R18

Time: 2 hours   Max. Marks: 75

Answer any five questions
All questions carry equal marks
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1.   Two spheres, A and B, are resting in a smooth through as shown in figure 1. Draw the free body diagrams of A and B showing all the forces acting on them, both in magnitude and direction. Radius of spheres A and B are 250 mm and 200 mm, respectively.   [15]
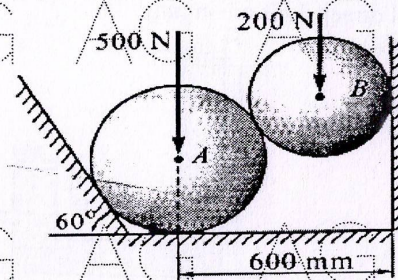

Figure: 1

2.a)   State the varignon's theorem for system of forces in plane.
   b)   A circular roller of weight 1000 N and radius 20 cm hangs by a tie rod AB = 40 cm and rests against a smooth vertical wall at C as shown in figure 2. Determine the tension in the rod and reaction at point C.   [5+10]
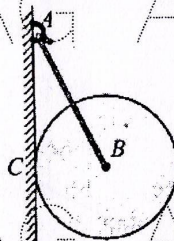

Figure: 2

3.   Two blocks A = 100 N and B = W are connected by a rod at their ends by frictionless hinges as shown in figure 3. Find the weight of block B (W) required for limiting equilibrium of the system if coefficient of friction at all sliding surfaces is 0.3.   [15]
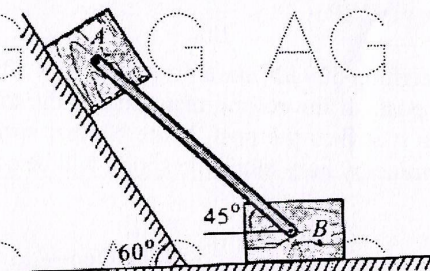

Figure: 3

4. Three plates ABC and BCDE and DEF are welded together as shown in figure 4. Circle of diameter 1.5 m is cut from the composite plate. Determine the centroid of the remaining area. [15]
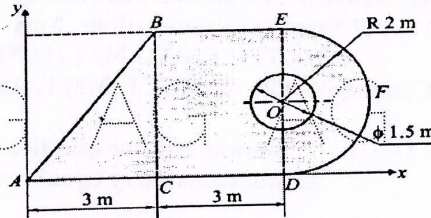

Figure: 4

5. For the given shaded area shown in figure 5. Find MI about the reference axes i.e., Ox and Oy axis. All dimensions are in mm. [15]
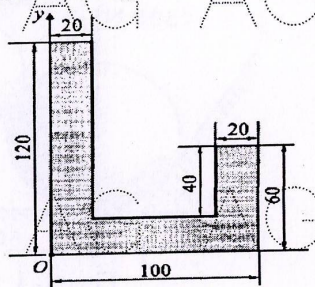

Figure: 5

6. Determine the mass moment of inertia of a quarter circular rod about x, y and z-axis as shown in figure 6. [15]
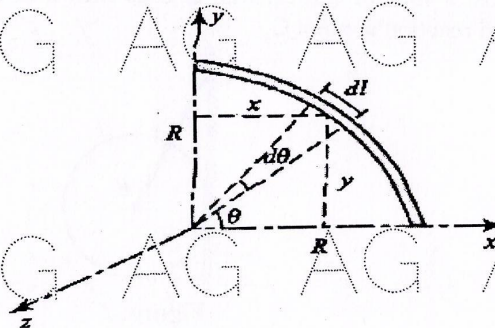

Figure: 6

7. A mass m kg is acted on by a constant force of P Newton for t seconds. In this interval of time, it moves a distance x meter and acquires a velocity V m/s. Show that, $x = Pt^2/2m = mV^2/2P$. [15]

8. A wagon weighing 500 kN starts from rest, runs 30 m down one percent grade and strikes the bumper post. If the rolling resistance of the track is 5 N/kN, find the velocity of the wagon when it strikes the post. If the bumper spring which compresses 1mm for every 15kN, determine by how much the spring will be compressed. [15]

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