Question Paper

Exam Date & Time: 25-Jun-2024 (09:30 AM - 12:30 PM)

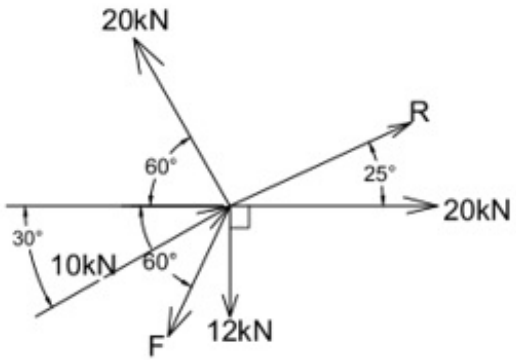
MANIPAL ACADEMY OF HIGHER EDUCATION

SECOND SEMESTER B.TECH. EXAMINATIONS - JUNE 2024
SUBJECT: CIE 1071/CIE_1071/CIE 1051-B - MECHANICS OF SOLIDS

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

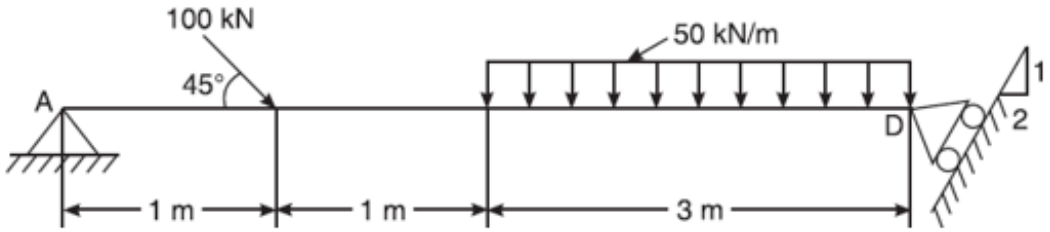
Answer all the questions.

1A) Resultant R of five concurrent forces is as shown in the figure. Determine the magnitude of force F and resultant R. (5)



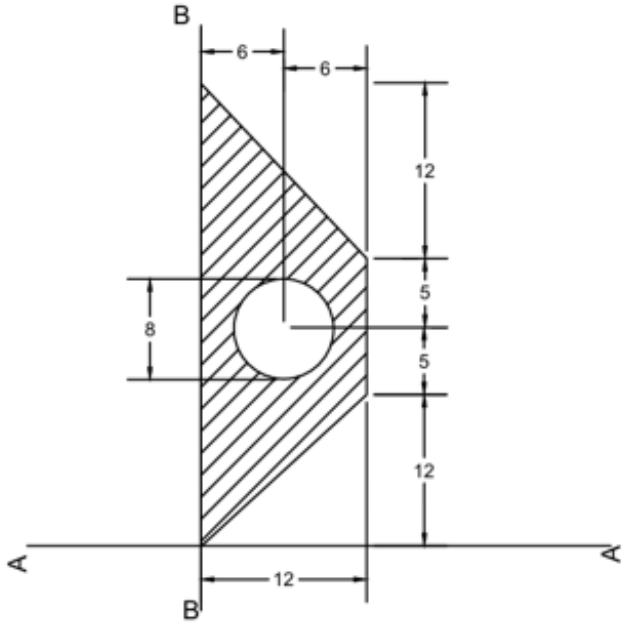
1B) For a thin cylindrical shell with dimensions 800 mm diameter, 10 mm thickness, and 3000 mm length, calculate the change in diameter, change in length, and change in volume when subjected to an internal pressure of 80m of water. Use the values of $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio μ = 0.26. (5)

2A) For the beam with loading shown in Figure 6.20, determine the reactions at the supports. (5)

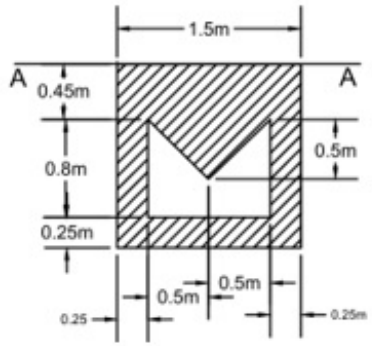


2B) A circular rod of 25 mm diameter and 500 mm long is subjected to a tensile force of 60 kN. Determine modulus of rigidity, bulk modulus and change in volume if Poisson's ratio =0.3 and Young's modulus E = 2 × 10^5 N/mm^2. (5)

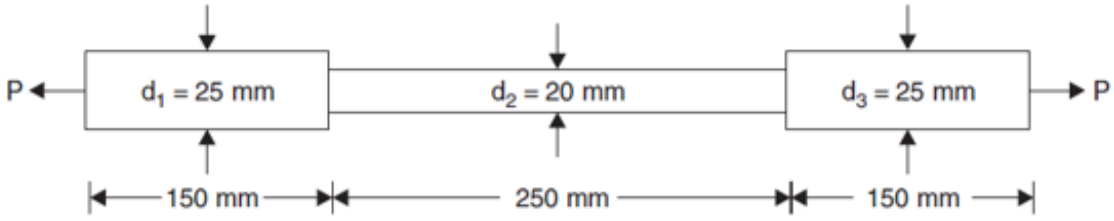
3A) Locate the centroid of the shaded portion of the figure with respect to AA and BB axes. All units indicated are in centimeter. (5)



3B) Determine the second moment of area of the shaded figure shown, with respect to AA axis. (5)

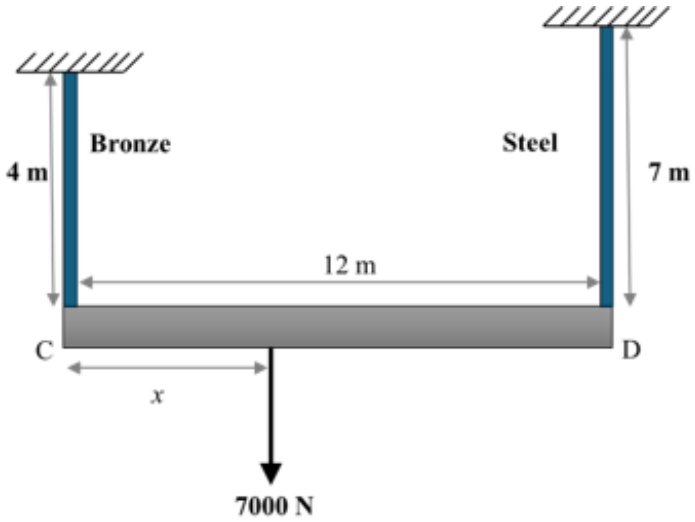


4A) The bar shown in Fig. 8.16 is tested in universal testing machine. It is observed that at a load of 40 kN the total extension of the bar is 0.280 mm. Determine the Young's modulus of the material. (5)



4B) Derive an expression for the total extension of the tapered bar of circular cross section shown in the figure, when subjected to an axial tensile load of W. (5)

5A) A rigid bar CD, 12 meters in length, is suspended horizontally by two vertical rods attached to its ends C and D, supporting it against its own weight. The rod at C, made of bronze, measures 4 meters in length, with a cross-sectional area of 1500 mm^2 and a modulus of elasticity (E_b) of 10^5 N/mm^2. The rod at D, made of steel, measures 7 meters in length, with a cross-sectional area of 500 mm^2 and a modulus of elasticity (E_s) of 200 GPa. Determine the distance x from point C at which a vertical load P = 7000 N can be applied for the rigid bar to maintain its horizontal position. (5)



5B) A railway line installed at 10°C with each rail measuring a length of 26m. Calculate the following: (5)
i) Determine the stress on the rails if temperature is raised to 60°C if there is no allowance for expansion.
ii) Find the stress in the rails at 60°C with an expansion allowance of 8 mm per rail.
iii) Calculate the expansion allowance required for the stress in the rail to be zero when the temperature reaches 60°C. Take $\alpha = 12 \times 10^{-6}$ and $E = 2 \times 10^{5} N/mm^{2}$

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