BT-MRE-I&II(S)-04.21-0285 Reg. No. | | | | | | | | |

A

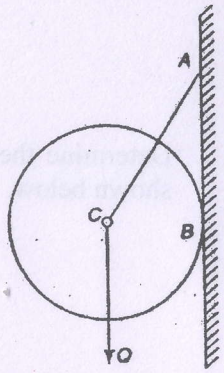
B.Tech. Degree I & II Semester Supplementary Examination in Marine Engineering April 2021

MRE 1105 ENGINEERING MECHANICS

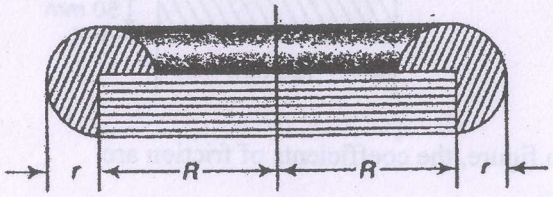
(2013 Scheme)

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 rest against a smooth vertical wall at B as shown in the figure. Determine the tension S in the tie rod and the reaction at B. (8)

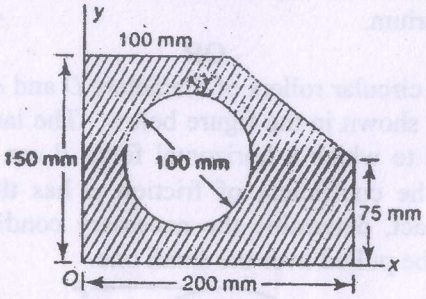


(b) Using the second theorem of Pappus, calculate the volume of the ring shown in the figure if $R = 250$ mm, $r = 100$ mm. (8)

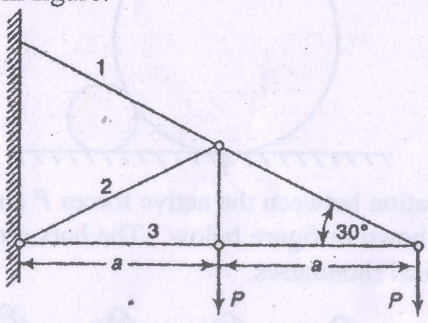


OR

II. (a) Referring to the figure below determine the coordinates x_c and y_c of the center of a 100 mm diameter, circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area. (10)



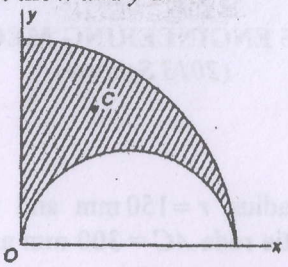
(b) Using the method of sections, find the axial force in each of the bars 1, 2, 3 of the plane truss in figure. (6)



(P.T.O.)

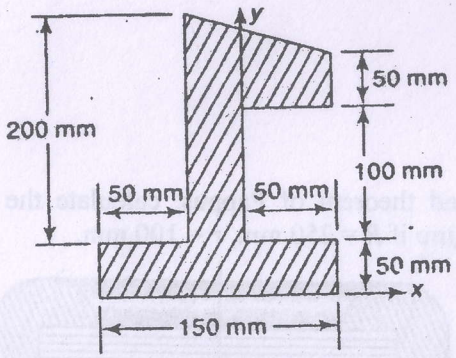
III. (a) State and prove the theorem of parallel axis. (7)

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



OR

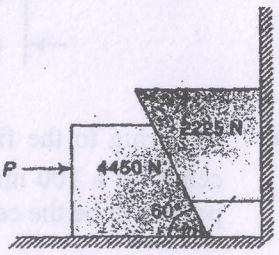
IV. Determine the moments of inertia about the centroidal axes of the figure shown below. (17)



V. Referring to figure, the coefficients of friction are as follows: (17)

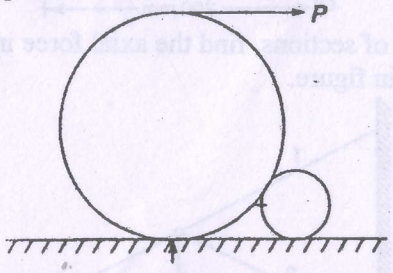
0.25 at the floor, 0.3 at the wall and 0.2 between blocks.

Find the minimum value of a horizontal force p applied to the lower block that will hold the system in equilibrium.

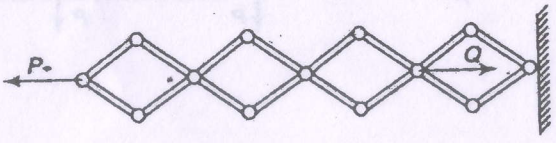


OR

VI. (a) Two heavy right circular rollers of diameters D and d, respectively, rest on a rough plane as shown in the figure below. 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 larger roller can be pulled over the small one. (10)



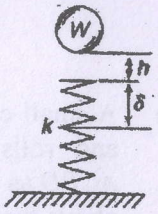
(b) Calculate the relation between the active forces P and Q for equilibrium of system of bars shown in figure below. The bars are so arranged that they form three identical rhombuses. (7)



(Continued to 3)

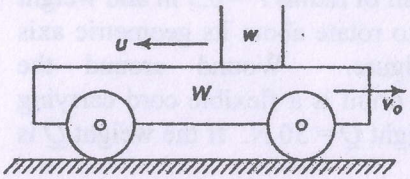
VII. (a) A stone is dropped into a well and falls vertically with constant acceleration $g = 9.81$ m/s^2. The sound of impact of the stone on the bottom of well is heard 6.5 s after it is dropped. If the velocity of sound is 336 m/s, how deep is the well? (8)

(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

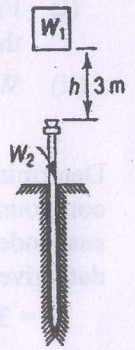
VIII. (a) A flat car can roll without resistance along a horizontal track as shown below. Initially the car together with a man of weight w is moving to the right with speed v_0. What increment of velocity Δv will the car obtain if the man runs with speed u relative to the floor of the car and jumps off at the left? (8)



(b) For the pile and pile driver shown in figure, the following numerical data are given: (8)

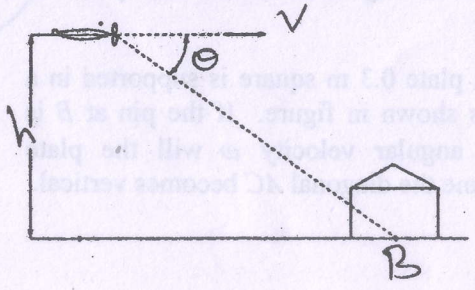
$W_1 = 8900$ N, $W_2 = 4450$ N and the coefficient of restitution $e = 0.25$.

If the resistance to penetration is constant and equal to 267000 N, how many blows of the hammer will be required to drive the pile 0.3 m.



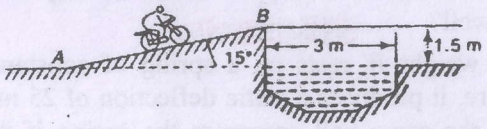
IX. (a) A particle travels with constant speed v along a parabolic path define by the equation $y = kx^2$, where k is a constant. Find the maximum acceleration of the particle. (8)

(b) Referring to the figure below, a pilot of an airplane flying horizontally with constant speed $v = 480$ kmph at the elevation $h = 600$ m above a level plain wishes to bomb a target B on the ground. At what angle θ below the horizontal should he see the target at the instant of releasing the bomb in order to hit the same? Neglect air resistance. (9)

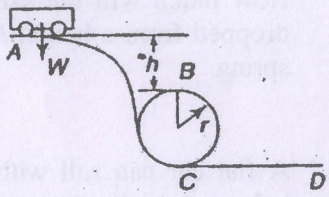


OR

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)



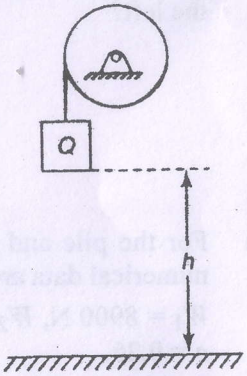
(b) A small car of weight W starts from rest at A and rolls without friction along the loop $ACBD$ as in the figure. What the least height h above the top of the loop at which the car can start without falling off the track at point B, and for such a starting position what velocity will the car have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



XI. (a) A solid circular drum of radius $r = 0.3$ m and weight $w = 150$ N is free to rotate about its geometric axis as shown in figure. Wound around the circumference of a drum is a flexible cord carrying at its free end a weight $Q = 50$ N. If the weight Q is released from rest, (9)

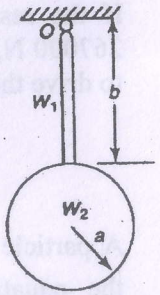
(i) Find the time t required for it to fall through the height $h = 3$ m.

(ii) With what velocity it will strike the floor?



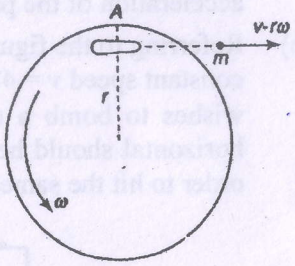
(b) Determine the period of small oscillations of the compound pendulum shown in figure, consisting of a disk suspended by a slender rod with the following numerical data given: (8)

$b = 300$ mm, $a = 125$ mm, $W_1 = 3$ N and $W_2 = 15$ N

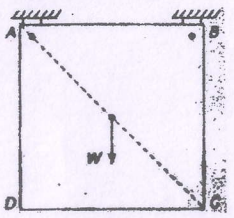


OR

XII. (a) A horizontal turntable as shown in figure carries a gun at A and rotates with initial angular velocity ω about its vertical geometric axis. Calculate the increment of angular velocity $\Delta\omega$ that the turntable will obtain if the gun fires a bullet of mass m with tangential muzzle velocity v. (8)



(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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