Question Paper

Exam Date & Time: 08-May-2019 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

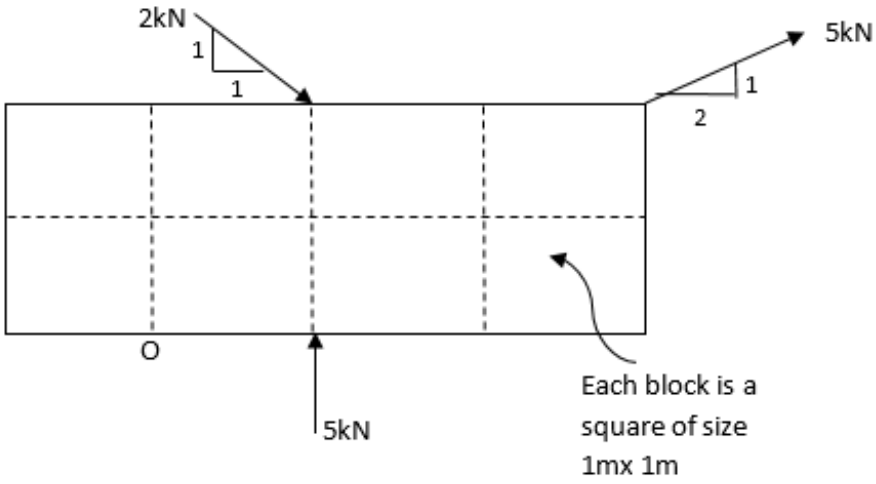
INTERNATIONAL CENTRE FOR APPLIED SCIENCES
I SEMESTER B.Sc.(Applied Sciences) IN ENGG.
END SEMESTER EXAMINATION-APRIL/MAY 2019
MECHANICS OF SOLIDS [ICE 111]

Marks: 100 **Duration: 180 mins.**

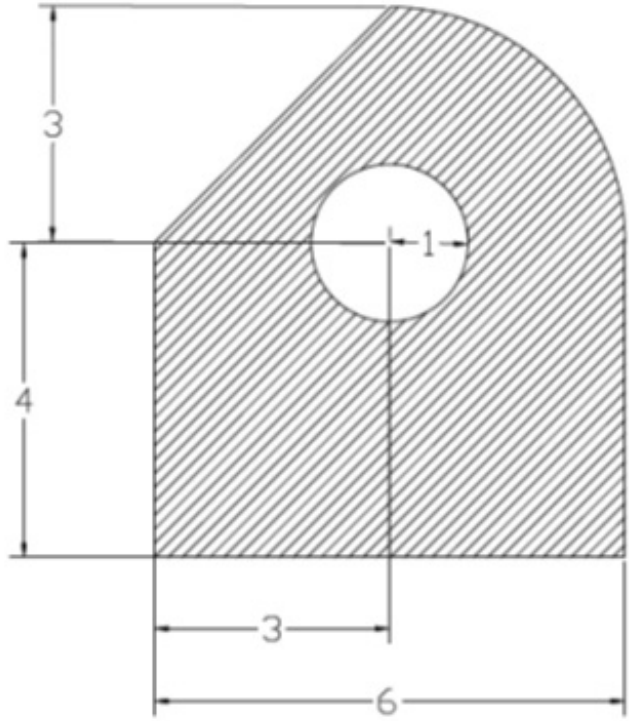
Answer 5 out of 8 questions.

1) Determine the location of resultant w.r.t. point O in the following system of non-concurrent coplanar forces. (8)

A)

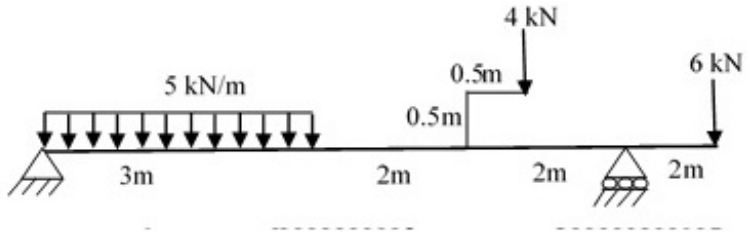


B) Determine the moment of inertia of the hatched portion in the figure, about its horizontal centroidal axis. All dimensions are in centimetres. (12)

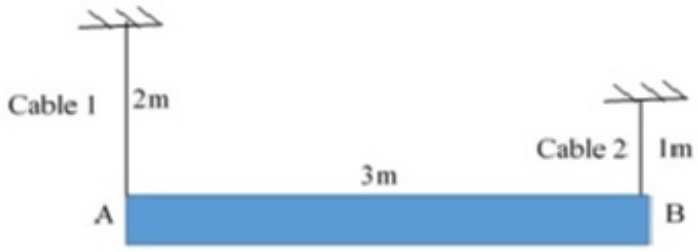


2) Determine the reactions and draw free-body diagram for the beam shown in Figure. (10)

A)

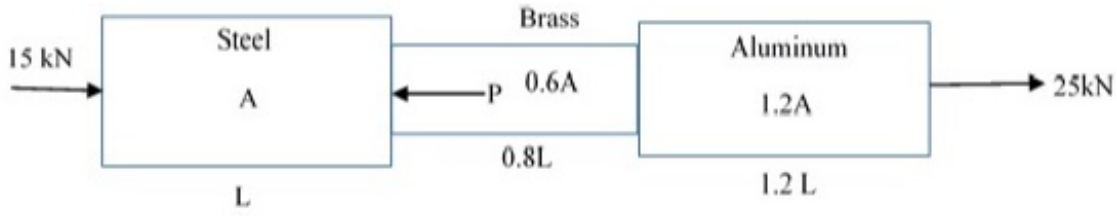


B) A homogeneous 800 kg bar AB of length 3m is supported at either end by a cable as shown in Figure. Calculate the ratio of diameters of the cables required so that the bar remains horizontal. E_1 = 120 GPa and E_2 = 210 GPa. (10)



3) Determine the unknown force P and calculate the stresses, strains and net change in the total length of bar. Modulus of elasticity of steel, brass and aluminum are 200GPa, 120GPa and 70 GPa respectively. Take length L=1m and c/s area A= 0.002m^2. (10)

A)



B) A reinforced concrete column 300 mm in diameter is designed to carry an axial compressive load of 400 kN. Determine the required area of the reinforcing steel if the allowable stresses are 10 MPa and 140 MPa for the concrete and steel, respectively. Use E_{co} = 14 GPa and E_{st} = 200 GPa. (10)

4) A steel rod is stretched between two rigid walls and carries a tensile load of 5000 N at 20°C. If the allowable stress is not to exceed 130 MPa at -15°C, what is the minimum diameter of the rod? Assume α = 11.7 x10-6 /°C and E = 200 GPa. (10)

A)

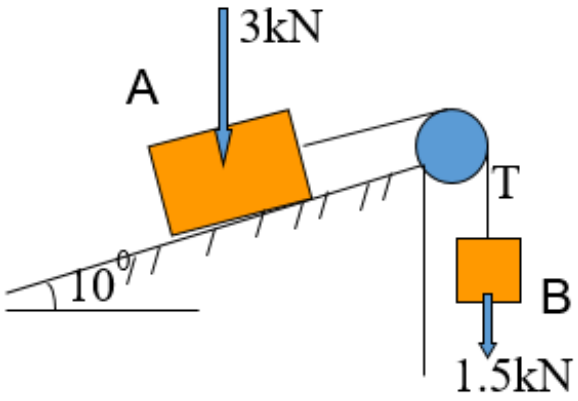
B) A cylindrical pressure vessel is fabricated from steel plating that has a thickness of 20 mm. The diameter of the pressure vessel is 450 mm and its length is 2.0 m. Determine the maximum internal pressure that can be applied if the longitudinal stress is limited to 140 MPa, and the circumferential stress is limited to 60 MPa. Assume circumferential and longitudinal joint efficiency as 60% and 80 % respectively. (10)

5) Define and explain the following (6)

A)

- Centroid and center of gravity
- Equilibrium and resultant
- Degree of redundancy and indeterminate structures.

B) A body of weight 3kN is resting on a rough plane inclined at 10^0 to the horizontal. It is pulled up the plane by means of a light flexible rope running parallel to the plane and passing over a light frictionless pulley at the top of the plane. The portion of the rope beyond the pulley hangs vertically down and carries a weight of 1.5kN at the end. If friction between the body and plane is 0.2 , find tension in the rope, acceleration with which the body moves up the plane, distance moved by the body in 2 secs after starting from rest. (14)



6) A) A block of weight 300 N is placed on a slope of 35^0 with the horizontal. Coefficient of friction between block and slope surface is 0.3. Determine the value of horizontal force P on the body with which the block remains stationary. (12)

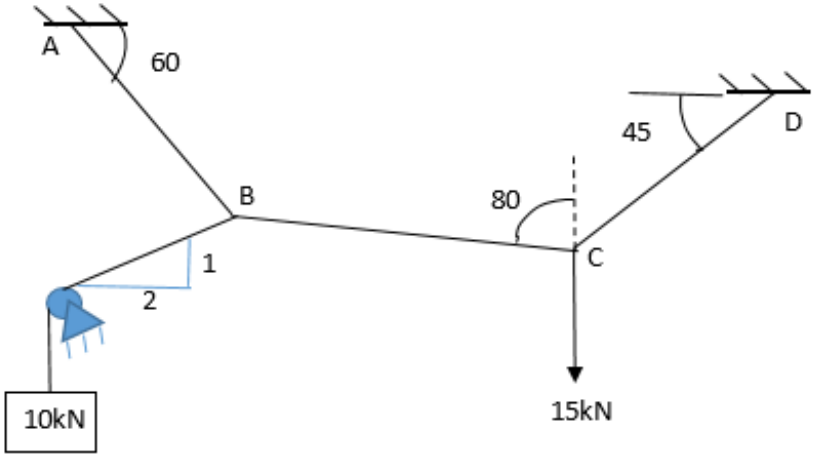
B) State and prove varignon's theorem. (8)

7) A) Derive an expression for the extension of a tapered circular bar subjected to axial force. (10)

B) A steel block of size 100×100 mm square cross section and 300 mm length, is subjected to normal tensile force of 65 kN on 100×100 face and a tensile 150 kN on its two 100×300mm faces. Determine the strains and change in dimensions of the block. Also, determine net change in volume of the block. Take modulus of elasticity as 210 GPa and Poisson's ratio as 0.3. (10)

8) A) Derive the relation between Young's modulus and Rigidity Modulus. (8)

B) Determine the forces in the cables AB, BC and CD the system shown in Fig. (12)



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