UNIVERSITY
OF
JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : METALLURGY*
SUBJECT	:	**STRENGTH OF MATERIALS II**
CODE	:	**TST 2111**
DATE	:	SUMMER SSA EXAM 2017 12 JANUARY 2017
DURATION	:	(SESSION 3) 15:00 – 18:00
WEIGHT	:	40:60
TOTAL MARKS	:	102
FULL MARKS	:	100

EXAMINER	:	MR K. TEKWEME
MODERATOR	:	MR T. MILLER
NUMBER OF PAGES	:	4 PAGES (front page included)

INSTRUCTIONS:	ALL SKETCHES MUST BE DONE WITH DRAWING INSTRUMENTS. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
REQUIREMENTS:	GRAPH PAPER.

2/...

QUESTION 1

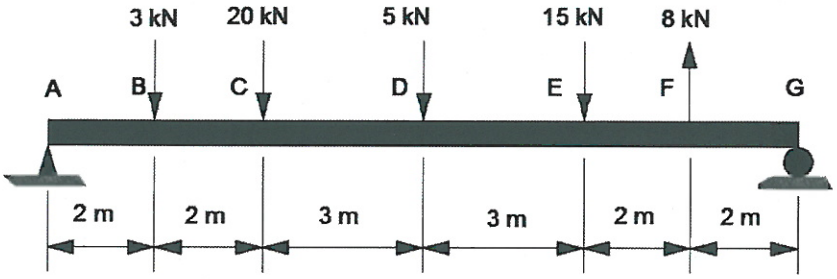

Figure 1

For the simply supported beam shown in Figure 1:

1.1 determine the support reactions at A and G, (4)

1.2 draw the shear force diagram, (12)

1.3 draw the bending moment diagram. (12)

[28]

QUESTION 2

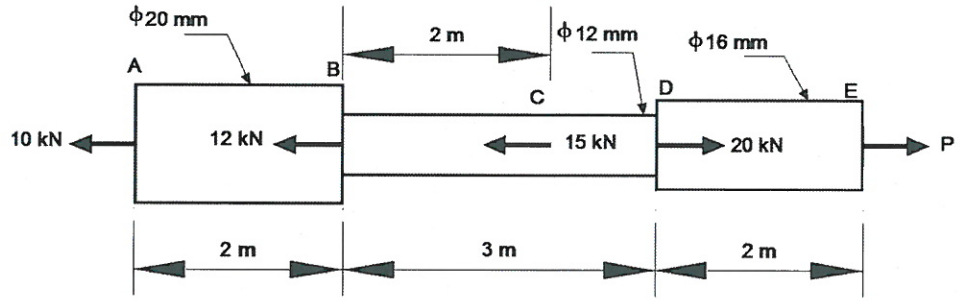

Figure 2

For the specimen AE shown in Figure 2, determine:

2.1 the force P if the member is in equilibrium, (2)

2.2 the stresses in the sections AB, BC, CD and DE, (12)

2.3 the change in length in each section, (4)

2.4 the total change in length. (5)

The following formulae may be used:

$$E = \frac{\sigma}{\varepsilon}; \qquad \varepsilon = \frac{\Delta l}{l}; \qquad \sigma = \frac{P}{A}; \qquad \Delta l = \frac{Pl}{AE}$$

[23]

QUESTION 3

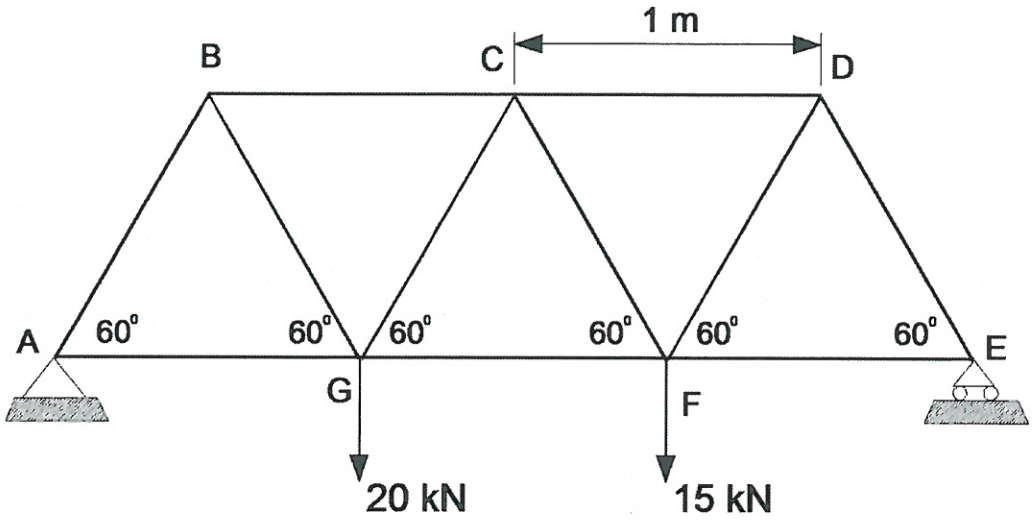

Figure 3

For the simple truss shown in Figure 3:

3.1 determine the support reactions at A and E, (4)

3.2 determine the forces and nature of the forces in each member. (30)

[34]

QUESTION 4

A steam boiler with an inside diameter of 2 m is 12 mm thick. The efficiencies of the longitudinal and circumferential joints are 65 % and 58 % respectively. If the circumferential stress (hoop) is 743 kPa and the factor of safety 5:

4.1 determine the ultimate tensile stress for the material, (3)

4.2 determine the safe pressure, if only the longitudinal stress is considered, (3)

4.3 determine the maximum safe pressure. (1)

The following formulae may be used:

$$\sigma_L = \frac{p_L Sd}{4t\eta_c}; \quad \sigma_C = \frac{p_C Sd}{2t\eta_L}$$

[7]

QUESTION 5

A composite rod at a temperature of 150^0 C consists of an aluminium rod 18 mm in diameter and 250 mm long joined rigidly to the end of a steel rod 10 mm in diameter and 100 mm long. If the ends of the composite rod are rigidly clamped at this temperature to restrict any contraction on cooling, calculate the stress in the aluminium and steel if the temperature drops to 15^0 C.

Let E_{AL} = 70 GPa; E_{ST} = 200 GPa; α_{AL} =23x10^{-6}/ ^{0}C; α_{ST} =12x10^{-6}/ ^{0}C.

The following formulae may be used:

$$\sigma_1 a_1 = \sigma_2 a_2 \; ; \; \Delta l = \Delta l_1 + \Delta l_2 = \left(\frac{\sigma l}{E}\right)_1 + \left(\frac{\sigma l}{E}\right)_2 \; ; \; \Delta l = l_1 \alpha_1 t + l \alpha_2 t$$

[10]

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