BT-MRE-I-12.19-1474 Reg. No. | | | | | | | | |

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B.Tech. Degree I Semester Examination in Marine Engineering December 2019

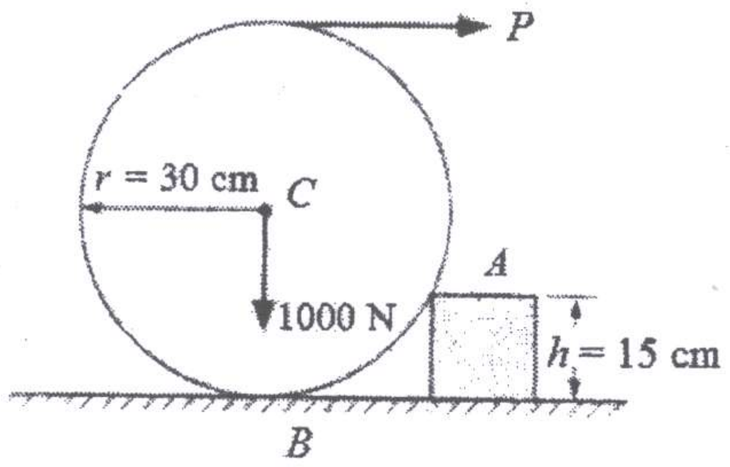
19-208-0104 ENGINEERING MECHANICS

(2019 Scheme)

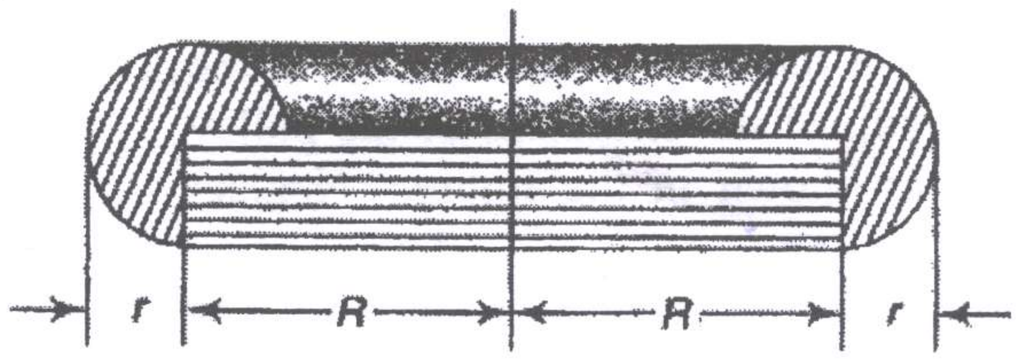
Time: 3 Hours Maximum Marks: 60

$(5 \times 15 = 75)$

I. (a) A circular roller of radius r=30cm and weight Q=1000 N is to be pulled over a rectangular block of height 15cm by a horizontal force P as shown in figure. Find the force P as the roller is about to roll over the block. (6)

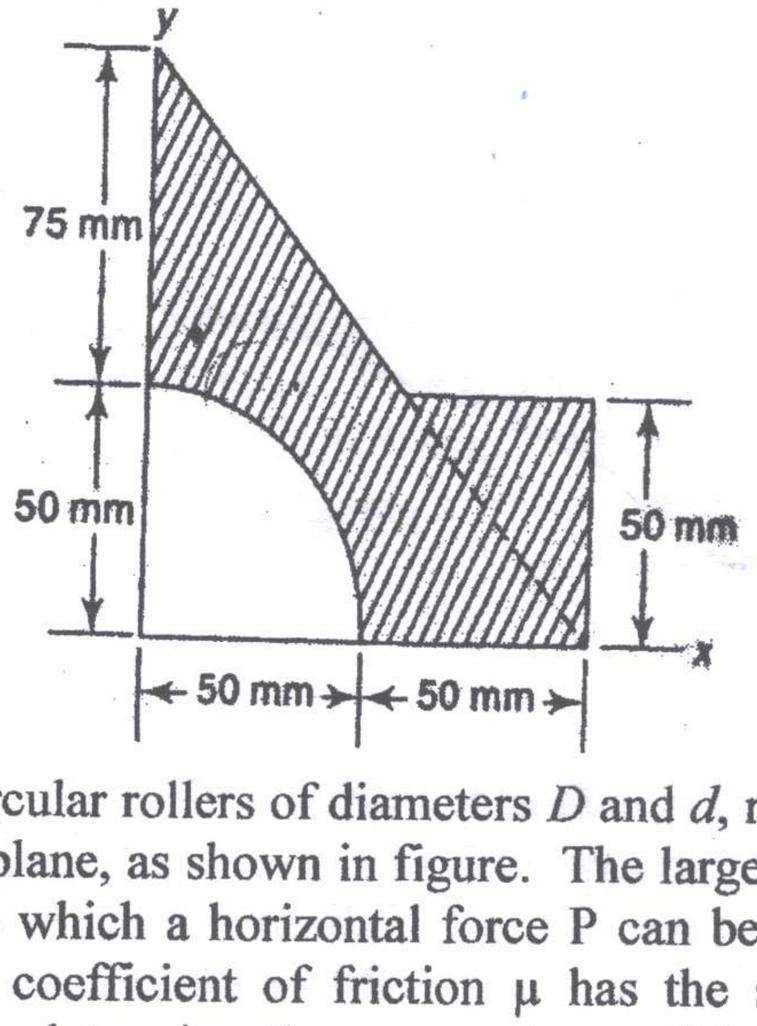


(b) Using the second theorem of Pappus, calculate the volume of the ring shown in the figure if R=250 mm, r=100 mm. (9)



OR

II. (a) With respect to the coordinate axes x and y, locate the centroid of the shaded area shown in figure below: (8)

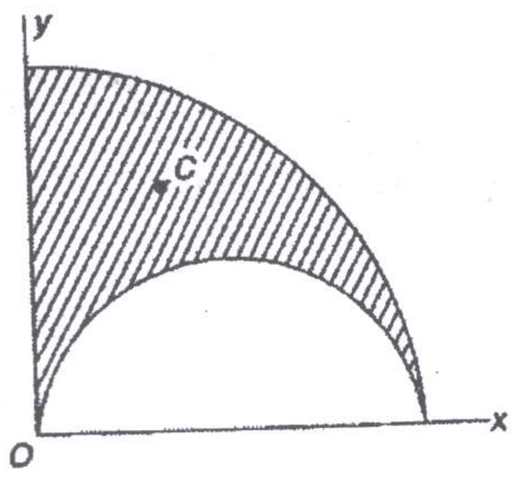


(b) Two heavy right circular rollers of diameters D and d, respectively, rest on a rough horizontal plane, as shown in figure. The larger roller has a string wound around it to which a horizontal force P can be applied as shown. Assuming that the coefficient of friction μ has the same value for all surfaces of contact, determine the necessary condition under which the large roller can be pulled over the small one. (7)

(P.T.O.)

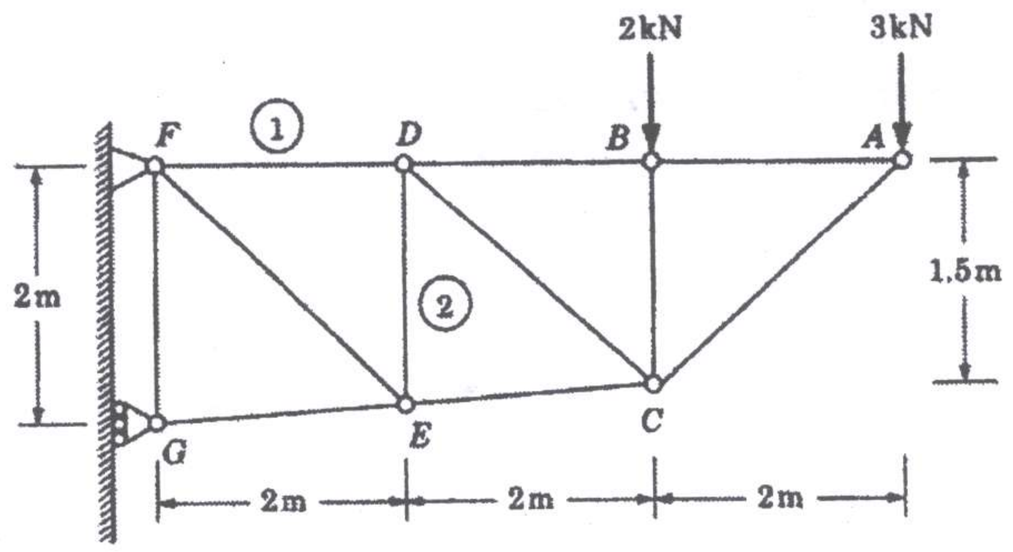
III. (a) State and prove theorem of parallel axis. (5)

(b) Find the moments of inertia about the centroidal axes of the shaded area obtained by cutting a semicircle of diameter a from the quadrant of a circle of radius 10 cm as shown in figure. (10)

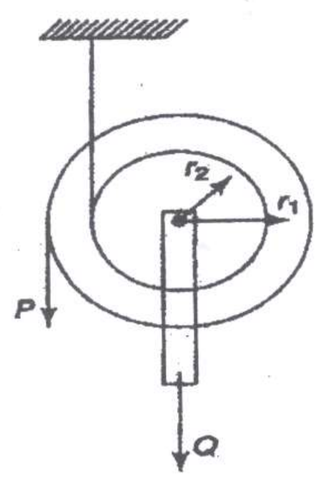


OR

IV. (a) Determine the axial force in each of the bars 1,2 of the plane truss in figure shown below: (9)

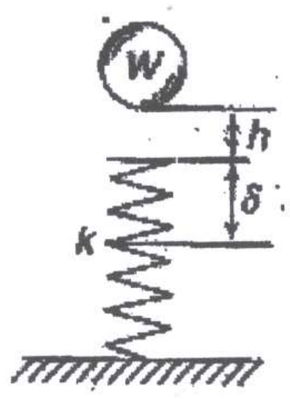


(b) The pulley arrangement shown in figure is used for hoisting a load Q. Find the ratio between the forces P and Q in the case of equilibrium of the system. The radii of the two steps of the pulley are r_1 and r_2 as shown in the figure. Neglect friction. (6)



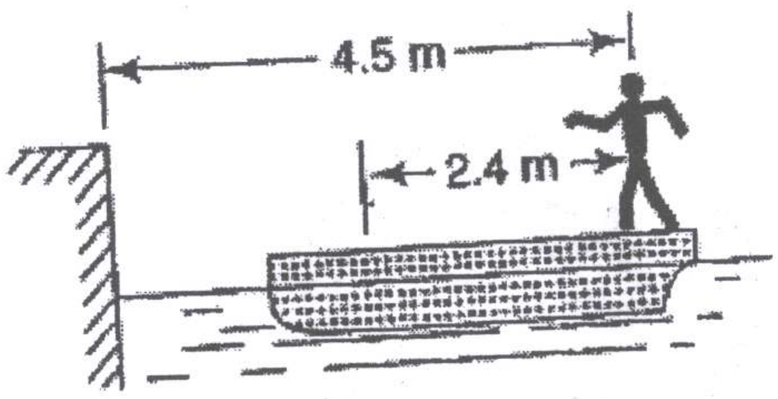
V. (a) Water drips from a pipe at the uniform rate of n drops per second. Find the distance x between any two adjacent drops as a function of the time t that the trailing drop has been in motion. Neglect air resistance and assume constant acceleration $g = 9.81\ m/s^2$. (7)

(b) When a ball of weight W rests on a spring of constant k shown as in figure, it produces a static deflection of 25mm. 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)



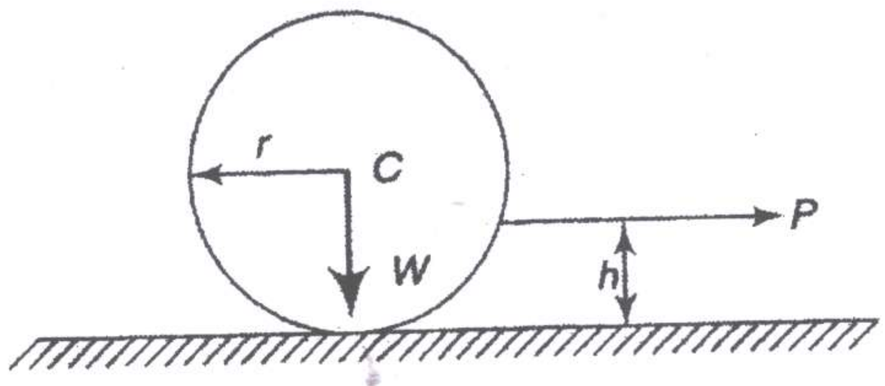
OR

VI. (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 weights 890N and there is assumed to be no friction between it and the water. (7)

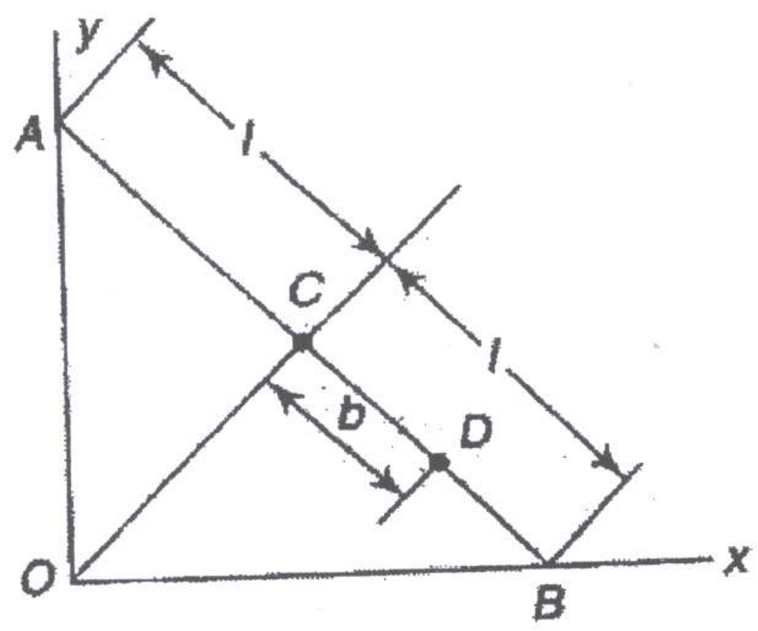


(Contd...3)

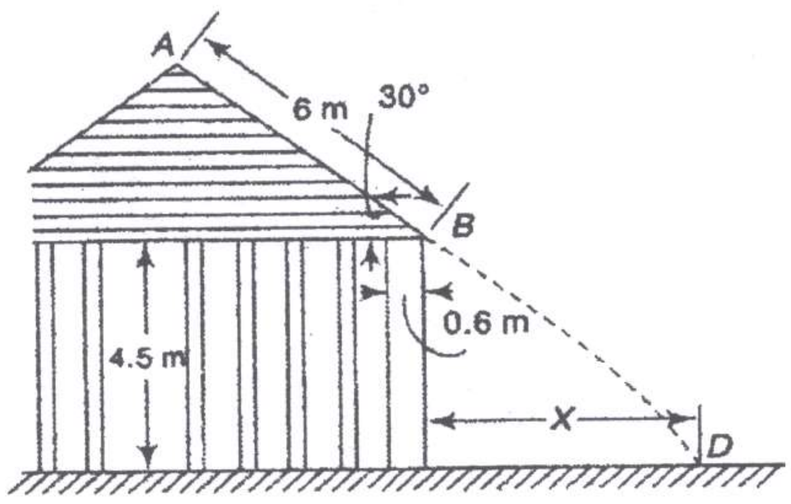
(b) A homogeneous sphere of radius r and weight W slides along the door under the action of a constant horizontal force P applied to a string, as shown in figure below. Determine the height h during this motion if the coefficient of friction between sphere and floor is μ. (8)



VII. (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 semiaxes $l+b$ and $l-b$, respectively. (6)

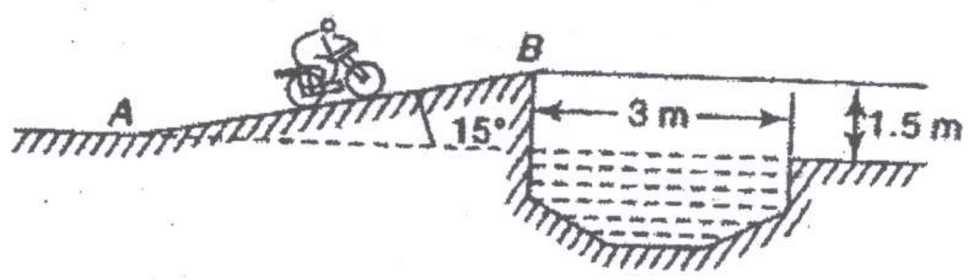


(b) In figure below, a hammer of weight W= 8.9 N starts from rest at A and slides down a roof for which the coefficient of friction is μ=0.2. Find the distance X to the point D where it hits the ground. (9)



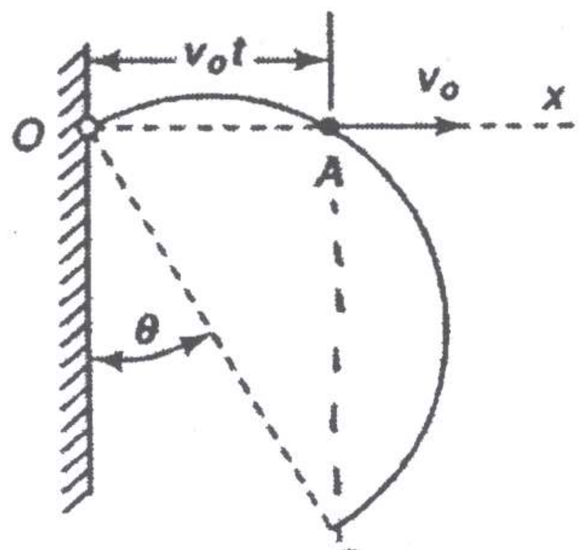
OR

VIII. (a) Referring to figure calculate the minimum speed v_0 with which a motorcycle stunt rider must leave the 15^0 ramp at B in order to clear the ditch. (7)

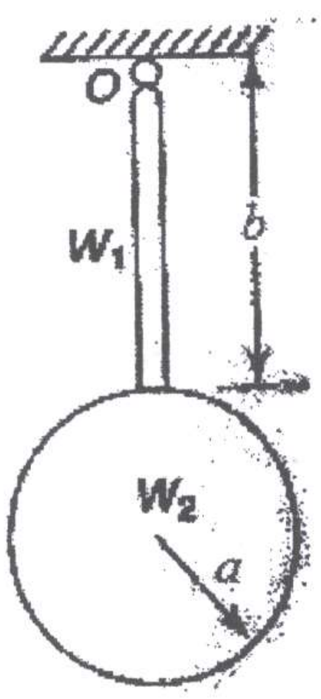


(b) A small car of weight W starts from rest at A and rolls without friction along the loop ACBD as in the figure. What the least height h above the top of the loop at which the car can start without falling off the track at point B, and for such a starting position what velocity will the car have along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

IX. (a) A slender but rigid semicircular wire of radius r is supported in its own vertical plane by a hinge at 'O' and a smooth peg A as shown in figure. If the peg starts from O and moves with constant speed V_0 along the horizontal x-axis, find the angular velocity $\theta = 60^0$. (5)



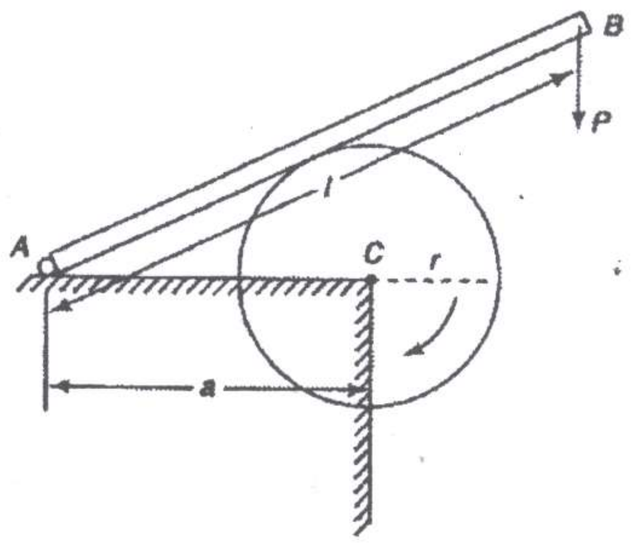
(b) Determine the period of small oscillations of the compound pendulum shown in figure and consisting of a disk suspended by a slender rod if the following numerical data are given: b=300mm, a=125 mm, W_1=2.225N and W_2= 13.35N (10)



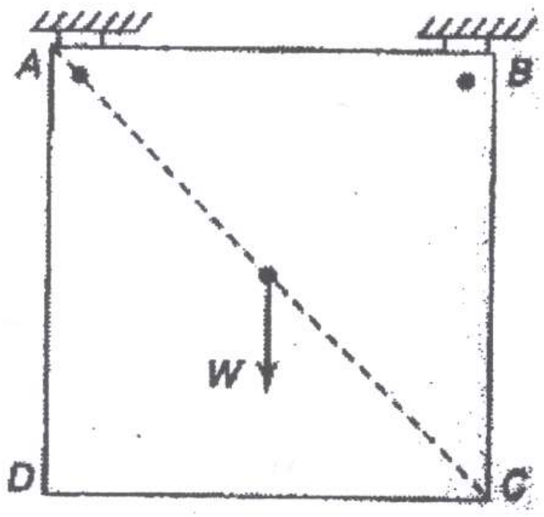
OR

X. (a) A right circular drum of radius r and weight W rotating at 600 rpm is braked by the device shown in figure K. Develop a formula for the time t required to bring the drum to rest if the coefficient of friction between the drum and breaking bar is μ. The following data are given: (6)

l = 1.2 m., r = 375 mm, μ = 0.25, W = 1780 N and P = 445 N.



(b) 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. (9)



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