[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec-22-0101

ME-101 (Engineering Mechanics)

B.Tech-1st (CBCS)

Time : 3 Hours **Max. Marks : 60**

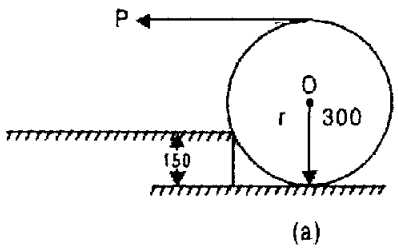
The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: Attempt five questions in all, selecting one question from each section A, B, C & D. Section E is compulsory. Assume any suitable missing data if any. Use of non-programmable calculator is allowed.

SECTION A

1. (a) Explain the principle of transmissibility of a force. What are its limitations? (3)

   (b) A roller of radius r = 300 mm and weight 2000 N is to be pulled over a curb of height 150 mm [Fig. 1] by a horizontal force P applied to the end of a string wound tightly around the circumference of the roller. Find the magnitude of P required to start the roller move over the curb. What is the least pull P through the center of the wheel to just turn the roller over the curb? (7)



(a)

Fig. 1

2. (a) Determine the resultant of the four forces and one couple which act on the plate shown in Fig.2. (7)

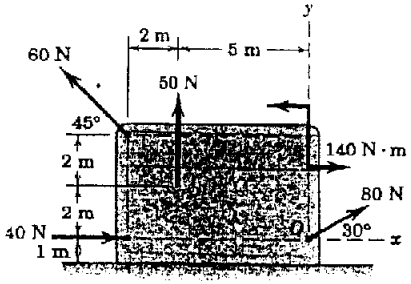


Fig. 2

   (b) What do you understand by the term 'Free Body Diagram'? Illustrate your answer with a few sketches. (3)

SECTION B

3. (a) Find the least horizontal force P required to just start the motion of any part of the system resting on one another as shown in Fig. 3. The weights of blocks A, B and C are 3000 N, 1000 N and 2000 N, respectively. Coefficient of friction between the blocks A and B is 0.3, between B and C is 0.2 and between the block C and ground is 0.1. (5)

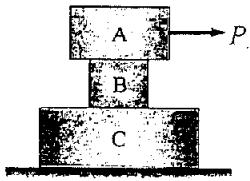


Fig. 3

   (b) A block weighing 160 kN is to be raised by means of the wedges A and B as shown in Fig. 4. Find the value of force P for impending motion of block C upwards, if coefficient of friction is 0.25 for all contact surfaces. The self-weight of wedges may be neglected. (5)

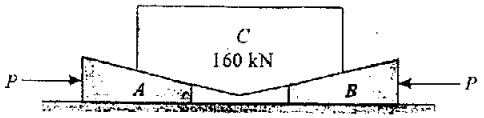


Fig. 4

[P.T.O.]

4. (a) A wire is bent into closed loop A-B-C-D-E-A as shown in Fig. 5, in which the portion AB is a circular arc. Determine the centroid of the wire. (7)

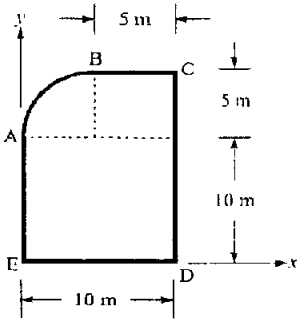


Fig. 5

(b) Explain the following: (i) Second moment of area; (ii) Radius of gyration; (iii) Perpendicular axis theorem. (3)

SECTION C

5. Analyse the truss shown in Fig. 6 by using Method of Joints. All the members are of 3 m length. (10)

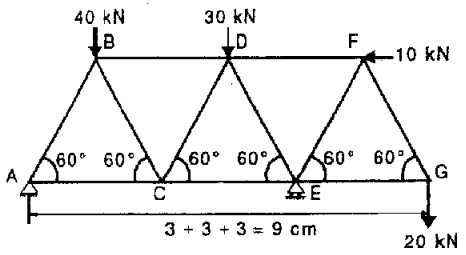


Fig. 6

6. Draw the shear force and bending moment diagrams for the beam shown in Fig. 7. (10)

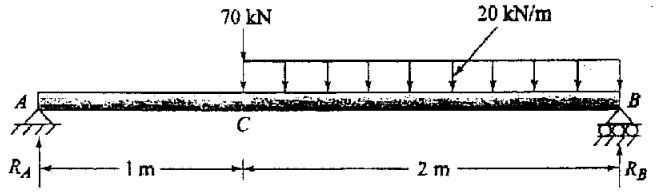


Fig. 7

SECTION D

7. (a) What do you understand by the term kinematics? Explain different types of plane motion of rigid bodies with suitable examples. (5)

(b) A flywheel starts rotating from rest and is given an acceleration of 1.2 rad/s^2. Find the angular velocity and the speed in rpm after 1 minute 20 seconds. If now the flywheel is brought to rest with a uniform retardation of 0.4 rad/s^2, determine the time taken by the flywheel to come to rest. (5)

8. (a) How do we apply the D' Alembert's principle to a rigid body rotating about a fixed axis under the action of a constant moment? (4)

(b) A sphere 'A' weighing 100 N moves on the x-axis in its positive direction with a velocity 4m/s. Another sphere 'B' of weight 80 N moving on the same axis but in opposite directions approaches it with a velocity of 6 m/s and impinges on it. If the coefficient of restitution is 0.7. Calculate the velocities of two sphere after impact. Also, calculate the loss of kinetic energy that takes place. (6)

SECTION-E (Compulsory Question)

9. (a) Define the terms 'particle' and 'rigid body' as used in mechanics. Why are these considered idealizations?

(b) What is the difference between a couple and a moment?

(c) List the conditions of equilibrium for different types of coplanar for systems.

(d) How do the three different types of supports resist external loads? Explain by diagrams their possible movements.

(e) Why are the joints of a truss considered pinned?

(f) A person is climbing a ladder leaned against a rough wall and resting on a rough floor. How many forces are acting on the ladder and what are they?

(g) What happens to the centroid of a right circular cylinder, if a cone with same central axis of the same diameter and height is cut out from the cylinder?

(h) In real life, generally the structural members are so oriented that moment of inertia obtained is the maximum. Why?

(i) Under what conditions is a ball likely to roll without sliding and under what conditions is it likely to roll as well as slide?

(j) Define impulse and momentum. (10×2=20)