BT-MRE-I & II/05.15-0561 Reg. No. | | | | | | | | | |

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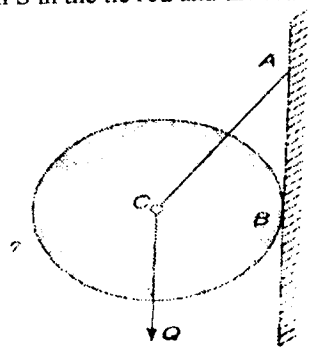
B.Tech. Degree I & II Semester Examination in Marine Engineering May 2015

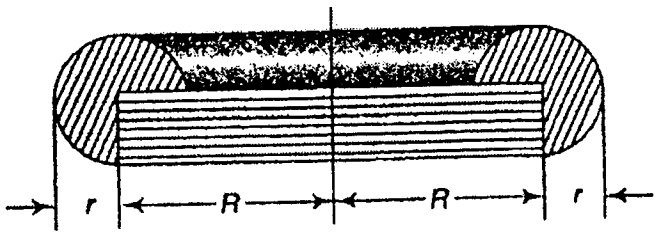
MRE 1105 ENGINEERING MECHANICS

Time: 3 Hours Maximum Marks: 100

I. (a) A circular roller of radius r = 150 mm and weight Q = 445 N hangs by a tie rode AC = 300 mm and rests against a smooth vertical wall at B as shown in the figure below. Determine the tension S in the tie rod and the reaction at B. (8)

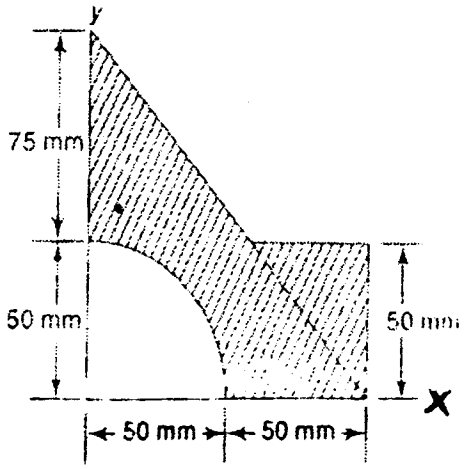


(b) Using the second theorem of Pappus, calculate the volume of the ring shown in the figure if R = 250 mm, r = 100 mm. (8)



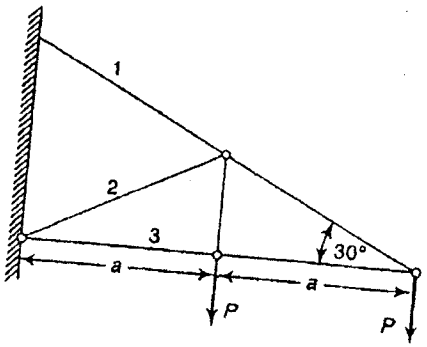
OR

II. (a) With respect to the coordinate axes x and y, locate the centroid of the shaded area shown in figure below. (10)



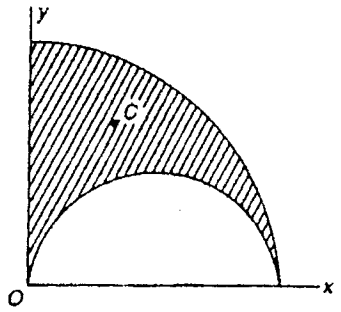
(P.T.O.)

(b) Using the method of sections, find the axial force in each of the bars 1, 2, 3 of the plane truss in figure. (6)



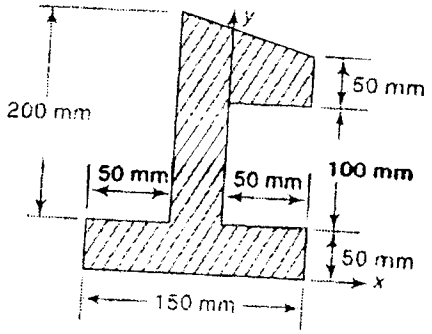
III. (a) State and prove theorem of parallel axis. (7)

(b) Locate the centroid C of the shaded area obtained by cutting a semicircle of diameter a from the quadrant of a circle of radius a as shown in figure. (10)

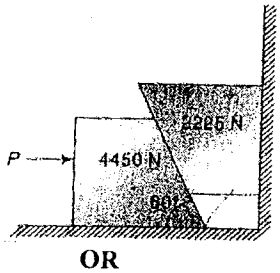


OR

IV. Determine the moments of inertia about the centroidal axes of the figure shown below: (17)



V. Referring to figure, the coefficients of friction are as follows; 0.25 at the floor, 0.3 at the wall and 0.2 between blocks. Find the minimum value of a horizontal force *p* applied to the lower block that will hold the system in equilibrium. (17)



OR

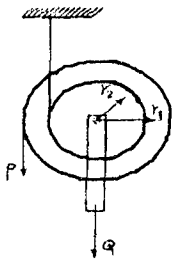
(Contd....3)

VI. (a) A screw-jack has a square thread, 7.5 cm mean diameter and 1.5 cm pitch. The load on the jack revolves with the screw. The co-efficient of friction at the screw threads is 0.05. (9)

(i) Find the tangential force to be applied to the jack at 36 cm radius so as to lift a load of 600 N.

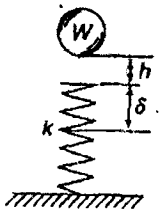
(ii) State whether the jack is self-locking. If it is find the torque necessary to lower the load. If not find the torque, which must be applied to keep the load from descending.

(b) The pulley arrangement shown in figure below is used for hoisting a load Q. Find the ratio between the forces P and Q in the case of equilibrium of the system. The radii of the two steps of the pulley are r_1 and r_2 as shown in the figure below. Neglect friction. (8)



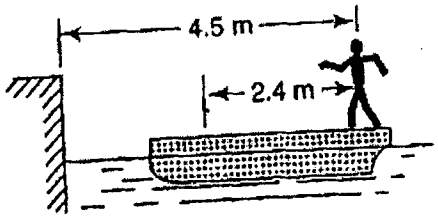
VII. (a) Water drips from a pipe at the uniform rate of n drops per second. Find the distance x between any two adjacent drops as a function of the time t that the trailing drop has been in motion. Neglect air resistance and assume constant acceleration $g = 9.81$ m/s^2. (8)

(b) When a ball of weight W rests on a spring of constant k shown as in figure, it produces a static deflection of 25 mm. How much will the same ball compress the spring if it is dropped from a height h = 0.3 m? Neglect the mass of the spring. (8)

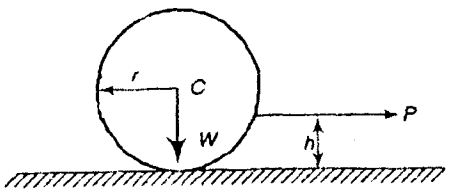


OR

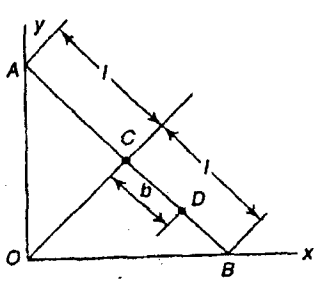
VIII. (a) A man weighing 712 N stands in a boat so that he is 4.5 m from a pier on the shore as in figure. He walks 2.4 m in the boat towards the pier and then stops. How far from the pier will he be at the end of walking? The boat weighs 890 N and there is assumed to be no friction between it and the water. (8)



(b) A homogeneous sphere of radius r and weight W slides along the door under the action of a constant horizontal force P applied to a string, as shown in figure below. Determine the height h during this motion if the coefficient of friction between sphere and floor is μ. (8)

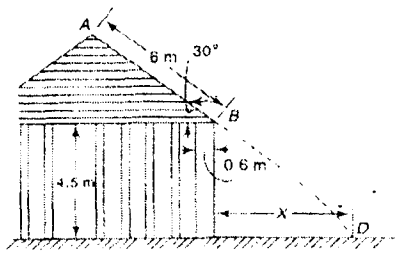


IX. (a) Prove that the ends A and B of a bar AB of length $2l$ as in figure are constrained to move along the y and x axes, respectively its mid-point C describes a circle of radius l with centre at O while any intermediate point D describes an ellipse with major and minor semi axes $l+b$ and $l-b$, respectively. (7)



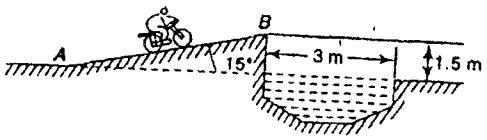
(Contd...4)

(b) In figure below, a hammer of weight W = 8.9 N starts from rest at A and slides down a roof for which the coefficient of friction is $\mu = 0.2$. Find the distance X to the point D where it hits the ground. (10)

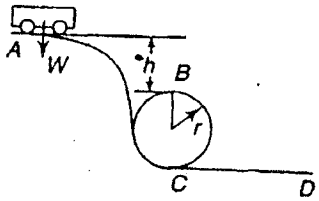


OR

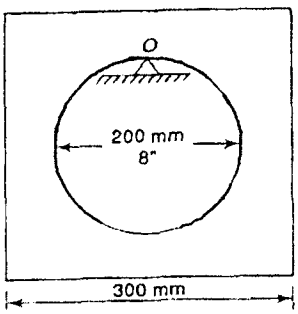
X. (a) Referring to figure calculate the minimum speed V_0 with which a motorcycle *stunt* rider must leave the 15° ramp at B in order to clear the ditch. (9)



(b) A small car of weight W starts from rest at A and rolls without friction along the loop ACBD as in the figure. What the least height h above the top of the loop at which the car can start without falling off the track at point B, and for such a starting position what velocity will the car have along the horizontal portion CD of the track? Neglect friction. (8)

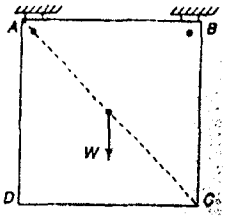


XI. A homogeneous square plate with a centered circular hole is supported as a compound pendulum as shown in figure below. Determine the period of small oscillations of the compound pendulum in the vertical plane of the plate. (17)



OR

XII. A homogeneous plate 0.3 m square is supported in a vertical plane as shown in figure. If the pin at B is removed, what angular velocity ω will the plate acquire by the time the diagonal AC becomes vertical. (17)



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