UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : METALLURGY*
SUBJECT	:	**STRENGTH OF MATERIALS II**
CODE	:	**TST 2111**
DATE	:	SUMMER EXAMINATION 2015 10 NOVEMBER 2015
DURATION	:	(SESSION 2) 12:30 - 15:30
WEIGHT	:	40:60
TOTAL MARKS	:	106
FULL MARKS	:	100

EXAMINER	:	MR K. TEKWEME
MODERATOR	:	MR T. MILLER
NUMBER OF PAGES	:	6 PAGES (front page included)

INSTRUCTIONS:	ALL SKETCHES MUST BE DONE WITH DRAWING INSTRUMENTS. MARKS WILL BE DEDUCTED FOR UNTIDY WORK. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
REQUIREMENTS:	GRAPH PAPER.

2/...

QUESTION 1

A tensile test was carried out on an alloy specimen. The data recorded was used to plot the load-extension diagram as shown in Figure 1.1. For easy and accurate data reading, the enlarged (zoomed) Yield Strength portion of the diagram is shown in Figure 1.2.

The following data is available:

- Initial gauge length 50, 0 mm
- Final gauge length after fracture 60, 2 mm
- Initial diameter 5, 0 mm
- Fracture diameter 3, 2 mm

Using the diagrams shown in Figure 1.1 and Figure 1.2 determine:

1.1 the tensile strength in Figure 1.1, (3)

1.2 the upper yield stress, (2)

1.3 the percentage reduction of area, (3)

1.4 the percentage elongation, (2)

1.5 the nominal breaking stress, (2)

1.6 the true breaking stress and (1)

1.7 the modulus of elasticity. (3)

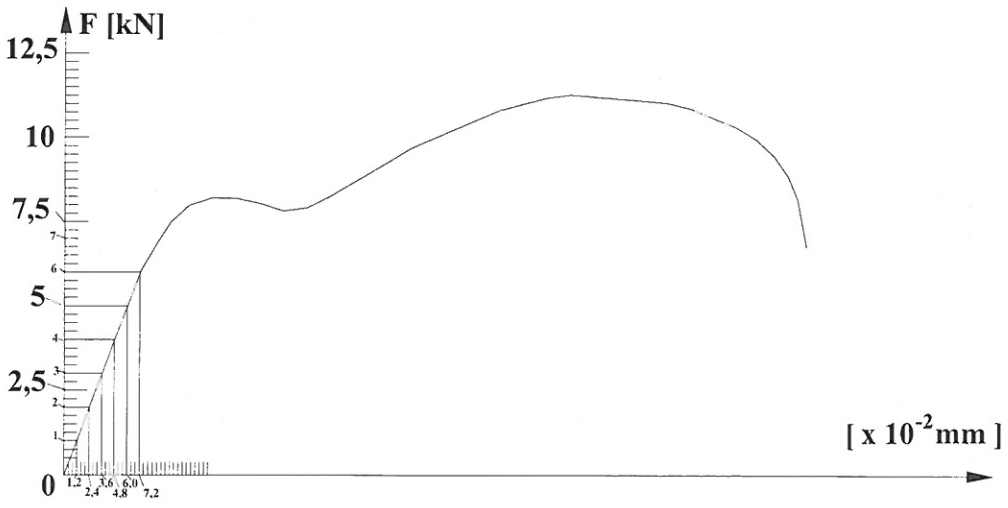

Figure 1.1

Question 1 (continued)

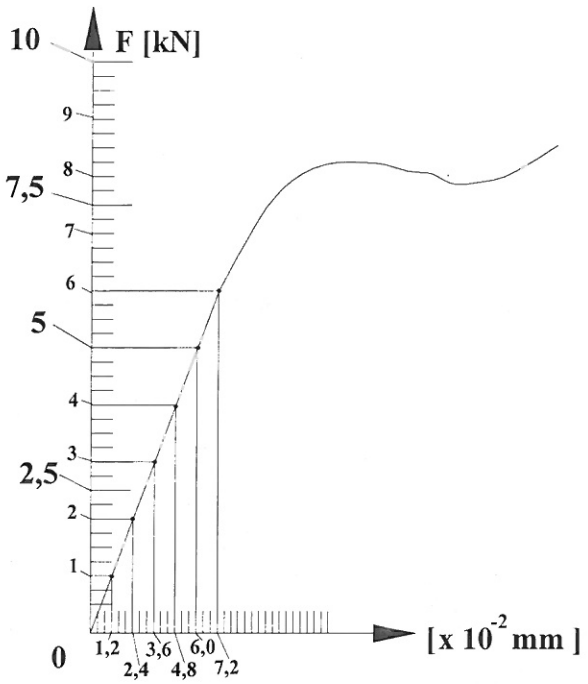

Figure 1.2

The following formulae may be used:

$$\%\ elongation = \frac{L_{final} - L_{initial}}{L_{initial}} \times 100; \%areareduction = \frac{A_{initial} - A_{final}}{A_{initial}} \times 100; A = \frac{\pi d^2}{4}; E = \frac{\sigma}{\varepsilon};$$

$$\varepsilon = \frac{\Delta l}{l}$$

[16]

QUESTION 2

A cylindrical vessel has an internal diameter of 1.6 m and is made of 10 mm thick plate. The efficiencies of the longitudinal and circumferential joints are 72 % and 56 % respectively. If the ultimate tensile stress for the material is 400 MPa and the factor of safety is 6, determine:

2.1 the safe pressure if only the circumferential stress is considered, (3)

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

2.3 the maximum safe pressure. (1)

The following formulae may be used:

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

[7]

QUESTION 3

A horizontal beam 11 m in length is simply supported at points B and E as shown in Figure 2. If the force applied at point D is 92.83 kN.

3.1 Calculate the reactions at points B and E; (4)

3.2 Plot the shear force and bending moment diagrams, inserting all the salient (relevant) values. (19)

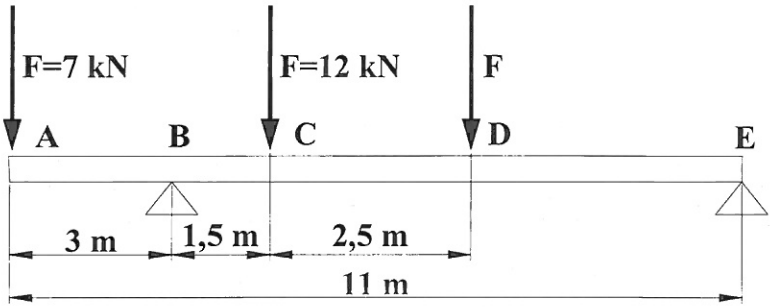

Figure 2

[23]

QUESTION 4

The rod AD is subjected to the indicated forces shown in Figure 3 below. If the modulus of elasticity is 200 GPa, determine:

4.1 the magnitude of force P required for equilibrium of rod AD; (2)

4.2 the stress induced in each section of the rod; (6)

4.3 the change in length of different parts of the rod; (3)

4.4 the total change in length of the rod. (4)

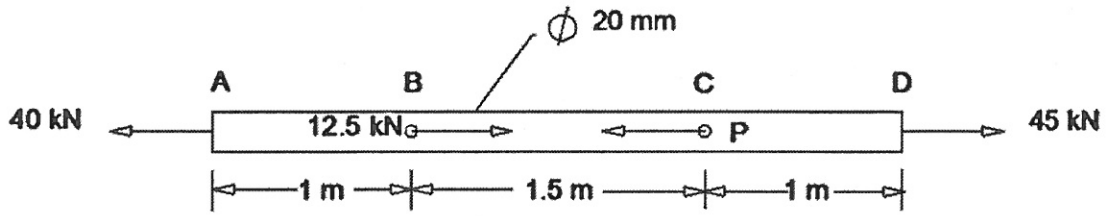

Figure 3

[15]

QUESTION 5

Determine the reactions at the supports, the forces and the nature of the stresses in members AB, AC, AD, BD and DC of the pin-jointed structure shown in Figure 4 below.

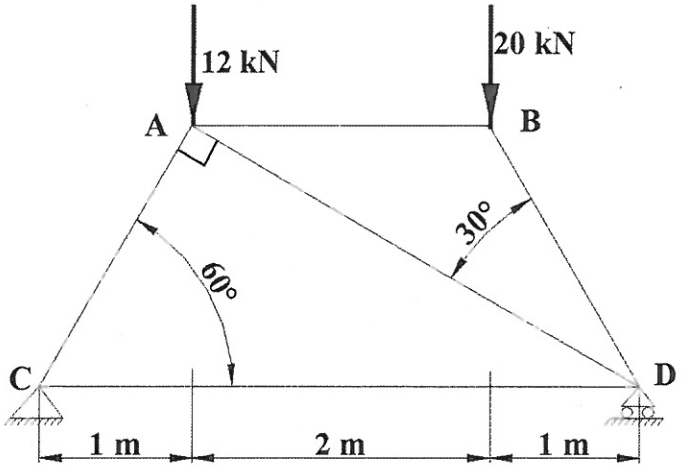

Figure 4

[17]

QUESTION 6

An effective pull of 6 kN is applied at the rim of an 800 mm diameter pulley that twists its hollow shaft through an angle of 1° over a length of 1 m. If the shaft has an inside diameter of 30 mm and an outside diameter of 55 mm, Calculate:

6.1 the maximum shear stress induced in the shaft; (7)

6.2 the modulus of rigidity; (2)

6.3 the shear strain and (2)

6.4 the power that the shaft would transmit at 200 r/ min. (2)

The following formulae may be used:

$$\theta = \frac{TL}{GJ} \quad ; J = \frac{\pi \times D^4}{32} ; J = \frac{\pi \times \left(D^4 - d^4\right)}{32} \quad ; \frac{T}{J} = \frac{\tau}{r} ; P = \frac{2\pi NT}{60} \quad ; \gamma = \frac{\tau}{G}$$

[13]

QUESTION 7

The Figure 5 below shows a built-up section with all dimensions in mm. Determine

7.1 the position of the centroid; (5)

7.2 the second moment of area about a horizontal axis through the centroid of area. (10)

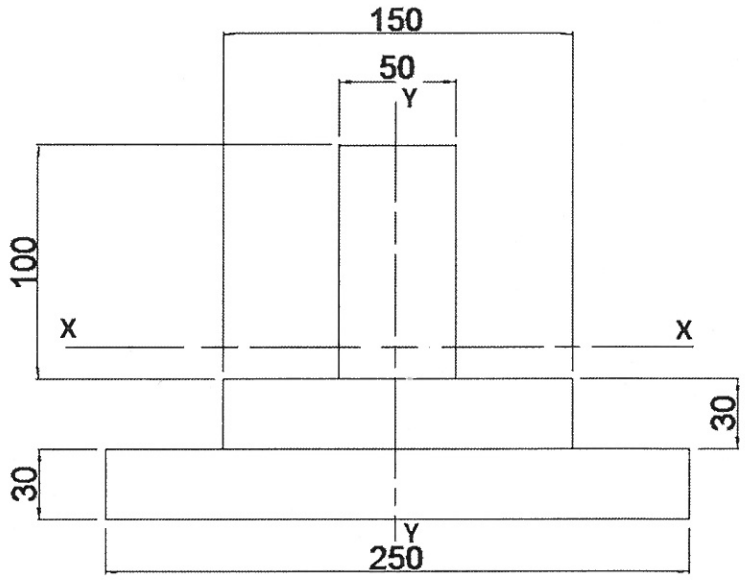

Figure 5

The following formulae may be used:

$$I = \frac{bd^3}{12} + bdh^2;\ \ \bar{y} = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1 + A_2 + A_3}$$

[15]

TOTAL MARKS: 106 FULL MARKS: 100