ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION, SCIENCE AND TECHNOLOGY DEVELOPMENT

HIGHER EDUCATION EXAMINATIONS COUNCIL (HEXCO)

NATIONAL DIPLOMA

IN

CIVIL/WATER RESOURCES /IRRIGATION ENGINEERING

SUBJECT: Theory of Structures **PAPER NO:** 578/15/S02

DURATION: 3 Hours

OCT/NOV 2018 EXAMINATION

REQUIREMENTS

Scientific Calculator

INSTRUCTIONS TO CANDIDATE

Answer any five (5) questions

This paper consists of 4 printed pages.

PAPER NO: 578/15/S02 - THEORY OF STRUCTURES

QUESTION 1

a) State Moh's moment area theorems. (5 marks)

b) Determine the fixed moments of the beam shown in Fig Q1 using the moment –area method. (15 marks)

QUESTION 2

a) Point out four types of statistically indeterminate beans common in structural engineering (4 marks)

b) A continuous beam ABC is carrying uniformly distributed load of 2KN/m as shown in Fig Q2.
Calculate all the reactions at the supports and hence draw the sheer force and bending moment diagrams.

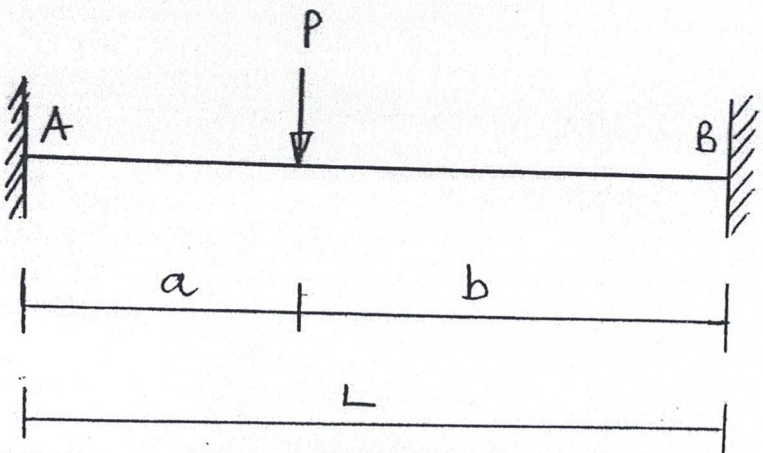


Fig. Q1

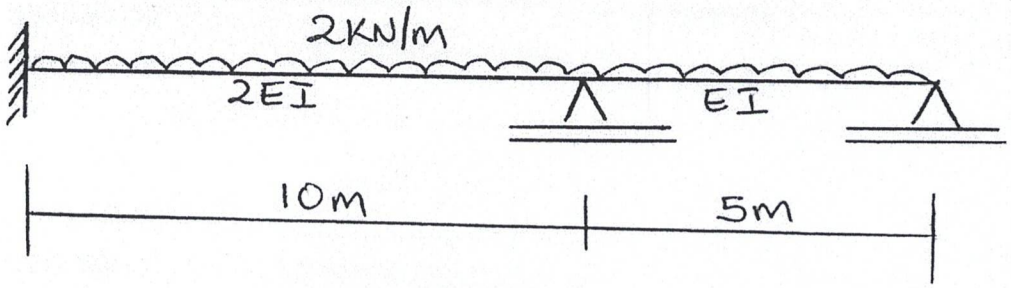


Fig. Q2

(16 marks)

QUESTION 3

a) Distinguish between factor of safety and load factor. (4 marks)

b) A monel shell (Em = 170GPa) of outside diameter 12mm and internal diameter 8mm encloses a brass core (Eb = 96GPa) of diameter 6mm. Initially both core and shell are of length 100mm. A load P is applied to both shell and core through a cap plate. Determine the load P required to compress both shell and core by approximately 0.10mm. (10 marks)

c) A compound bar is constructed from three bars 50mm wide by 12mm thick fastened together to form a bar 50mm wide by 36mm thick. The middle bar is of aluminium alloy for which E = 70GPa and the outside bars are of brass with E = 100GPa. If the bars are initially fastened at $18^{0}C$ and the temperature of the whole assembly is then raised to $50^{0}C$, determine the stresses set up in the brass and aluminium.

$\alpha_B = 18 \times 10^{-6}$ per ^{0}C

$\alpha_A = 22 \times 10^{-6}$ per ^{0}C (6 marks)

QUESTION 4

a) i) For a rectangular beam section of width b and depth d, carrying a shear force Q, derive the general expression for the shear stress at any depth, given that y is the vertical distance from the neutral axis. (8 marks)

ii) Show that the maximum shear stress is

$\tau_{max} = \frac{3}{2} \frac{Q}{bd}$ (2 marks)

b) The I - section beam with flange width 150mm, flange thickness 20mm, web depth 210mm and web thickness 10mm is loaded such that at a certain section there is a bending moment of 75KNm together with a vertical shearing force. Calculate the value of the shearing force if the maximum shear stress in the bean is not to exceed 120MPa. (10 marks)

QUESTION 5

A 7.2m long steel tube having internal and external diameters of 70mm and 75mm respectively is to be used as a pin-ended column.

a) Determine the maximum axial load the column can support without bucking. (15 marks)

b) Check whether the Euler's formula is appropriate or not. Take Es = 200GPa; 6y = 250MPa. (5 marks)

QUESTION 6

a) Calculate the reactions and end moments for the rigid frame shown in Fig Q6. (10 marks)

b) Draw the Shear force and Bending moment diagrams. (10 marks)

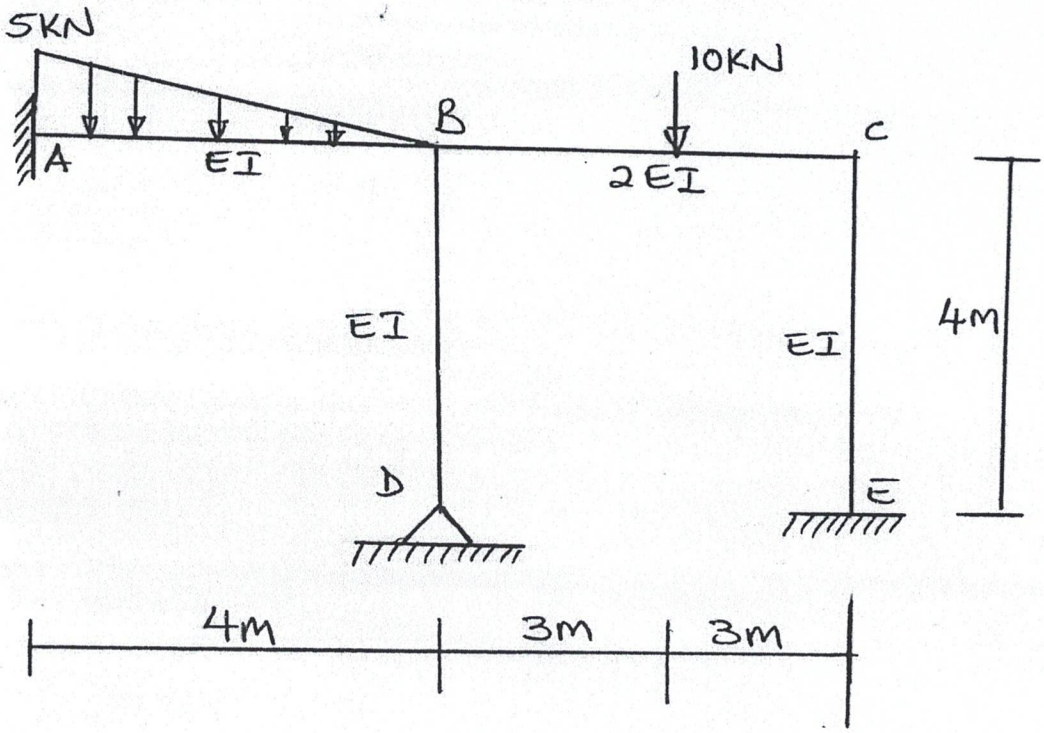
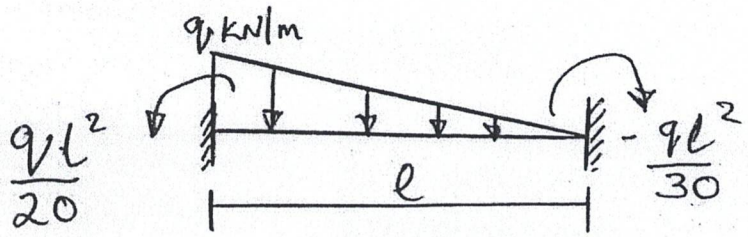


Fig Q6



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