $y = x^2/3$ with a constant speed of 8 m/s. Determine the x and y components of the velocity, the radius of curvature and the total acceleration at the instant when $x = 3$ m. 6

Q. 4

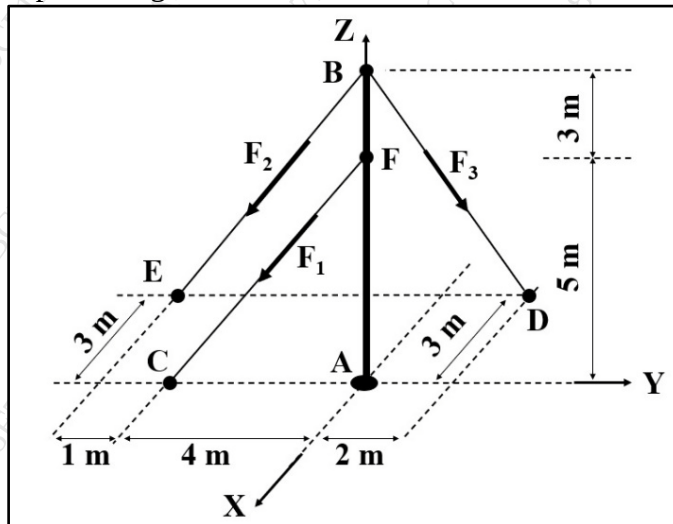
- A Find the reactions at the supports A & E for the given beam shown in figure. 8



- B When the mechanism of figure is in the position shown, the angular velocity of bar AB is 3 rad/s clockwise. Using instantaneous center of rotation, calculate the angular velocity of bar BC and the velocity of slider C for this position. 6



- C A vertical pole AB of 8 m high is held upright using three cables FC, BD and BE as shown in the diagram. If the forces passing through these cables are $F_1 = 500$ N, $F_2 = 800$ N and $F_3 = 600$ N respectively, find the resultant force and couple at origin A. 6



Q. 5

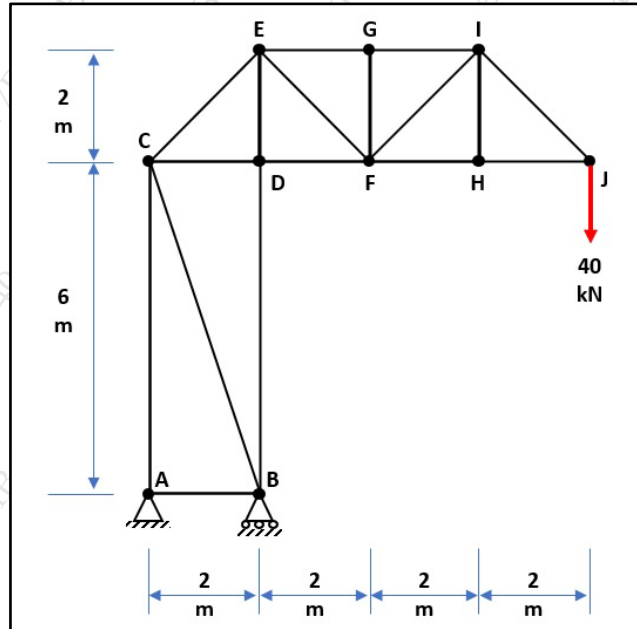
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A

For the pin jointed truss loaded as shown, find:

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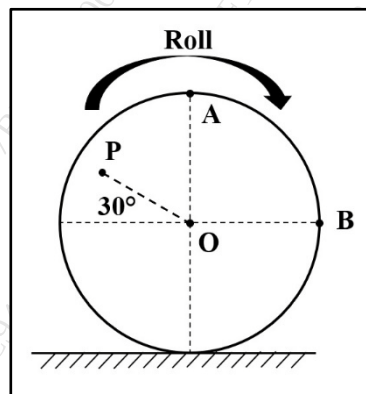
- Support reactions at A and B
- Identify and justify the zero force members in the truss system
- Forces in members EC, ED and DF by method of sections



B

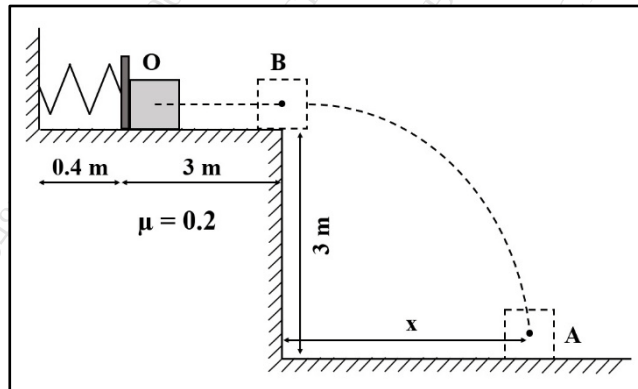
A wheel of diameter 1.6 m is rolling clockwise along a straight path without slipping. Determine the velocity of points A, B and P. Take $OP = 600$ mm and $V_o = 4$ m/s to the right.

6



- C A block of mass 80 kg is compressed against a spring as shown. Determine the how far the distance from point B will the block strike the floor. Take free length of the spring as 0.9 m and the spring stiffness $k = 40 \times 10^2 \text{ N/m}$.

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Q. 6 All questions are compulsory

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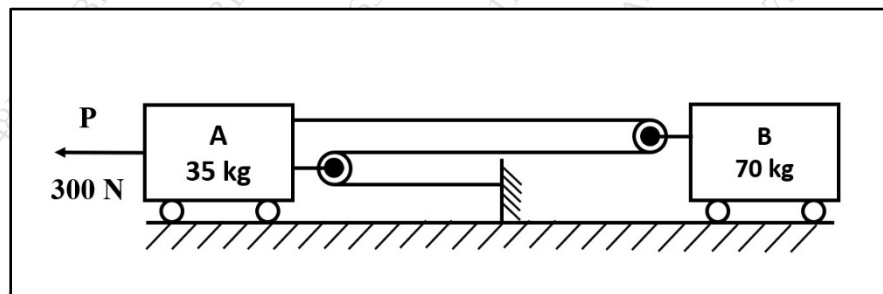
- A A ball is projected from top of a tower 110 m high with velocity 100 m/s and angle 25° to horizontal. Neglecting air resistance, determine:

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1. Maximum height reached by the ball above the ground
2. Horizontal distance it travels before it strikes the ground
3. Velocity with which it strikes the ground

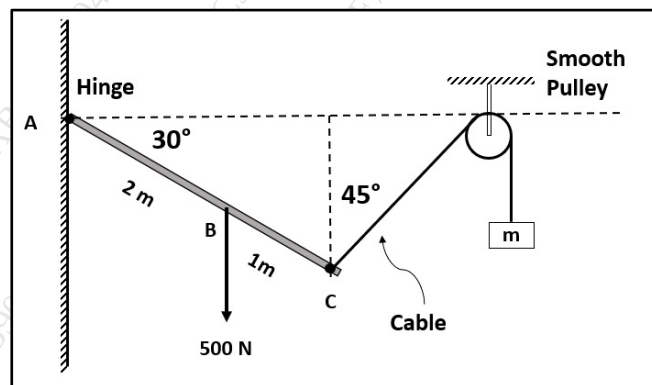
- B Determine the acceleration of A and B and the tension in the cable due to the application of 300 N force on A. Neglect the friction and masses of pulleys.

5



- C Using principle of Virtual work, determine the value of mass 'm' of the body for the equilibrium. Take AB = 2 m and BC = 1 m.

5



- D For a particle moving along a straight line, the $a - t$ graph is shown. Construct the $v - t$ and $x - t$ graphs for the same if at $t = 0$, $x = 10$ m and $v = 5$ m/s. 5

