UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	LGD22003
COURSE TITLE	:	MECHANICS OF MATERIALS
PROGRAMME NAME	:	DIPLOMA OF ENGINEERING TECHNOLOGY (NAVAL ARCHITECTURE AND SHIPBUILDING)
DATE	:	26 JANUARY 2025
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Section A consist total of 60 marks. Answer ALL questions.
5. Section B consist of three questions. Answer TWO (2) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 16 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 60 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Stress distribution is a fundamental concept in engineering that describes how forces are transmitted through material when subjected to external loads. This concept is particularly important in geotechnical engineering, where understanding how loads affect soil behavior is essential for the design and stability of structures such as buildings, bridges, and jetty construction.

Refer Below - Figure1 : Bridge Structure .

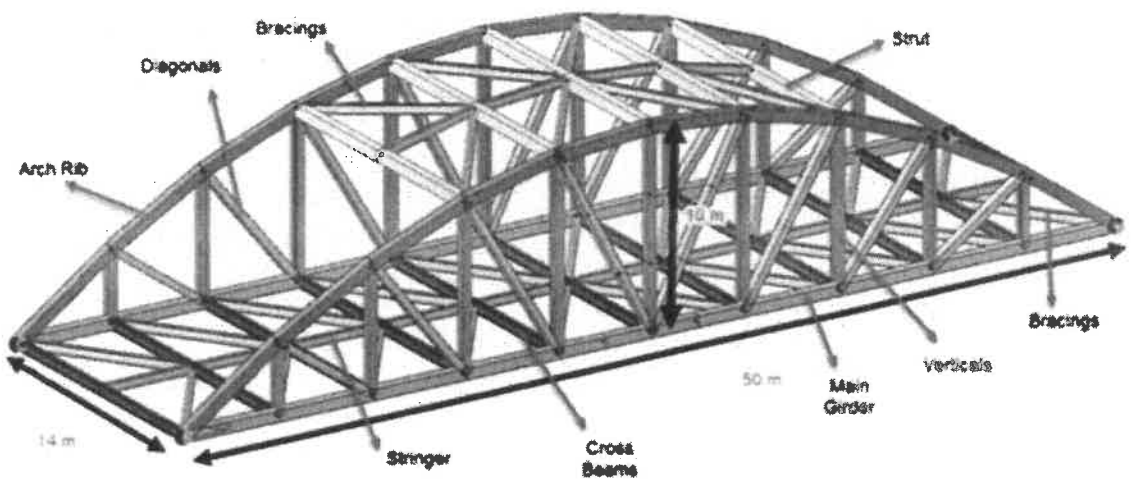

Figure 1: Bridge Structure

(a) A tension test was performed on a magnesium alloy specimen having a diameter 0.5 mm and gauge length 2 mm. The resulting stress–strain diagram is shown in the figure. Determine;

i) Modulus of Elasticity, E

ii) Yield strength of the material

Refer Below - Figure2 : Stress-Strain Graph .

(10 marks)

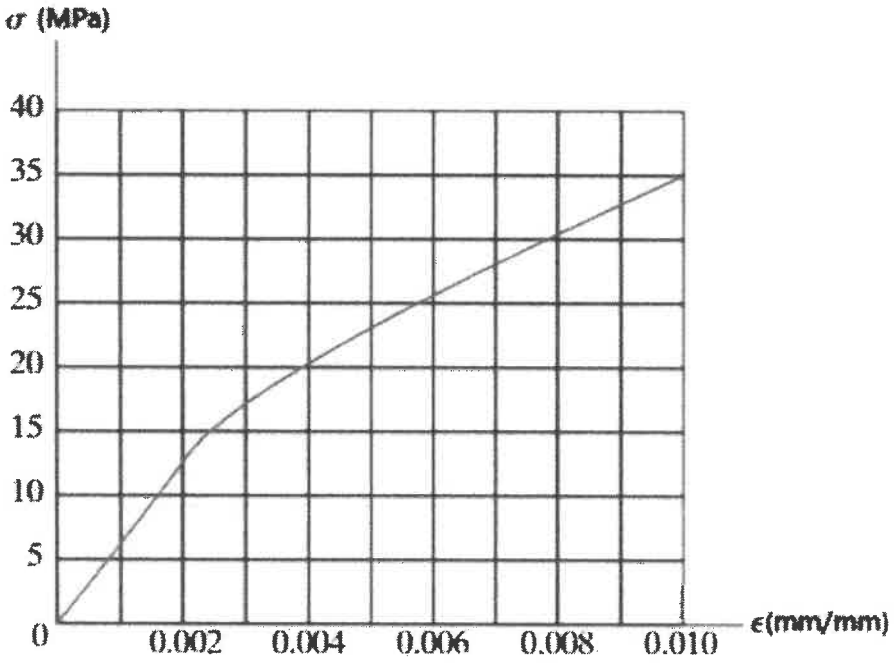

Figure 2: Stress-Strain Graph

(b) The yoke-and-rod connection is subjected to a tensile force of 5 kN. Determine;

i) Free Body Diagram (FBD) of the system

ii) Stress value at 40 mm diameter

iii) Stress value at 30 mm diameter

iv) Average shear stress at Pin A

Refer Below - Figure3 : Yoke Rod Connector .

(10 marks)

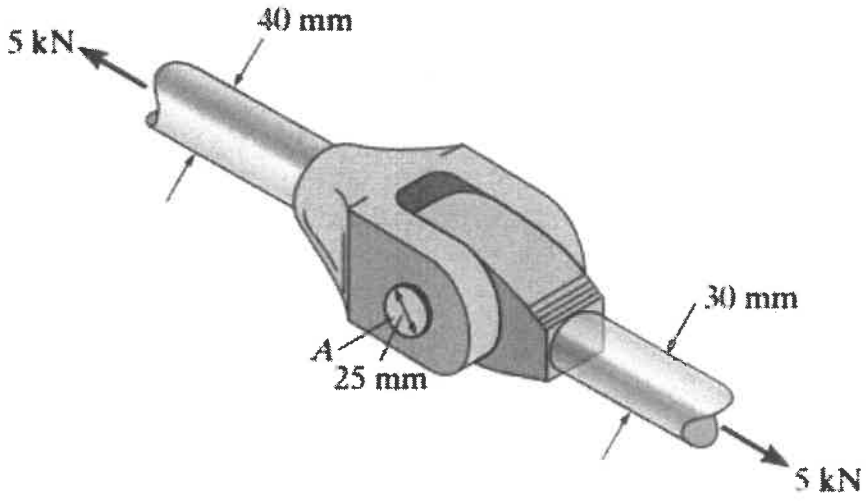

Figure 3: Yoke Rod Connector

Question 2

Beams are frequently classified on the basis of supports or reactions. A beam supported by pins, rollers, or smooth surfaces at the ends is called a simple beam. A simple support will develop a reaction normal to the beam, but will not produce a moment at the reaction.
Refer Below - Figure4 : Three Point Bending .

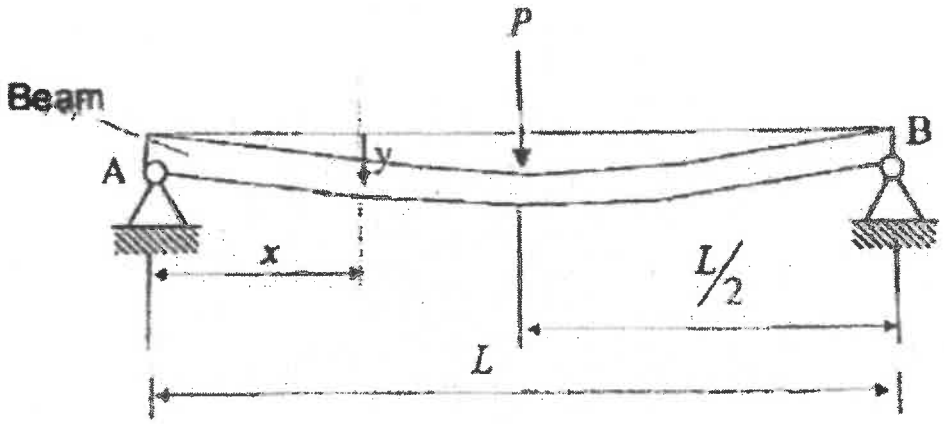

Figure 4: Three Point Bending

(a) List of the three support reaction pin with their diagram

(7 marks)

(b) Describe the four different types of resulting loading:
a) Normal force, N
b) Shear force, V
c) Torque, T
d) Bending moment, M

(8 marks)

(c) Determine the internal normal force, shear force, and bending moment at point C in the beam.
Refer Below - Figure5 : Support Beam .

(5 marks)

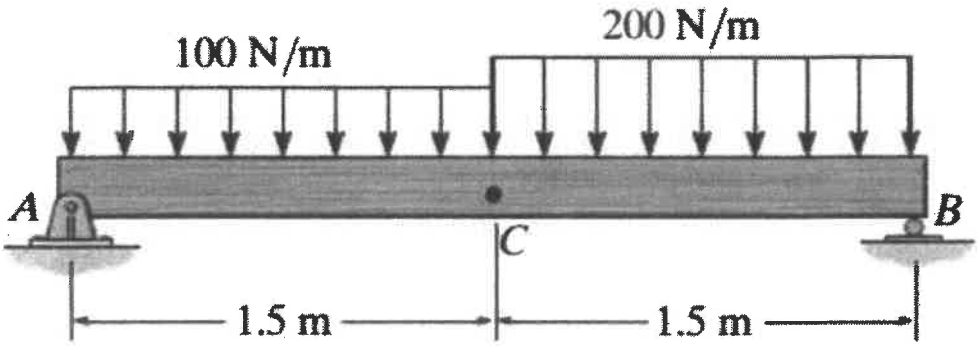

Figure 5: Support Beam

Question 3

Stress–strain analysis (or stress analysis) is an engineering discipline that uses many methods to determine the stresses and strains in materials and structures subjected to forces.

Refer Below - Figure6 : Stress Distribution for Metal Plate .

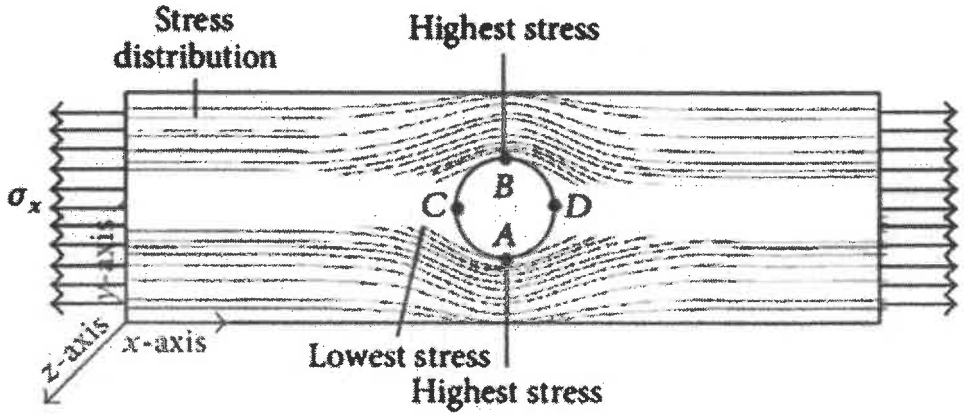

Figure 6: Stress Distribution for Metal Plate

(a) Define the Normal stress and Normal strain

(4 marks)

(b) The bar has a constant width of 35 mm and a thickness of 10 mm. Determine;
i) Free Body Diagram (FBD) for the bar plate
ii) Normal stress at region BC

Refer Below - Figure7 : The Plate Bar .

(6 marks)

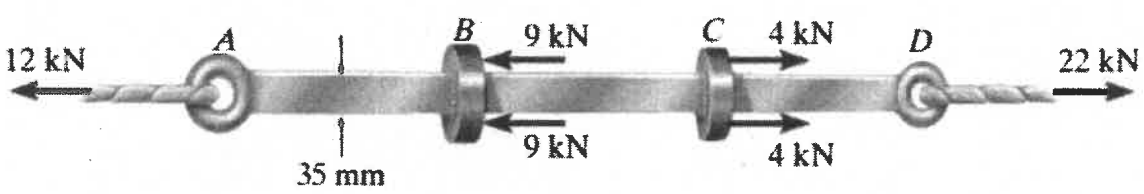

Figure 7: The Plate Bar

(c) The 80-kg lamp is supported by two rods AB and BC. If AB has a diameter of 10 mm and BC has a diameter of 8 mm, determine;

i) Sketch the Free Body Diagram (FBD) for this system

ii) Force at BC

iii) Force at BA

iv) Normal stress at BC

v) Normal stress BA

Refer Below - Figure8 : Hanging Lamp .

(10 marks)

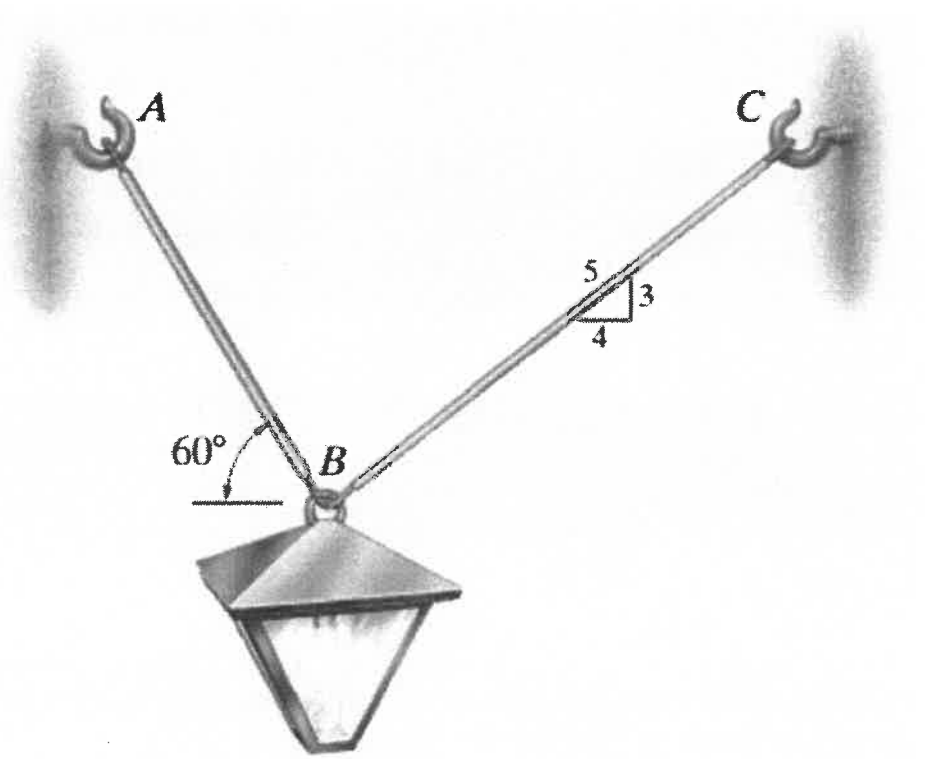

Figure 8: Hanging Lamp

SECTION B (Total: 40 marks)

Answer TWO (2) questions only.

Please use the answer booklet provided.

Question 1

When a deformable body is subjected to an axial tensile force, not only does it elongate but it also contracts laterally. For example, if a rubber band is stretched, it can be noted that both the thickness and width of the band are decreased. Likewise, a compressive force acting on a body causes it to contract in the direction of the force and yet its sides expand laterally.

(a) Consider a bar having an original radius r and length L and subjected to the tensile force P. This force elongates the bar by an amount δ, and its radius contracts by an amount δ'. Define

i) The Poisson Ratio with it formula for the mechanics of materials

ii) The Shear Modulus of Elasticity with it formula for the mechanics of materials

Refer Below - Figure9 : Tensional Testing for Rod .

(6 marks)

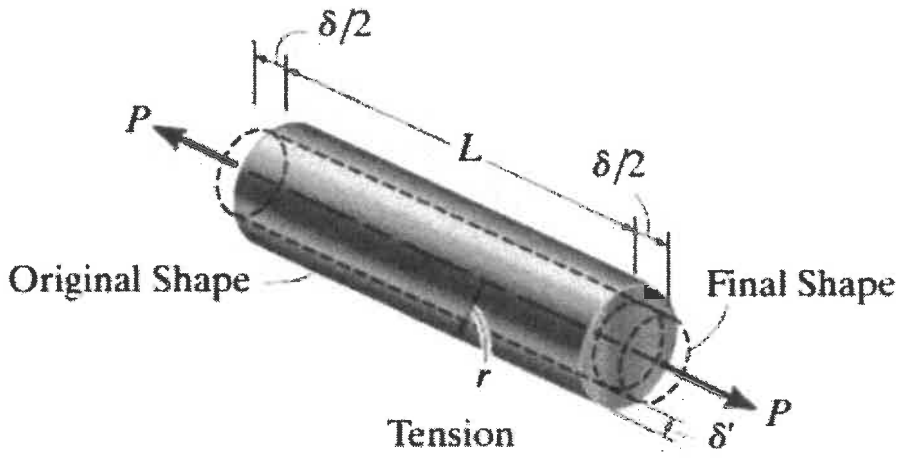

Figure 9: Tensional Testing for Rod

(b) An aluminum specimen has a diameter of d = 25 mm and a gauge length of L = 250 mm. If a force of 165 kN elongates the gauge length by 1.20 mm. Take G_{al} = 26 GPa and σ_Y = 440 MPa. Determine;

i) Normal Stress

ii) Normal Strain

iii) The modulus of elasticity, E.

iv) Poisson Ratio

Refer Below - Figure10 : Aluminum Rod .

(10 marks)

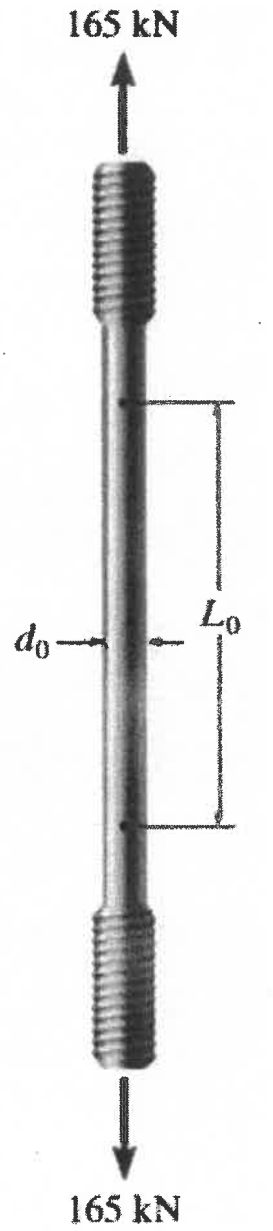

Figure 10: Aluminum Rod

(c) The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, determine
i) Change in its length
ii) Change in its diameter.
Use Ep = 2.70 GPa, νp = 0.4.

Refer Below - Figure11 : Tensional Acrylic Plastic .

(4 marks)

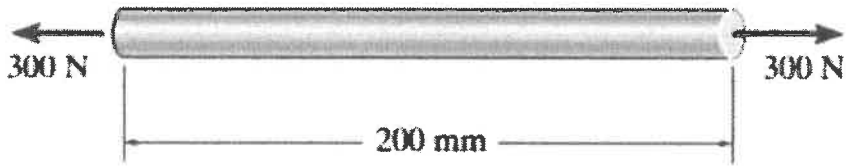

Figure 11: Tensional Acrylic Plastic

Question 2

The strength of a material depends on its ability to sustain a load without undue deformation or failure. This property is inherent in the material itself and must be determined by experiment. One of the most important tests to perform in this regard is the tension or compression test.

Refer Below - Figure12 : Universal Testing Machine (UTM) .

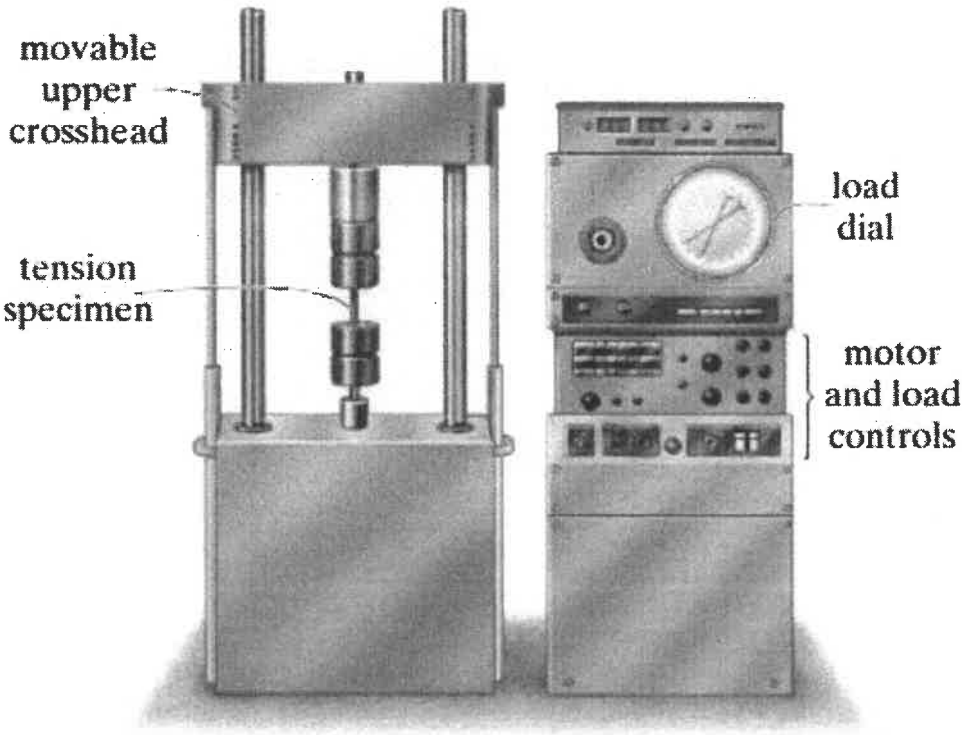

Figure 12: Universal Testing Machine (UTM)

(a) The corresponding values of σ and ε are plotted so that the vertical axis is the stress and the horizontal axis is the strain, the resulting curve is called a conventional stress–strain diagram. From the diagram, indicate

i) Elastic behavior of materials

ii) Ultimate stress

iii) Rapture stress

Refer Below - Figure13 : Stress-Strain Diagram .

(6 marks)

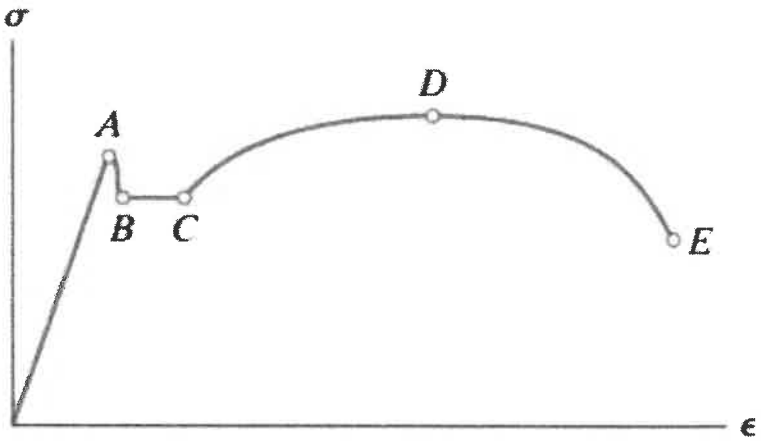

Figure 13: Stress-Strain Diagram

(b) An aluminum rod has a circular cross section and is subjected to an axial load of 10 kN and 15.0 mm of diameter. Determine;
i) Normal stress at AB
ii) Normal stress BC

Refer Below - Figure14 : Aluminum Rod .

(4 marks)

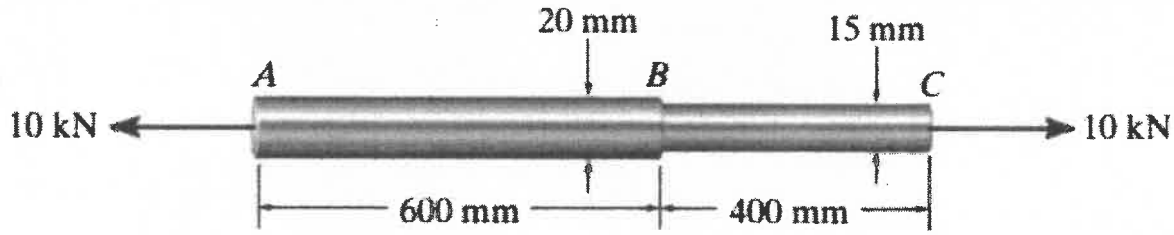

Figure 14: Aluminum Rod

(c) A tension test was performed on a steel specimen having an original diameter of 12.0 mm. and gauge length of 50.0 mm. Using the data listed in the table, plot the stress–strain diagram and determine approximately the modulus of toughness.

Refer Below - Table1 : Load Tensile Testing Result .

(10 marks)

Table 1: Load Tensile Testing Result

Load (kN)	Elongation (mm)
0.0	0.0000
11.0	0.0230
29.0	0.0640
38.0	0.1020
41.0	0.1650
43.0	0.2490
53.0	1.0160
62.0	3.0480
64.0	6.3500
62.0	8.8900
58.7	11.9380

Question 3

When the material is stressed beyond the yield point, permanent deformation will occur. In particular, steel has a region of yielding, whereby the material will exhibit an increase in strain with no increase in stress. The region of strain hardening causes further yielding of the material with a corresponding increase in stress. Finally, at the ultimate stress, a localized region on the specimen will begin to constrict, forming a neck. It is after this that the fracture occurs.

(a) i) Define the exhibit for ductile materials with stress-strain diagram for materials characteristic behavior

ii) Define the exhibit for brittle materials with stress-strain diagram for materials characteristic behavior

(10 marks)

(b) The assembly consists of a steel rod CB and an aluminum rod BA, each having a diameter of 12 mm.If the rod is subjected to the axial loadings at A and at the coupling B, determine the displacement of the coupling B and the end A. The unstretched length of each segment is shown in the figure. Neglect the size of the connections at B and C, and assume that they are rigid. Est = 200 GPa, Eal = 70 GPa

Determine;

i) The displacement at coupling B

ii) The displacement of end A

Refer Below - Figure15 : Assembly Rod .

(10 marks)

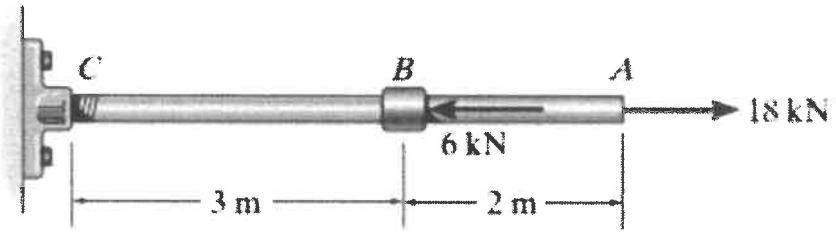

Figure 15: Assembly Rod

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