



<u>PROGRAM</u>	: NATIONAL DIPLOMA <i>ENGINEERING METALLURGY / EXTRACTIVE METALLURGY</i>
<u>SUBJECT</u>	: MATERIAL TESTING: METALLURGY
<u>CODE</u>	: MTM 3111
<u>DATE</u>	: SUPPLEMENTARY EXAMINATION JUNE 2018
<u>DURATION</u>	: 3 hours
<u>WEIGHT</u>	: 40: 60
<u>TOTAL MARKS</u>	: 100
<u>FULL MARKS</u>	: 100
<u>EXAMINER</u>	: MISS TS TSHEPHE
<u>MODERATOR</u>	: DR D NYBWE
<u>NUMBER OF PAGES</u>	: 3 PAGES IN TOTAL
<u>INSTRUCTIONS</u>	: ALL THE ANSWERS MUST BE COMPLETED IN THE EXAM SCRIPTS AND HANDED IN
<u>REQUIREMENTS</u>	: 1 POCKET CALCULATOR NO CORRECTION FLUID SHALL BE USED ALL WORK SHALL BE HANDED IN.
<u>INSTRUCTIONS TO CANDIDATES:</u>	
PLEASE ANSWER ALL THE QUESTIONS	

QUESTION 1

- 1.1. What is strength of materials? (2)
- 1.2. State if the following statements are true or false:
 - 1.2.1. In equilibrium condition, if there are the external forces acting on the member, there will be the internal forces resisting the action of the external loads. (2)
 - 1.2.2. The internal resisting forces are usually expressed by the stress acting over a certain area, so that the internal force is the integral of the stress times the differential area over which it acts (2)
 - 1.2.3. Excessive plastic deformation occurs when the elastic limit is exceeded yielding (2)
 - 1.2.4. Failure due to excessive elastic deformation is controlled by the strength of the materials (2)
- 1.3. For a brass alloy, the stress at which plastic deformation begins is 345 MPa, and the modulus of elasticity is 103 GPa.
 - (a) What is the maximum load that may be applied to a specimen with a cross-sectional area of 130 mm² without plastic deformation? (5)
 - (b) If the original specimen length is 76 mm, what is the maximum length to which it may be stretched without causing plastic deformation? (5)

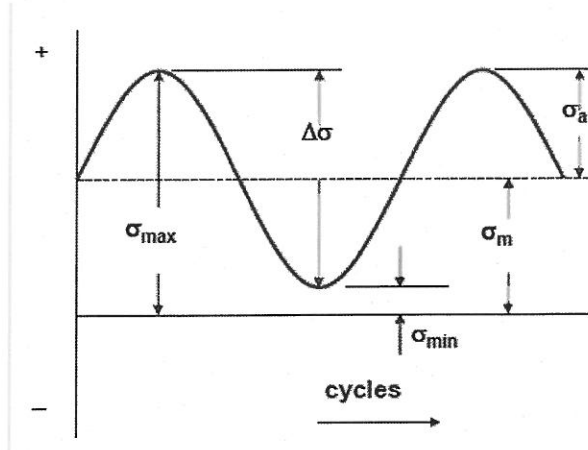
QUESTION 2

- 2.1. Discuss the three impressions made by the Vickers hardness (6)
- 2.2. Determine the Brinell hardness number and predict the tensile strength of the plate if a 10mm diameter indenter and a 3000kg load, produces an indentation of 4.5mm on a nickel plate (5)

QUESTION 3

3.1. From the curve below, write mathematical expressions to calculate the following:

- (a) Maximum stress (2)
- (b) Minimum stress (2)
- (c) Stress range (2)
- (d) Alternating stress (2)
- (e) Amplitude ratio (2)



- 3.2. A 4340 steel bar is subjected to a fluctuating axial load that varies from a maximum of 330 kN tension to a minimum of 110 kN compression. The mechanical properties of the steel are: $\sigma_u = 1090$ MPa, $\sigma_o = 1010$ MPa, $\sigma_e = 510$ MPa. Determine the bar diameter to give infinite fatigue life based on a safety factor of 2.5. (10)
- 3.3. Discuss the four commercial methods that introduces favourable compressive stress (8)

QUESTION 4

- 4.1. Show a typical creep curve and explain the three stages of creep (8)
- 4.2. Discuss the three deformation processes at elevated temperature (6)

4.3. Explain the following creep mechanisms:

- (a) Dislocation glide (2)
- (b) Diffusion creep (2)
- (c) Grain boundary sliding (2)

QUESTION 5

- 5.1. What are the three factors that contribute to a brittle cleavage fracture? (3)
- 5.2. Show how does grain size affects the DBTT curve (4)
- 5.3. Discuss the five embrittlement processes in metals (10)
- 5.4. List four reasons why NDT are used? (4)

TOTAL

[100]