



Answer the following questions

(Question 1): (25 marks)

A- Which of the two tests, tension or compression, requires a higher capacity testing machine than the other? Explain. (5 marks)

B- A cable is made of four parallel strands of different materials, all behaving according to the equation $\sigma = K \epsilon^n$, where $n = 0.3$. The materials, strength coefficients, and cross sections are as follows:

- Material A: $K = 450 \text{ MPa}$, $A_0 = 7 \text{ mm}^2$; Material B: $K = 600 \text{ MPa}$, $A_0 = 2.5 \text{ mm}^2$;
 Material C: $K = 300 \text{ MPa}$, $A_0 = 3 \text{ mm}^2$; Material D: $K = 760 \text{ MPa}$, $A_0 = 2 \text{ mm}^2$;

- (i) Calculate the maximum tensile load that this cable can withstand prior to necking.
 (ii) Explain how you would arrive at an answer if the n values of the three strands were different from each other (20 marks)

(Question 2): (25 marks)

A- Which hardness tests and scales would you use for very thin strips of material, such as aluminum foil? Why? (5 marks)

B- (i) Calculate the work done in expanding a 2 mm-thick spherical shell from a diameter of 100 mm to 140 mm, where the shell is made of a material for which $\sigma = 200 + 50 \epsilon^{0.5} \text{ MPa}$. (20 marks)
 (ii) Does your answer depend on the particular yield criterion used? Explain

(Question 3): (25 marks)

A- Describe the difference between creep and stress-relaxation phenomena, giving two examples for each as they relate to engineering applications. (5 marks)

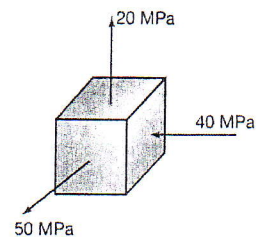
B- During the production of a part, a metal with a yield strength of 110 MPa is subjected to a stress state $\sigma_1, \sigma_2 = \sigma_1/3, \sigma_3 = 0$. Sketch the Mohr's circle diagram for this stress state. Determine the stress σ_1 necessary to cause yielding by the maximum shear stress and the von Mises criteria. (20 marks)

(Question 4): (25 marks)

A- Can a material have a negative Poisson's ratio? Explain. (5 marks)

B- A metal is yielding plastically under the stress state shown in the accompanying figure. (20 marks)

- (a) Label the principal axes according to their proper numerical convention (1, 2, 3).
 (b) What is the yield stress using the Tresca criterion?
 (c) What if the von Mises criterion is used?
 (d) The stress state causes measured strains of $\epsilon_1 = 0.4$ and $\epsilon_2 = 0.2$, with ϵ_3 not being measured. What is the value of ϵ_3 ?



With our best wishes

This exam contributes "by measuring" in achieving Programme Academic Standards according to NARS															
Question Number	Q1-a	Q2-a	Q3-a	Q4-a		Q1-b	Q2-b	Q3-b	Q4-b		Q1-b	Q2-b	Q3	Q4	
	a1-1	a1-2	a1-1	a2-1		b4-1	b5-1	b5-1	b4-1		c1-1	c2-1	c1-1	c1-1	
Skills			a2-1						b5-1					c2-1	
	Knowledge & Understanding Skills					Intellectual Skills					Professional Skills				