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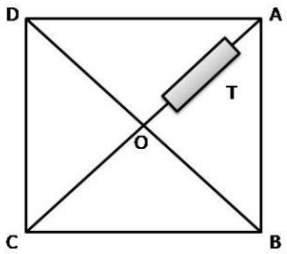
# B.Tech.
## (SEM I) THEORY EXAMINATION 2015-16
## ENGINEERING MECHANICS

**Time: 3 Hours** **Max. Marks: 100**

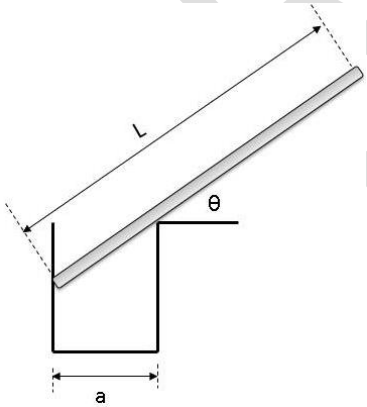
**Note:** ***1. Attempt all questions. Marks are indicated against each question.***
***2. Assume any missing data suitably.***

**1. Answer any two questions.** **[10x2=20]**

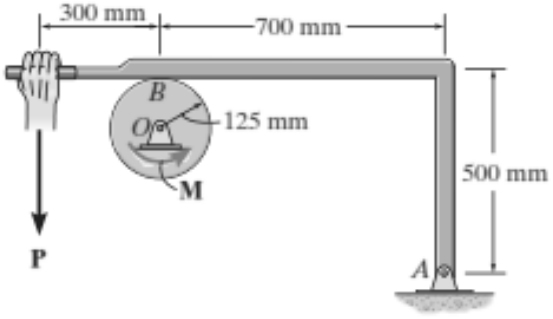
a. A tensile force of T = 800 N is produced using a turnbuckle in one of the radial bars of regular square in which all joints are hinged, shown in figure. Determine the forces produced in all other bars.




b. A uniform bar of weight *20 N* is resting as shown in figure. Draw the free body diagram of the system and determine the angle θ for equilibrium of the bar. Take *a = 2m* and *L = 6m*.

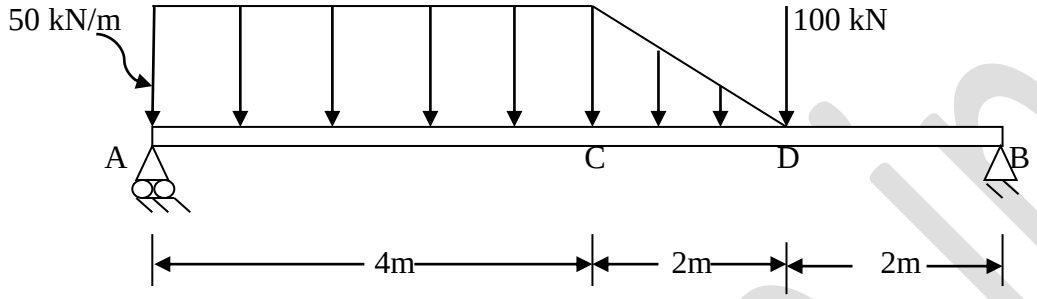



c. The coefficients of static and kinetic friction between the drum and brake bar are $\mu_s = 0.4$ and $\mu_k = 0.3$, respectively (fig 2). If M = 50 N-m and P = 85 N determine the horizontal and vertical components of reaction at the pin *O*. Neglect the weight and thickness of the brake. The drum has a mass of 25 kg.

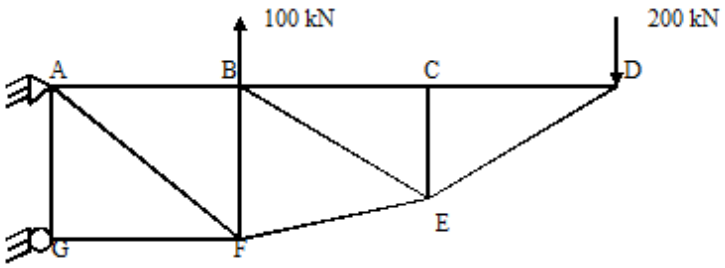


**2. Attempt any two of the following: [10x2=20]**

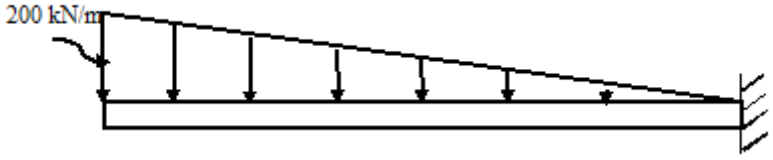
a. Find the equations for shear force and bending moment forthe beam AB after taking origin at A, and also draw SFD and BMD. The beam is subjected to a uniformly distributed load between A and C, linearly varying load between C and D and a concentrated load of at D.




b. Calculate the forces in members BC, BE, CD and EF of the truss shown in figure. The lengths of the members are as follows: AB=BC=CD=AG=BF=GF=5m and CE=4m.

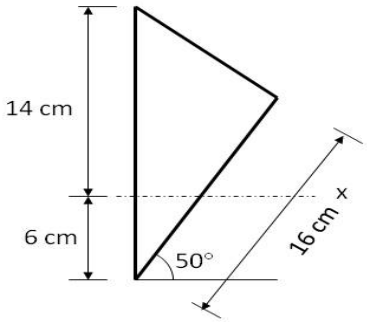



c. For 10 meter long cantilever beam, shown in figure, find the equations for shear force and bending moment, and also draw SFD and BMD.

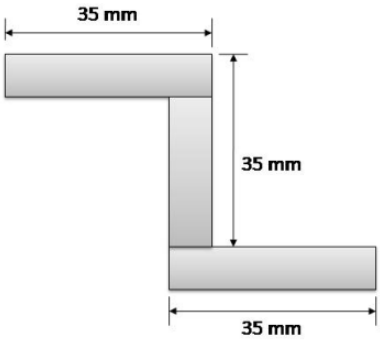



**3. Attempt any two of the following: [10x2=20]**

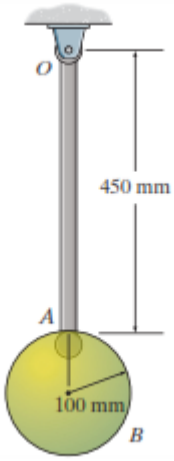
a. Determine the centroid of a wire bent in shape of a triangle as shown in figure 1 about the given x axis.




b. Determine area moment of inertia of the region shown about its centroidal axes.




c. Determine the mass moment of inertia of the pendulum about an axis perpendicular to the page and passing through point *O*. The slender rod has a mass of 10 kg and the sphere has a mass of 15 kg.

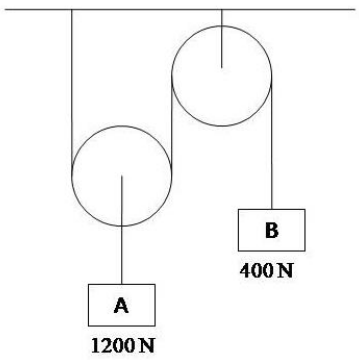



**4. Attempt any two of the following: [10x2=20]**

a. The acceleration of a particle is defined by the relation $a = 21 - 12s^2$,where $a$ is acceleration in m/s² and $s$ is in meters. The particle sarts with $s = 0$. Determine (i) velocity of the particle when $s = 1.5$ m, (ii) the position where the velocity is again zero, and (iii) the position where the velocity is maximum.

b. A car starts from rest on a curved road of 200 m radius and accelerates at a constant angular acceleration of 0.5 m/s². Determine the distance and time which the car will travel before the total acceleration attained by it becomes 0.75 m/s².

c. The Using D'Alembert's principle determine the tension in the string and acceleration of the blocks A and B weighing 1200 N and 400 N connected by a string as shown. Assume pulleys are friction less.

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**5. Attempt any two of the following: [10x2=20]**

a. Derive an expression for the elongation of a tapered bar of circular cross section, diameter varies from $D_1$ to $D_2$ over a length L and is subjected to an axial load P. Why a brittle material is unsuitable for impact loading, discuss the reasons in detail.
b. A simply supported beam 10 cm wide by 60 cm high and 10 meter long is subjected to a concentrated anticlockwise couple of 200kNm at a point 2 meter from the left support. Determine the maximum fiber stress when (i) beam is assumed to be weightless (ii) weight of beam is 200kN.
c. A hollow shaft having outer diameter 1.25 times its inner diameter is used as a substitute of a solid shaft to transmit the same power at the same speed. Determine the diameters of hollow shaft in terms of the diameter of solid shaft and calculate the saving in the material, if same maximum shearing stressesare induced in both the shafts. Also compare the angles of twist for the solid and hollow shafts.

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