Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	BNJ10602
PROGRAMME CODE	:	BNK / BNL / BNG / BNM
EXAMINATION DATE	:	JUNE/JULY 2018
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) State **FOUR (4)** type of basic materials in engineering materials classification.

(2 marks)

(b) Sketch the following directions in a cubic unit cell:

(i) [0 2 1]
(ii) [$\bar{2}$ 1 2]
(iii) [0 1 $\bar{2}$]
(iv) [1 $\bar{1}$ 0]

(12 marks)

(c) Based on stress and strain curve of metal component that has both elastic and plastic deformation, state the critical points as stated below by giving an appropriate sketch;

(i) Modulus of Elasticity or ModulusYoung, E
(ii) Yield Point
(iii) Ultimate Tensile strengh
(iv) Fracture point

(8 marks)

(d) Demonstrate between ductile and brittle fracture of materials by giving an appropriate plot of stress and strain that exposed uniaxial tensile load and state.

(3 marks)

Q2 (a) (i) Identify the volume of atomic portion that located or occupy in the (101) plane of α-iron BCC .

(2 marks)

(ii) Based on the above volume of atomic portion of α-iron BCC, calculate the planar atomic density, ρ_l of α-iron BCC which has a lattice constant a, 0.367 nm.

(8 marks)

(b) Strain and stress behavior consist of two deformation mechanisms which are elastic deformation and plastic deformation. Please differentiate both mechanisms using plot of stress and strain curve by providing some illustration on the material changes and condition at each critical points of this plot.

(8 marks)

(c) State at least **THREE (3)** important factors that should be considered for any engineering component to ensure that the component

(3 marks)

(d) Explain briefly **TWO (2)** general types of hardness measurement.

(4 marks)

Q3 (a) Identify **THREE (3)** variables that determine the microstructure of an alloy.

(6 marks)

(b) Differentiate in between the normalizing and annealing heat treatment for steel.

(4 marks)

(c) Define the term 'component' in phase diagram.

(2 marks)

(d) As an alloy of composition Zn–48 wt% Cu is cooled to room temperature, cite the phases present and their mass fractions at the following temperatures:
(i) 500 °C
(ii) 300 °C
Please refer to **Figure Q3(d)**.

(8 marks)

(e) Based on **Figure Q3 (e),** define each process labeled as "*1*", "*2*" and "*3*" and give the types of microstructure at the end of all process.

(5 marks)

Q4 (a) State **THREE (3)** properties of ceramic materials.

(3 marks)

(b) Explain the term of "Refractories material" that refer to the ceramic material property and give **ONE (1)** example of this material application.

(5 marks)

(c) Illustrate briefly the basic step in fabricating clay product from loose particles to the solidified finished body.

(5 marks)

(d) Classify **TWO (2)** types of alloy steel and give **ONE (1)** example for each type.

(4 marks)

(e) Illustrate briefly **TWO (2)** of the metal forming as stated below;
(i) Extrusion
(ii) Rolling
(iii) Drawing

(8 marks)

Q5 (a) (i) List **TWO (2)** types of polymerization.

(2 marks)

(ii) Describe the meaning of thermoset polymer.

(3 marks)

(b) Compare between thermoplastic and thermoset and give **ONE (1)** example of each type of the polymer.

(6 marks)

(c) Define the concept of composite material.

(2 marks)

(d) Calculate the composite modulus of elasticity for polyester reinforced with 60% volume of E-glass particles if under condition:

(i) isostrain

(ii) isostress

Given : $E_{polyester}$ = 6.9 GPa and $E_{E\text{-}glass}$ = 72.4 GPa

(8 marks)

(e) Outline the advantages and disadvantages of pultrusion method in polymer matrix composites processing.

(4 marks)

~ END OF QUESTIONS ~

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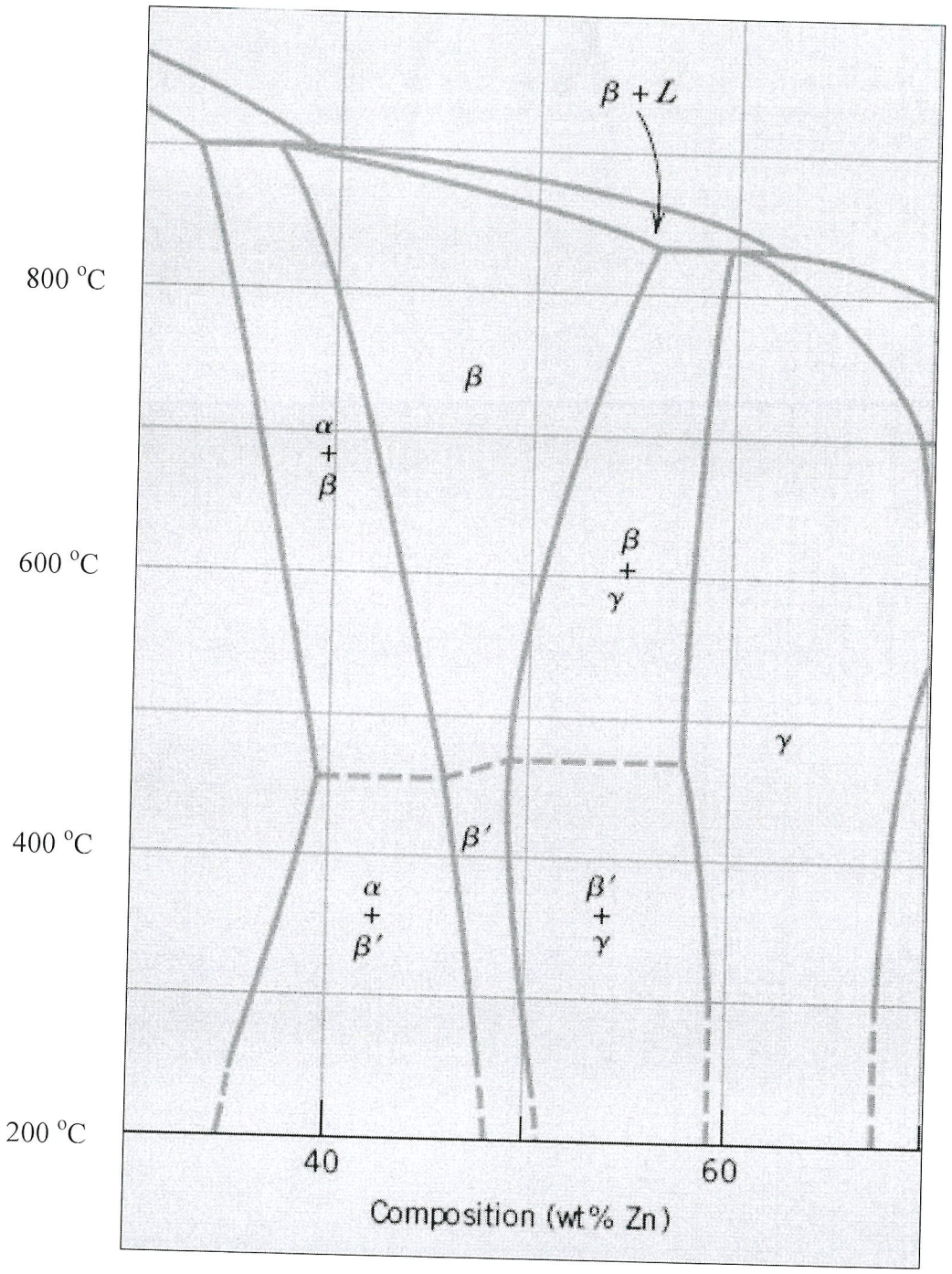

Figure Q3(d)

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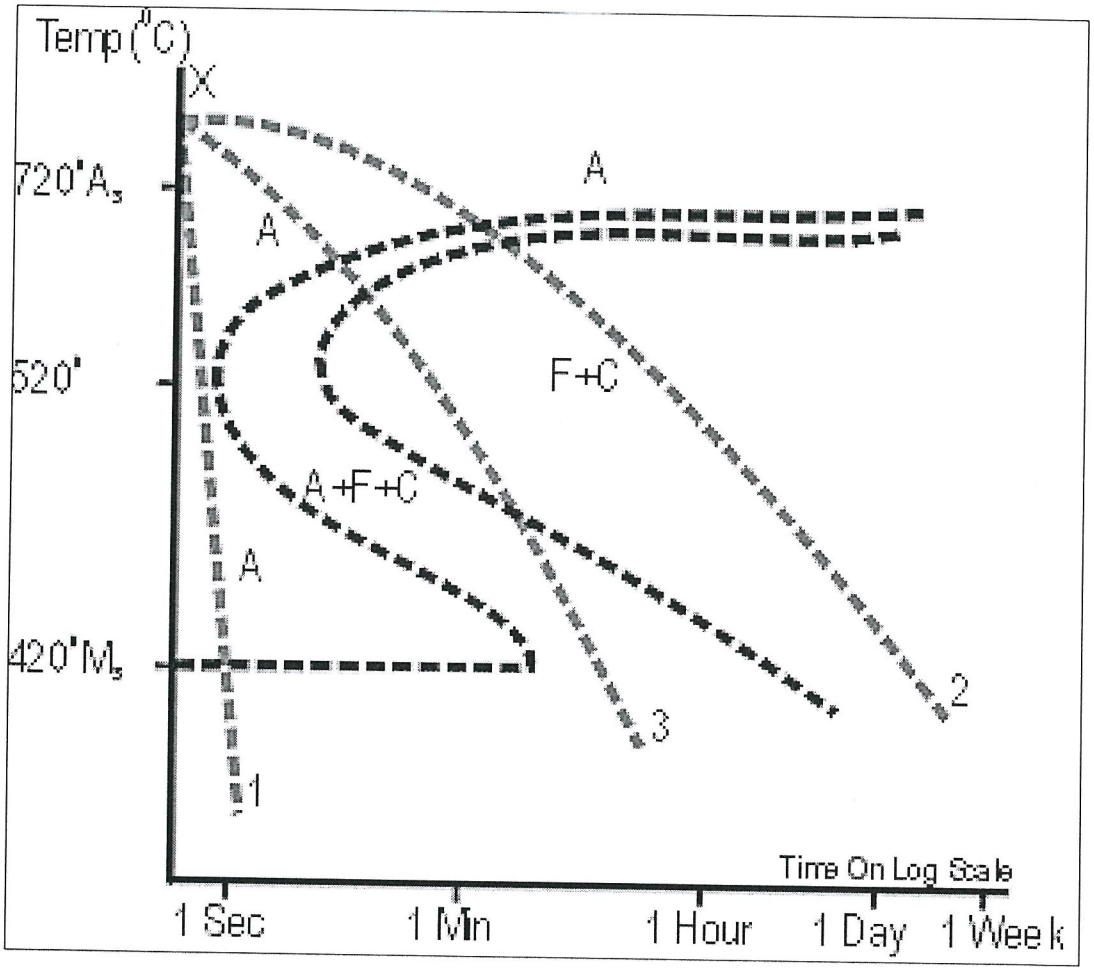

Figure Q3 (e)