

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013**

COURSE NAME : MATERIAL SCIENCE FOR TEXTILE
COURSE CODE : BNH 10102
PROGRAMME : 1BNH
EXAMINATION DATE : JUNE 2013
DURATION : 2 HOURS
INSTRUCTION : 1. ANSWER FIVE (5) QUESTIONS ONLY FROM SIX (6) QUESTIONS PROVIDED
2. ATTACH **FIGURE Q2, FIGURE Q4 (a) AND FIGURE Q4 (b)** WITH YOUR ANSWER BOOKLET

THIS QUESTION PAPER CONSISTS OF **EIGHT (8) PAGES**

- Q1**
- (a) The lattice constant for unit cell of aluminum is 0.4049 nm. Calculate the value of d_{220} and d_{111} ? (4 marks)
- (b) A plane in a cubic crystal intersects the x-axis at 3, the y axis at 1. And the z axis at 1. Determine the miller indices for this plane? Sketch this plane in a single cube and show all key dimensions. (6 marks)
- (c) By applying W. Pollack's formula, determine and sketch the distribution of electron of Ca with atomic number 20. (10 marks)
- Q2** An alloy of 20 % Sn-80 wt% Pb at the temperature of 250°C (see. **Figure Q2**). The density at 250°C takes the densities of Pb and Sn to be 11.23 and 7.24 g/cm³ respectively. (Please submit your answer with Figure Q2. Put your finding value in that Figure).
- (a) Describe what phase (s) is (are) present? (2 marks)
- (b) Determine the compositions of the phases? (4 marks)
- (c) Calculate the relative amount of each phase present in terms of mass fraction. (6 marks)
- (d) Calculate the relative amount of each phase present in terms of volume fraction. (8 marks)

Q3 Data molecular weights for a propylene material are tabulated in Table 1:

Table 1: Data molecular weight

Molecular weight Range (g/mol)	X_i	w_i
8,000-16,000	0.05	0.02
16,000-24,000	0.16	0.10
24,000-32,000	0.24	0.20
32,000-40,000	0.28	0.30
40,000-48,000	0.20	0.27
48,000-56,000	0.07	0.11

Mer Structure of propylene is shown in **Figure Q3**, The atomic weight of C and H are 12.01 g/mol and 1.01 g/mol respectively.

Calculate :

- (a) The number –average molecular weight (7 marks)
- (b) The weight average molecular weight (7 marks)
- (c) The number –average degree of polymerization (4 marks)
- (d) The weight –average degree of polymerization (2 marks)

Q4 (a) Plot the radial hardness profile (center, $\frac{1}{2} R$, $\frac{3}{4} R$ and surface) for a 50 mm diameter cylindrical specimen of 4140 steel that has been quenched in moderately agitated water (Using data of **Figure Q4 (a)** and **Q4 (b)**). Please provide/submit your answer with **Figure Q4 (a)** and **Q4 (b)**.

(10 marks)

(b) An aluminum rod and nylon rod and nylon have equal unstressed length at 30°C. If each rod is subjected to a tensile stress of 10×10^6 Pa, derive the formula related to the mechanical and thermal stress and calculate the temperature at which the two stressed rod will have equal length. (E (aluminum) = $E^{Al} = 70 \times 10^9$ Pa, E (nylon) = $E^n = 2.8 \times 10^9$ Pa, $\alpha^{AL}_{th} = 25 \times 10^{-6} C^{-1}$, $\alpha^n_{th} = 80 \times 10^{-6} C^{-1}$)

(10 marks)

- Q5** (a) A common brick has the following data: The weight of a dry brick is 1,360 g; the weight after 24 hr submerged in cold water is 2,267 g; after 5 hr submerged in boiling water it is 2,350 g. Find:
- The cold water percentage of absorption
 - The hot water percentage of absorption, and
 - The coefficient of saturation
- (6 marks)
- (b) The modulus of elasticity for spinel ($MgAl_2O_4$) having 5 vol % porosity is 240 GPa. Calculate:
- The modulus elasticity for non porous material
 - The modulus elasticity for 15% porosity
- (4 marks)
- (c) Calculate the modulus elasticity for a laminated composite consisting of 62 percent by value of unidirectional carbon fiber and an epoxy matrix under isostress conditions. The modulus of elasticity of the carbon fibers is 340 GPa and that of the epoxy is 1.50×10^3 MPa.
- (2 marks)
- (d) A tensile-testing apparatus is to be constructed that must withstand a maximum load of 220,000 N. The design calls for four cylindrical support posts, each of which is to support quarter of the maximum load. Furthermore, plain-carbon (1045) steel ground and polished shafting rounds are to be used; the minimum yield and tensile strength of this alloy are 310 MPa and 565 MPa, respectively. Determine a suitable diameter for these support posts.
- (8 marks)
- Q6** A continuous and aligned glass fiber- reinforced composite consist of 50 % of glass fibers having a modulus of elasticity of 69 GPa and 50 % of polyester resin that, when hardened , displays a modulus of 3.4 GPa
- Calculate the modulus of elasticity of this composite in the longitudinal direction.
- (2 marks)
- If the cross – sectional area is 250 mm^2 and stress of 20 MPa is applied in this longitudinal direction, calculate the magnitude of the load carried by each of the fiber and matrix phases.
- (8 marks)
- Determine the strain that is sustained by each phase when the stress in Q6 (b) is applied.
- (10 marks)

- END OF QUESTION -

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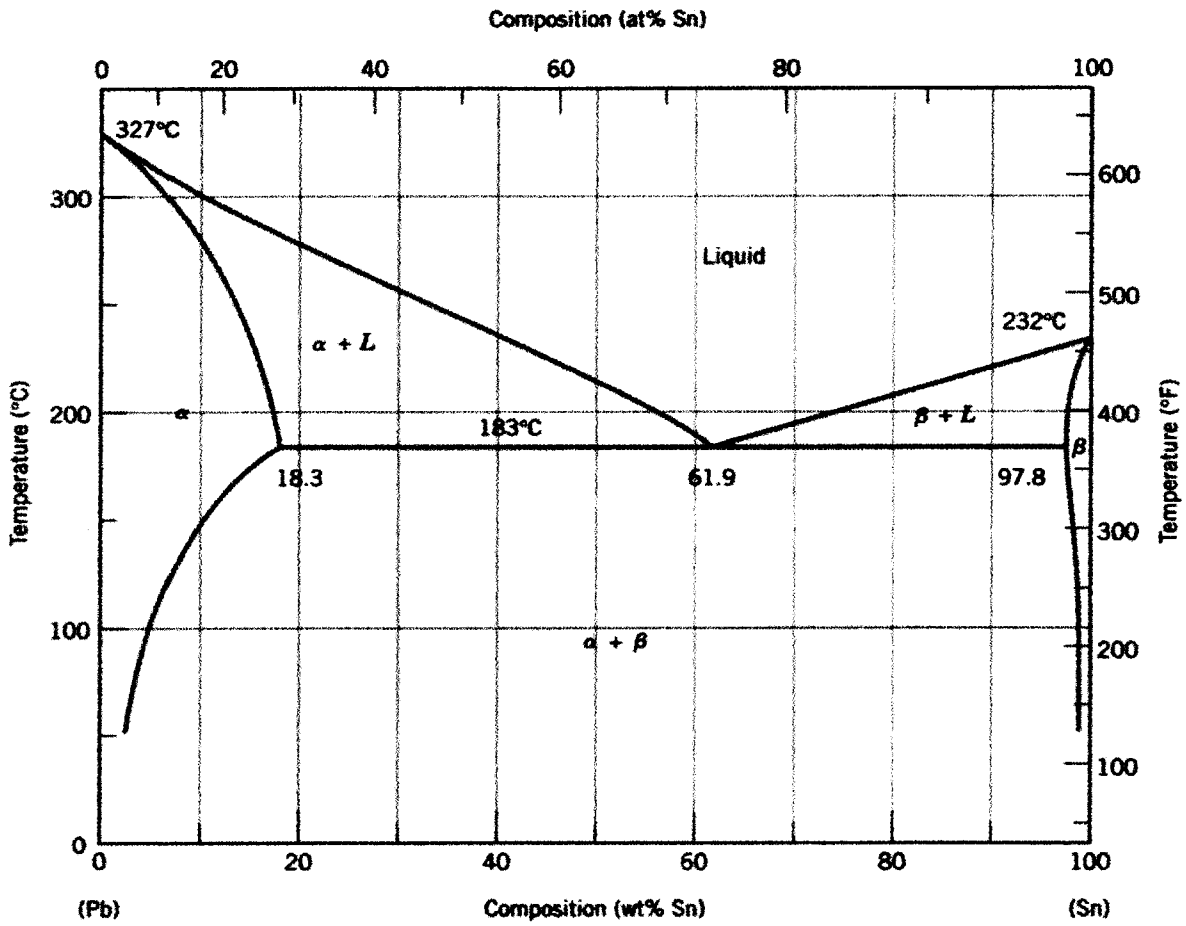


FIGURE Q2

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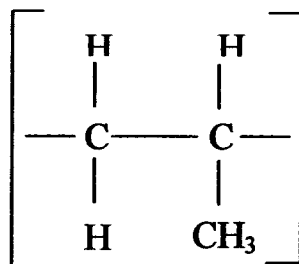


FIGURE Q3

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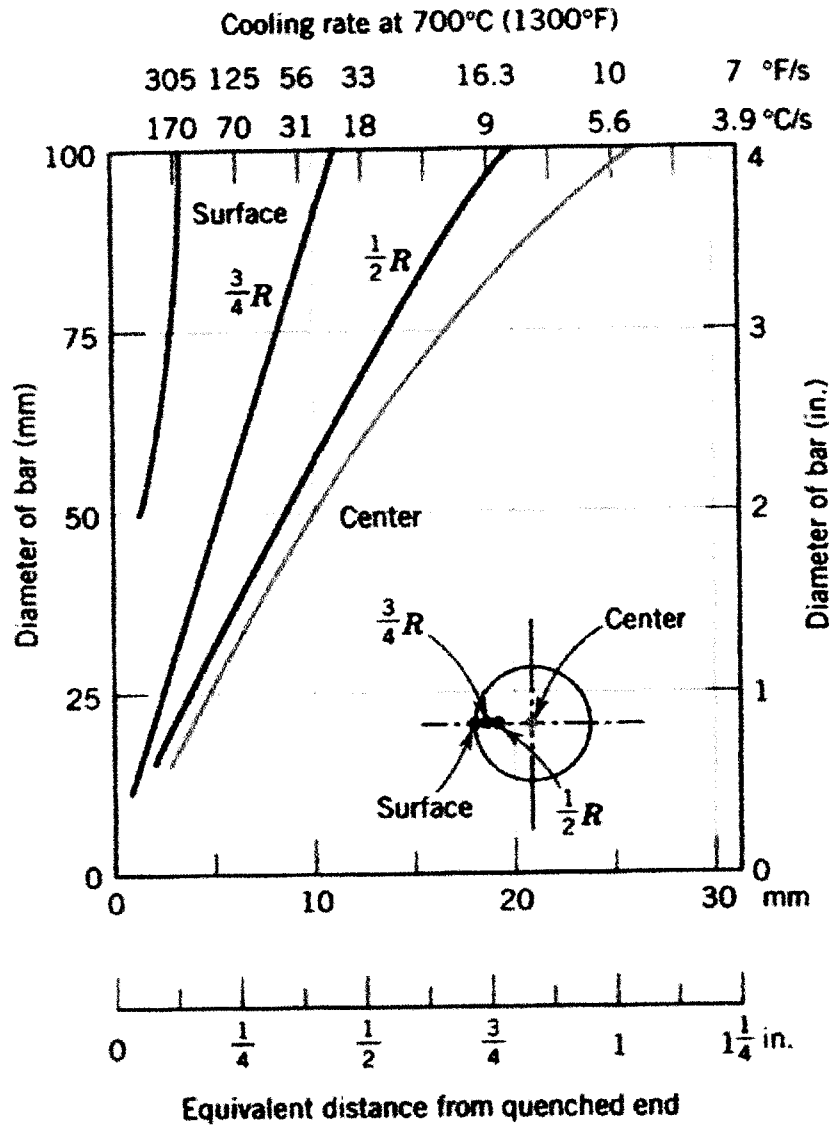


FIGURE Q4 (a)

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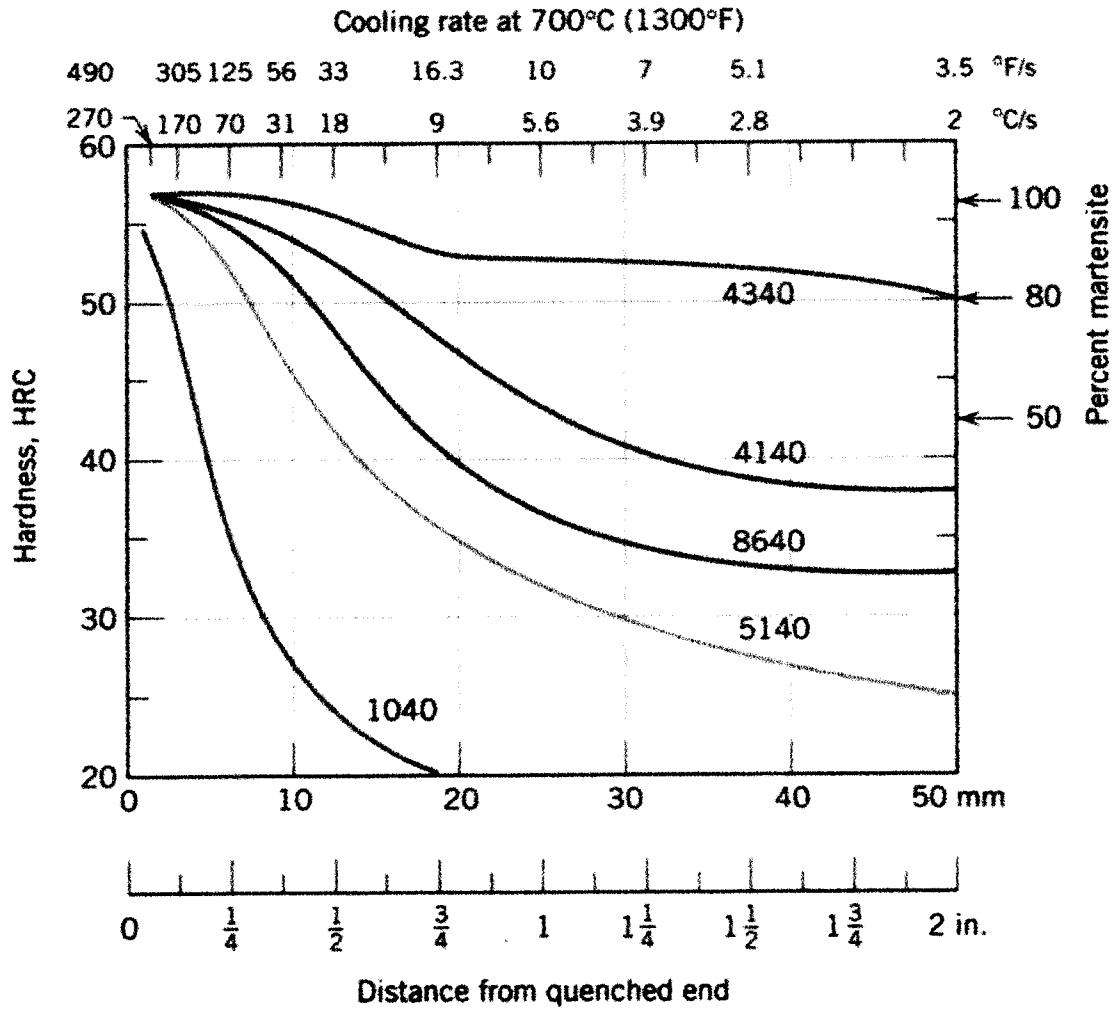


FIGURE Q4 (b)