Question Paper

Exam Date & Time: 23-Nov-2018 (08:30 AM - 11:30 AM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2018

Mechanics of Solids [CIE 1051 - 2018 -PHY]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

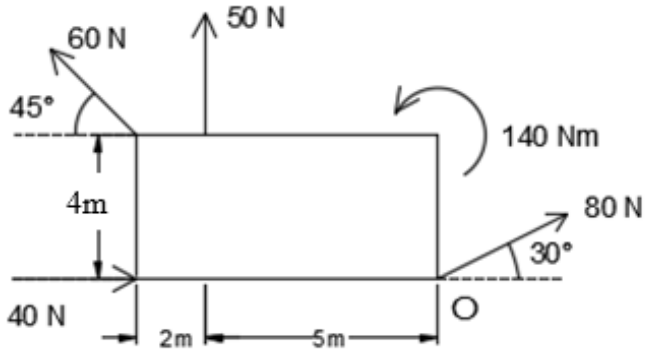
Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) (2)

A) Define:
(i) Resultant of a force system (ii) Collinear forces (iii) Composition of forces (iv) Rigid body

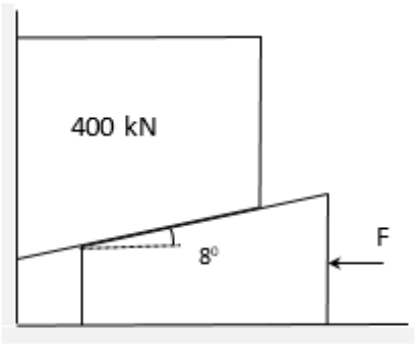
B) (4)

Find magnitude, direction and position of a resultant force for a system of forces shown in the figure with respect to 'O'.



C) (4)

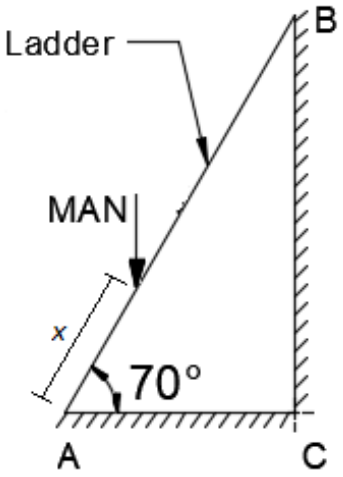
A block of weight 400 kN is lifted by a wedge as shown in the figure. Calculate force 'F' required to rise the block. Consider angle of limiting friction as 19Â° at all contact surfaces.



2) (3)

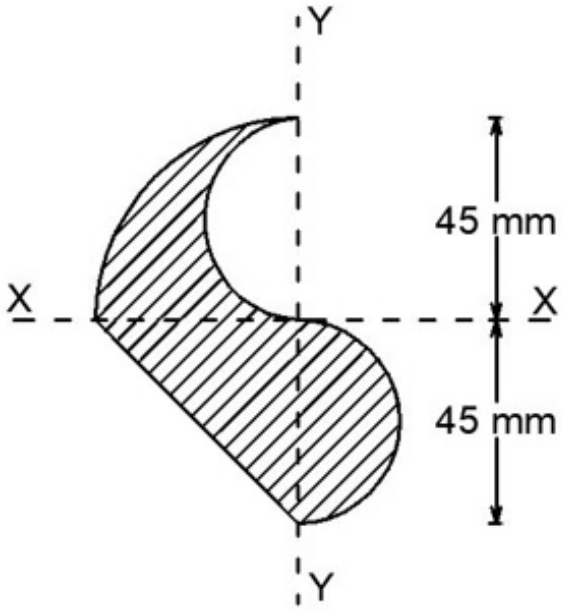
A) A man weighing 750 N starts to climb 7m long ladder weighing 250 N. Determine distance 'x' indicated in the

figure when the ladder starts to slip. The coefficient of friction for all rubbing faces is 0.30.



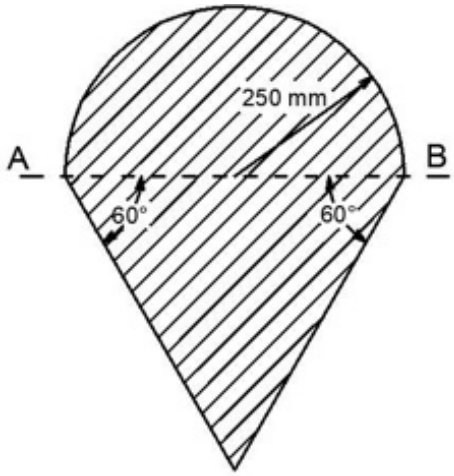
B) Illustrate with neat sketches: (i) Free body diagram (ii) Space diagram (2)

C) Locate the centroid of shaded area with respect to the axes shown in the figure. (5)



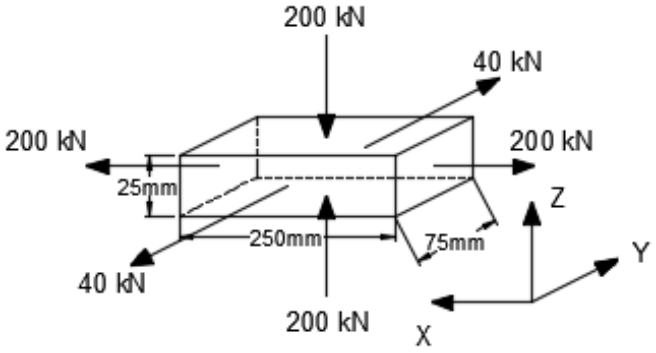
3) Determine moment of inertia of the shaded area shown in the figure with respect to a given reference axis AB . (2)

A)



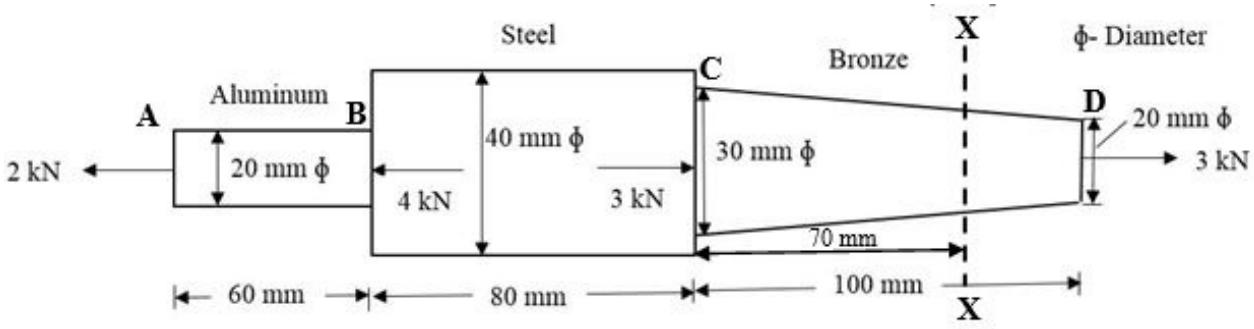
B) Derive an expression to calculate moment of inertia of triangular area with respect to its base. (3)

C) A rectangular bar (250mm X 75mm X 25mm) is loaded as shown in the figure. Determine (i) change in length, (ii) change in breadth, (iii) change in thickness and (iv) change in volume. What axial longitudinal load alone can produce the same longitudinal strain as in the case (i)? Take E = 200GPa and μ = 0.3. (5)



4) A) A thin cylinder 1000mm diameter, 10mm thick and 5m long is subjected to an internal fluid pressure of 3 N/mm^2. If E = 200GPa and μ = 0.3, determine (i) the change in length, (ii) change in diameter and (iii) change in volume. (3)

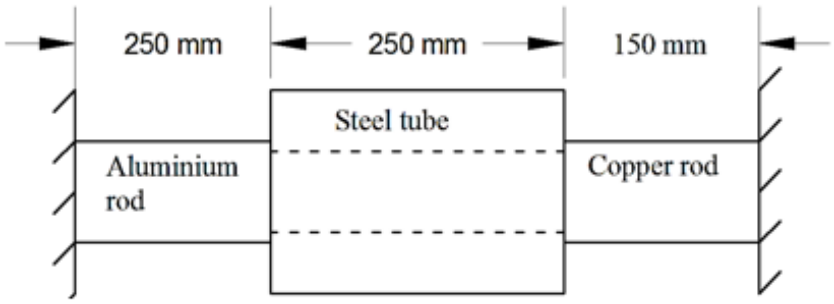
B) A composite circular bar consists of a steel section rigidly fastened between aluminium and bronze sections as shown in the figure. Axial loads are applied at the positions indicated. (5)
(i) Determine stresses in sections AB, BC and at section X-X of the tapered bar CD.
(ii) Calculate the total deformation.
Take $E_{aluminium}$=70 GPa, E_{steel}=200 GPa, E_{bronze}=90GPa.



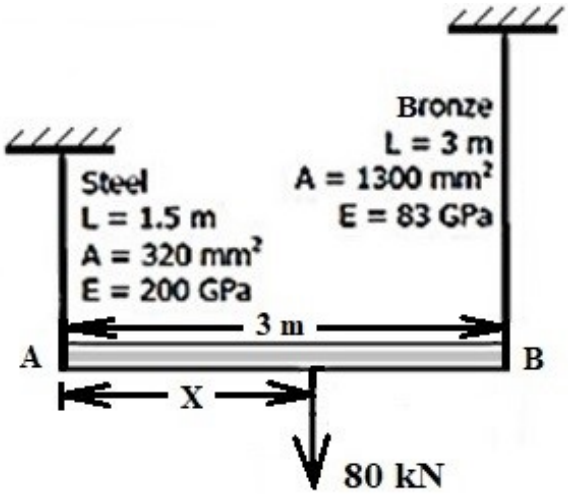
C) A metal rod of 12 m long is kept between two supports with a gap between rod and supports. If the stress developed due to temperature increment of 90Â°C is 75 MPa, what is the gap left between the rod and the supports? Young's modulus of the material is 110 GPa and coefficient of thermal expansion is $19x10^{-6}$/Â°C. (2)

5) A steel tube of internal diameter 16 mm and external diameter of 25 mm is rigidly fastened between aluminium and copper rods of 20 mm diameter each as shown in the figure. If the temperature of the system is raised by 30Â°C, calculate the nature and magnitude of the stresses developed: $E_{aluminium}$ = 70 GPa; E_{steel} = 200 GPa; E_{copper} = 110 GPa and $\alpha_{aluminium}$ = 24 x 10^{-6}/Â°C; α_{steel} = 13 x 10^{-6}/Â°C; α_{copper} = 17 x 10^{-6}/Â°C. (5)

A)



B) A rigid bar AB of 3m long is suspended by two vertical rods at its ends A and B and hangs in a horizontal position as shown in the figure. At what distance 'x' from A, a vertical load P = 80 kN may be applied for the rigid bar to remain horizontal. Neglect self-weight of the rigid bar. (3)



C) Calculate the safe load that can be supported by a reinforced concrete circular short column of 300 mm diameter, if the stress developed in concrete is 15 MPa. Take E_{Steel} = (14.3 $E_{Concrete}$). Given, total area of steel provided = 6 bars of 25mm diameter each. (2)

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