Question Paper

Exam Date & Time: 19-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTER FOR APPLIED SCIENCES
FIRST SEMESTER B.SC APPLIED SCIENCES THEORY EXAMINATION
NOVEMBER 2018
MECHANICS OF SOLIDS [ICE 111]

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

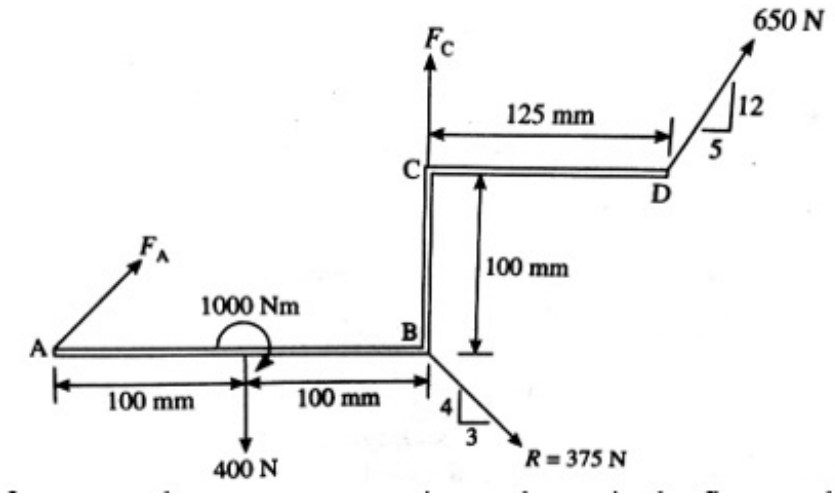
Answer 5 out of 8 questions.

Assume missing data, if any, suitably and indicate them clearly.

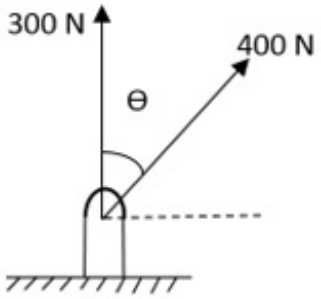
1) Define the following terms (4)

1A) i) Principle of transmissibility of forces
ii) Continuum of a body
iii) Varignon's theorem
iv) Resolution of a force

1B) For the system of five forces shown in figure, R acting at B is the resultant. Determine the unknown forces and also the inclination of the force F_A. (10)



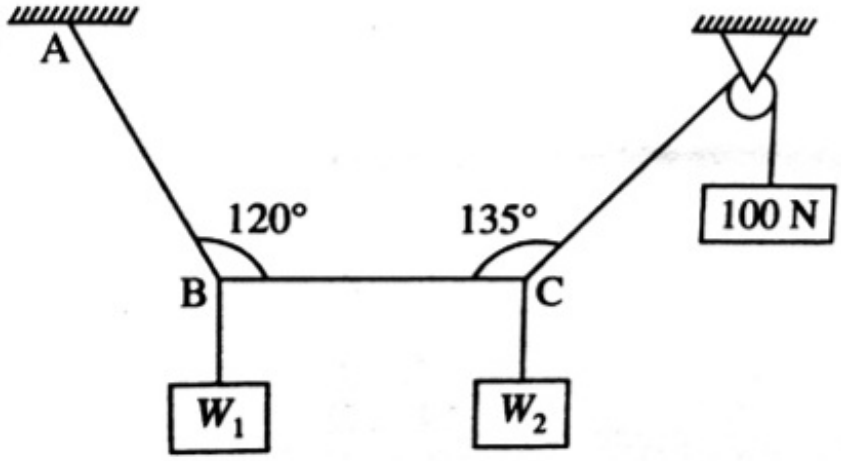
1C) Two forces of 400 N and 300 N act at a point as shown in the figure. The resultant of these two forces is 600 N. Determine the angle between the forces and the direction of the resultant. (6)



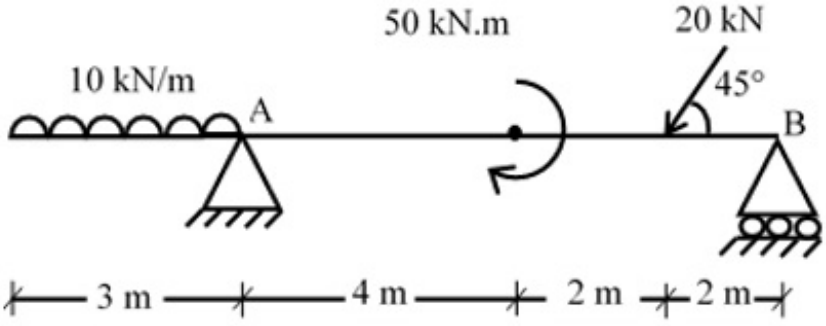
2) Explain with neat sketches (4)

2A) i) free body diagram
ii) space diagram

2B) In figure the portion BC of the string is horizontal and pulley is frictionless. Determine tension in string AB and BC. Also find W1 and W2. (8)



2C) Find the support reaction for the given beam as shown in the figure. (8)

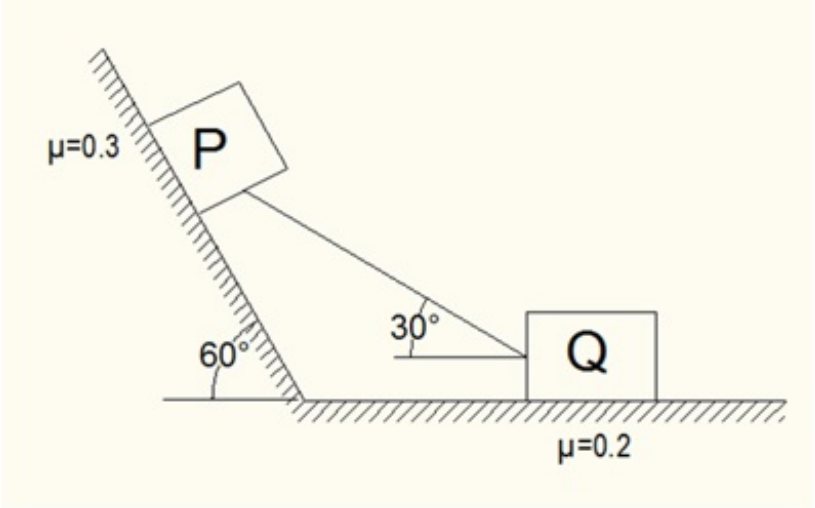


3) Define (2)

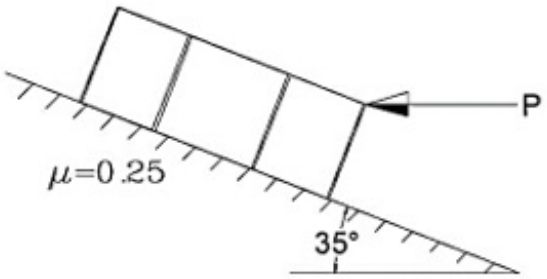
3A) i) Angle of friction

ii) Coefficient of friction

3B) Two blocks P and Q are connected by a rigid bar as shown in figure. If the weight of the block P is 2800N, determine the minimum weight of block Q to prevent sliding. Neglect the weight of connecting rod. (8)



3C) The block shown in figure has weight of 5689.8N. (10)
i) If P = 6000N, find the magnitude and sense of the frictional force which acts on the block.
ii) What value of P will cause the block to have impending motion up the plane?



4) i) State and prove parallel axis theorem of M.I. (6)
ii) Explain radius of gyration

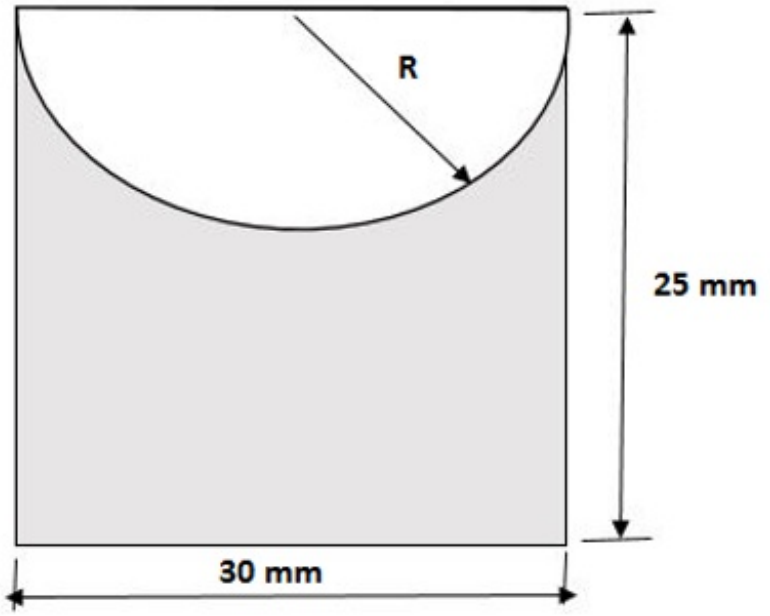
4A)

4B) Define the following: (4)

i) Shear stress
ii) Shear Strain
iii) State of simple shear
iv) Complementary shear

4C) Find the radius of gyration of the shaded area shown in figure w.r.t both horizontal and vertical centroidal axes. All (10)

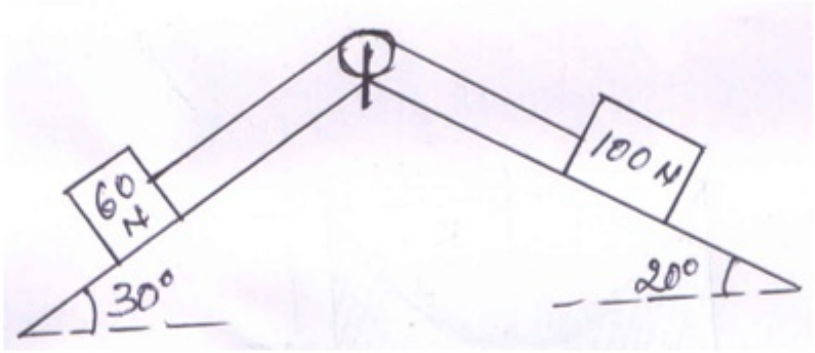
dimensions are in mm.



5) Explain D'Alembert's principle and Impulse Momentum principle used in kinetics. (4)

5A)

5B) Determine the acceleration and tension in the string while 100 N block moves down the plane. Assume the planes and pulley as smooth. (8)



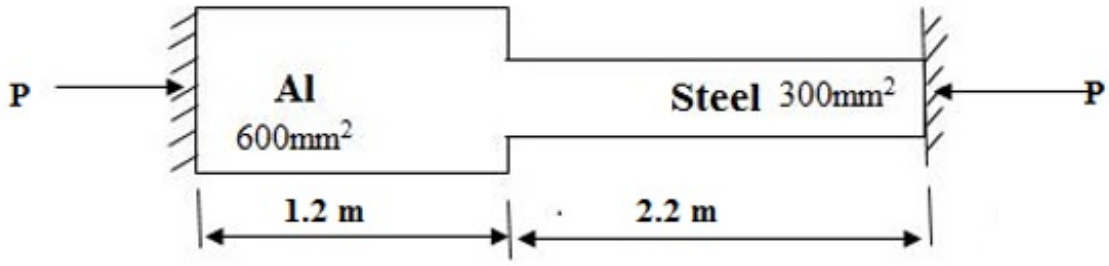
5C) A hammer of mass 1000 kg drops from a height of 0.6 m on a pile of mass 500 kg. Find, (8)
a) The common velocity after impact
b) Resistance of the ground if the pile comes to rest after penetrating 50mm in to the ground.

6) Define FOUR elastic constants with usual notations. (6)

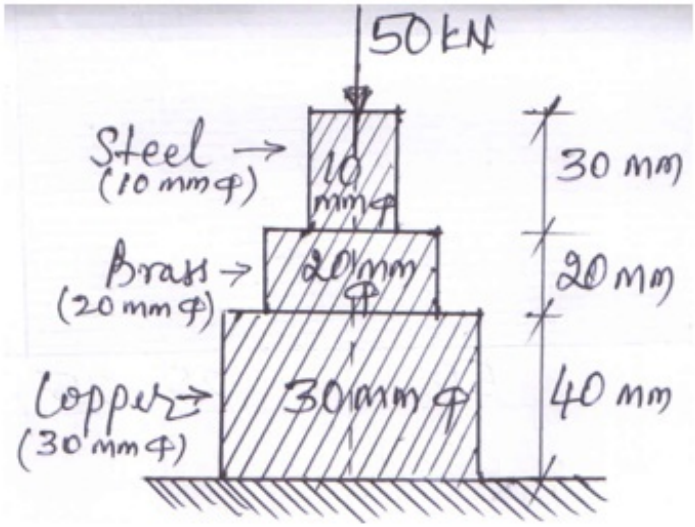
6A)

6B) A composite bar rigidly connected at the ends is acted upon by (8)

axial force P as shown in the figure is heated through 40^0 C. If $E_{Aluminium}$ = 70 GPa, E_{Steel} = 200 GPa, $\alpha_{Aluminium}$ = 18.5 x $10^{-6}/^0C$, α_{Steel} = 12x $10^{-6}/^0C$. The cross section area of Aluminium and steel is 600 mm^2 and 300 mm^2 respectively. Find the reaction developed at the supports and corresponding normal stress in each segment.

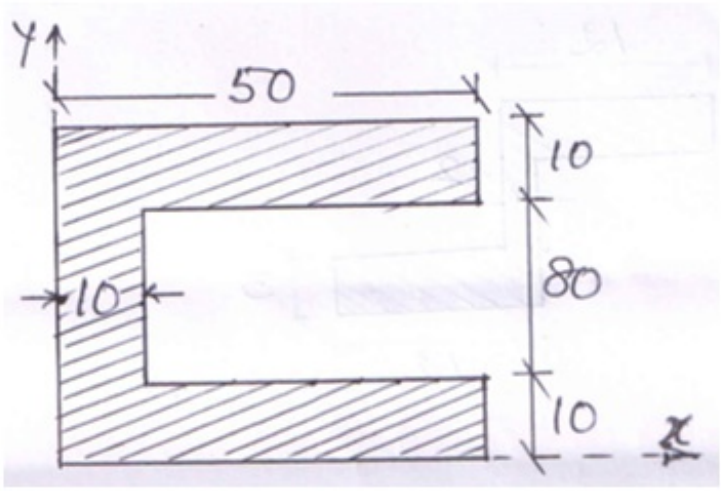


6C) Determine the total compression of the bar shown in the figure. Take E_{st} = 210 GPa, E_{br} = 105 GPa and E_{cu} = 100 GPa (6)



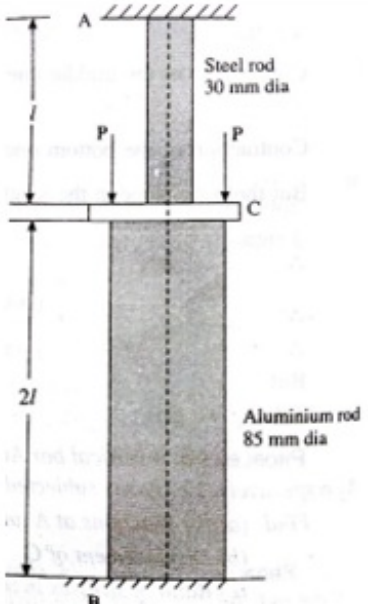
7) Determine the centroid of the shaded area shown in the Fig. w.r.t the axes shown. All dimensions are in mm (4)

7A)



7B) Derive the relation between Modulus of Elasticity and Modulus of Rigidity. (6)

7C) An 85 mm diameter aluminium rod and a 30 mm diameter steel rod are rigidly connected at the ends A and B to rigid supports and to a rigid plate at C as shown in the figure below. Lengths of steel and aluminium rods are 'l' and '2l' respectively. Two equal and symmetrically placed loads P = 50 kN are applied on a rigid plate. Determine the stresses in the rods, if the temperature of steel rod is increased by 10^{o}C. Consider $E_s = 2x10^5$ N/mm^2; $E_{Al} = 0.69 \times 10^5$ N/mm^2 and $\alpha_s = 1.2 \times 10^{-5}$/^{o}C ; $\alpha_{Al} = 2.3x10^{-5}$ / ^{o}C (10)

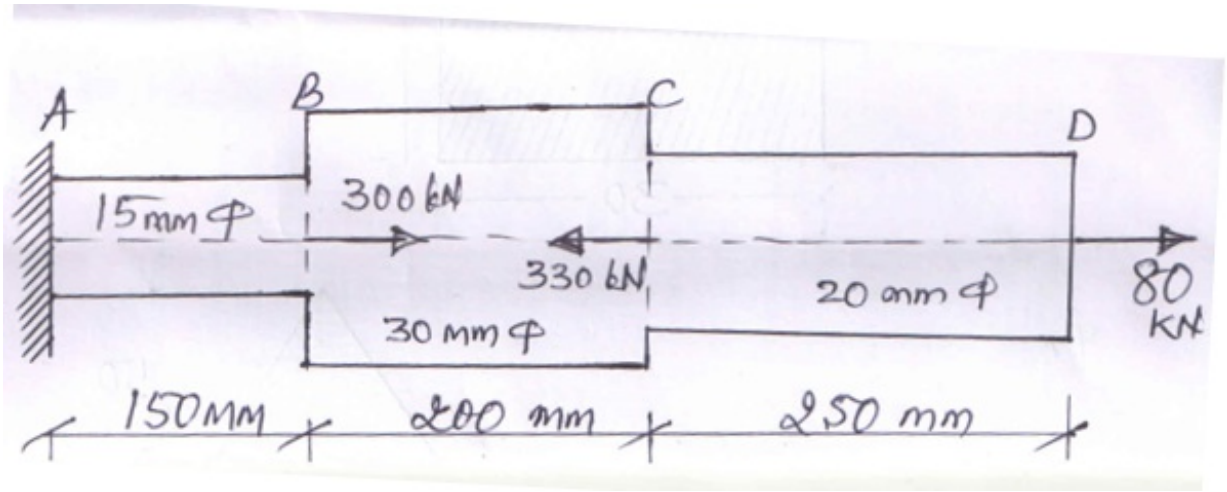


8) Define compound bar. List the assumptions made in the analysis of compound bar. (4)

8A)

8B) A steel circular bar has three segments as shown in the fig, (8)

Determine,
i) The total elongation of bar
ii) The length of the middle segment (BC) to have zero elongation of the bar.
iii) The diameter of the last segment (CD) to have zero elongation of the bar.
Take E = 205 GPa



8C) A cylindrical boiler is 700 mm in diameter and 1800 mm in length. It is required to withstand a pressure of 1000 kPa. If the permissible tensile stress is 22 MPa, permissible shear stress is 10 MPa and permissible change in diameter is 0.25 mm, determine minimum thickness of metal wall required. Take E = 90 GPa and μ = 0.31 (8)

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