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Total number of printed pages – 4

B. Tech
BE 2104

Second Semester Examination – 2013

MECHANICS

QUESTION CODE : A 439

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.

The figures in the right-hand margin indicate marks.

1. Answer the following questions :

2×10

- To turn left, the steering wheel of a car has to be rotated by applying a force of 10 N. If the radius of the wheel is 0.2 m, compute the required moment.
- Sketch the free body diagram of a ladder of weight W leaning against a wall. Both wall and floor are rough.
- Whether bending is allowed in the members of a truss ?
- What is the unit of coefficient of static friction ?
- What will be the second moment of area about the centroidal y -axis of a rectangle having width b and height h ?
- What will be the work done if the point of application of force moves in a direction normal to the force ?
- Find the reactive moment at the fixed end of a cantilever due to its self-weight.
- What quantities can be determine from a velocity-time diagram ?
- A 50N weight is suspended by a helical spring having a constant $k = 900 \text{ N/m}$. Neglecting mass of the spring, find the period t for small amplitudes of vertical vibration.

P.T.O.

- (j) For a given velocity and horizontal range, how many angles of projections are possible ?
2. (a) Two spheres weighing 120 kN and 200 kN are connected by a flexible string and rest on two mutually perpendicular planes PQ and QR as shown in Figure 1. Find tension in the string which passes freely through slots in smooth inclined planes PQ and QR. 5

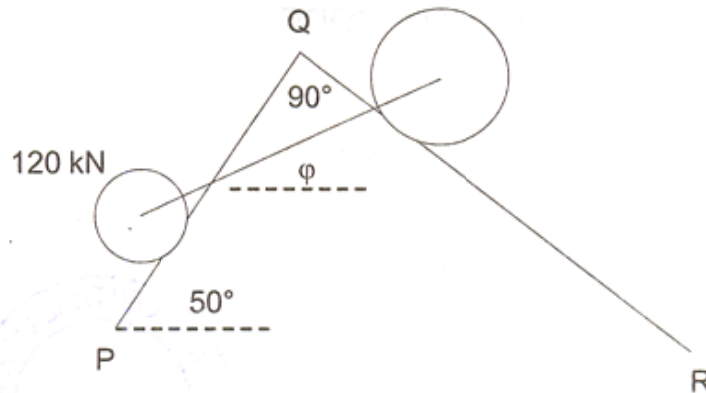


Figure 1

- (b) A simply supported beam AB of 6 m span is loaded with a uniformly varying load whose intensity varies from zero at one end to 100 kN/m at the other. Find the reactions at the supports A and B. 5
3. Find the forces in the members of the pin jointed truss loaded and supported as shown in Figure 2. All triangles shown the figure are equilateral triangles. 10

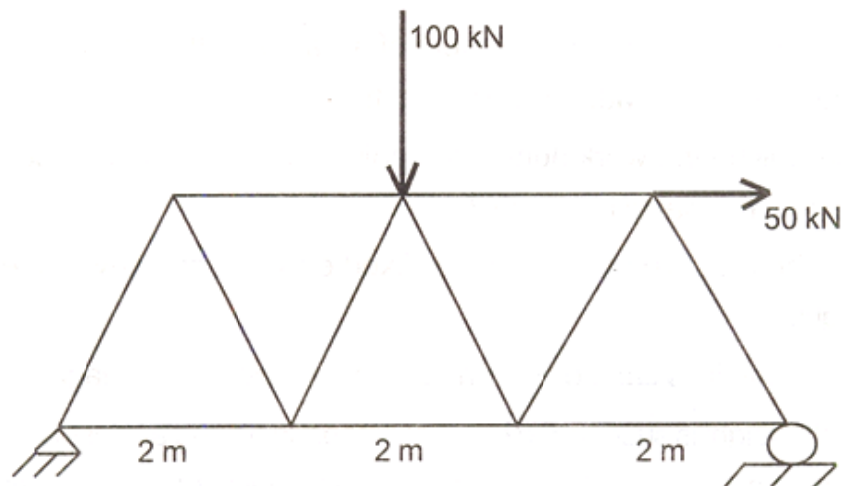


Figure 2

4. (a) A heavy drum of mass m rests on a horizontal floor in contact with a rough wall (Figure 3). Determine the couple necessary to act on the drum to start its counter clockwise rotation.

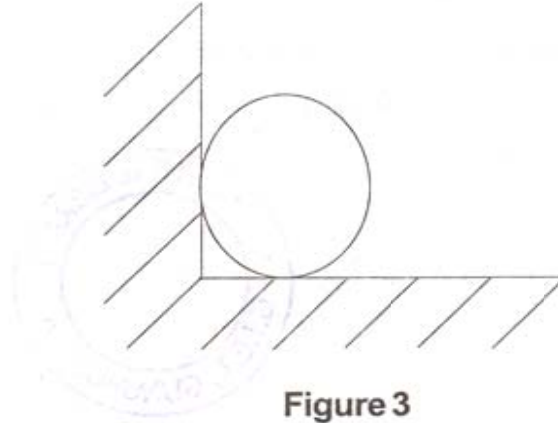
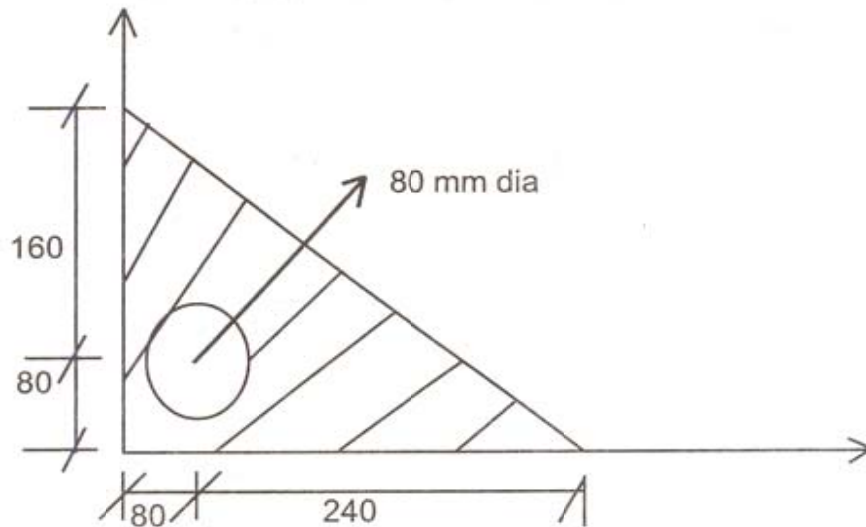


Figure 3

- (b) State and prove Varignon's theorem.
5. The triangular area (base = 320 mm and height 240 mm) shown in Figure 4 has a circular hole of 80 mm diameter whose center is positioned at (80 mm, 80 mm). For the shaded area shown in this figure
- (a) locate the centroid.
- (b) find the moment of inertia about the centroidal X and Y axis.



(All the dimensions are in mm)

Figure 4

6. (a) A stone is dropped into a well while the splash is heard after 4.5 seconds. Another stone is dropped with an initial velocity v and the splash is heard after 4 seconds. If the velocity of sound is 336 m/sec, determine the initial velocity of the second stone. 5
- (b) Two bullets are fired from a defective rifled gun. First one undershoots the target by 10 m while it was projected at 17° . Second bullet projected at 44° overshoots the target by 25 m. Determine the correct angle of projection for hitting the target. 5
7. (a) A locomotive weighing 600 N goes round a curve of radius 300 m at a uniform speed of 60 kmph. Determine the total lateral thrust on the rails. 5
- (b) Determine the circumferential tension S produced in a uniformly rotating thin circular ring of uniform cross-sectional area 2 cm^2 and mean radius 50 mm, if the peripheral velocity of the ring is 2 m/sec. 5
8. (a) A particle travels with constant speed v along a parabolic path defined by the equation $y = 7x^2$. Find the maximum acceleration of the particle. 5
- (b) A homogeneous sphere of radius 200 mm and weight 500 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed of 240 rpm in 20 revolutions, find the acting moment M . 5